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INTERNATIONAL REFERENCE GROUP ON GREAT LAKES POLLUTION FROM LAND USE ACTIVITIES

INTERNATIONAL JOINT COMMISSION

INVENTORY OF LAND USE AND LAND USE PRACTICES
VOLUME VI - LAKE ONTARIO BASIN

INVENTORY OF LAND USE AND LAND USE PRACTICES IN THE UNITED STATES GREAT LAKES BASIN

REPORT OF THE INTERNATIONAL REFERENCE GROUP ON GREAT LAKES POLLUTION FROM LAND USE ACTIVITIES

VOLUME VI
LAKE ONTARIO BASIN

MAY 1976

INVENTORY OF LAND USE AND LAND USE PRACTICES
IN THE UNITED STATES GREAT LAKES BASIN with
Emphasis on Certain Trends and Projections to
1980 and Where Appropriate, to 2020

prepared by the office of the
GREAT LAKES BASIN COMMISSION
Ann Arbor, Michigan

To be used as portion of the U.S. Task B
Report on GREAT LAKES POLLUTION FROM LAND
USE ACTIVITIES BY the International Joint
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Mr. L. Robert Carter, Indiana Water Pollution Control Board
Mr. James P. Dooley, Michigan Department of Natural Resources
Dr. Richard Weismiller, Purdue University
Mr. Ray Dideriksen, USDA-SCS, Washington
Mr. Robert Fellows, USDA-SCS, East Lansing
Mr. John Putman, USDA, Economic Research Service
Mr. Fred Sullivan, USEPA Project Officer, Chicago
Mr. Manfred Neumann, USEPA, Chicago
Mr. Eugene A. Jarecki, GLBC Technical Representative

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PREFACE

As its title suggests, this volume presents an Inventory of Land Use and Land Use Practices in the Lake Ontario Basin, with emphasis on certain trends and projections to 1980 (and to 2020 where appropriate). The report, prepared by the Great Lakes Basin Commission staff, integrates several studies by contractors and subcontractors. These studies were part of the U.S. Task B effort for the Great Lakes Pollution from Land Use Activities Reference Group, International Joint Commission. The Task A report, Management Programs, Research and Effects of Present Land Use Activities on Water Quality of the Great Lakes, dated November 1974, preceded the Task B study.

The Task B report for the United States part of the Great Lakes Basin is contained in six volumes:

Volume I --Great Lakes Basin
Volume II --Lake Superior basin
Volume III--Lake Michigan basin
Volume IV --Lake Huron basin
Volume V --Lake Erie basin
Volume VI --Lake Ontario basin

Knowledge of present and future land use and land use practices are important as background to evaluating and controlling nonpoint sources of water pollution. This report describes and quantifies, as appropriate, the Great Lakes Basin's geology, soils, minerals, climate, surface and ground water, vegetation, wildlife, and economic and demographic characteristics. It inventories available information on waste disposal operations, lakeshore and riverbank erosion, high-density nonsewered residential areas, and recreational land uses as well as materials application of agricultural chemicals, fertilizers, lime, animal wastes, and salts on highways. Finally, future trends and projections are shown for the above categories.

The Great Lakes Basin Summary and each of the five Lake basin volumes have been reviewed by Task Group B, whose comments were consedered before approval for final report development and submittal to the U.S. Environmental Protection Agency for meeting contractual terms. This study forms a U.S. contribution to the U.S. Task B effort of the study on Great Lakes Pollution from Land Use Activities.

The study discussed in this report was carried out as part of the efforts of the Pollution from Land Use Activities Reference Group, an organization of the International Joint Commission, established under the Canada-U.S. Great Lakes Water Quality Agreement of 1972. Funding was provided through U.S. Environmental Protection Agency. Findings and conclusions are those of the author(s) and do not necessarily reflect the views of the Reference Group or its recommendations to the Commission.

INTRODUCTION AND SUMMARY

INTRODUCTION

The Great Lakes Water Quality Agreement, with Annexes and Texts and Terms of Reference Between the United States of America and Canada, signed at Ottawa on April 15, 1972, included a reference to study pollution in the Great Lakes System from agricultural, forestry, and other land use activities. The reference asked that the study assess whether the boundary waters of the Great Lakes System were being polluted by land drainage and if so, what remedial measures would provide improvements in controlling pollutants from land usage. The need for better definition of the impact of land use activities, practices and programs on water quality in the Great Lakes area had become increasingly magnified. Through the Agreement, both the United States and Canadian governments requested the International Joint Commission to investigate land use activity impacts upon the Great Lakes. Accordingly, the International Reference Group on Great Lakes Pollution From Land Use Activities was established in December, 1972, and produced a detailed study plan (February, 1974 and updated with the detailed study plan supplement, August, 1976) outlining an intensive study, scheduled for completion in 1978.

The final report will consist of study conclusions and recommendations by PLUARG to the International Joint Commission.

Detailed Study Plan, February, 1974

The study plan emphasizes four main tasks:

Task A: To assess problems, management programs and research and to attempt to set priorities in relation to the best information now available on the effects of land use activities on water quality in boundary waters of the Great Lakes.

Task B: Inventory of land use and land use practices, with emphasis on certain trends and projections to 1980 and, if possible, to 2020.

Task C: Intensive studies of a small number of representative watersheds, selected and conducted to permit some extrapolation of data to the entire Great Lakes Basin and to relate contamination of water quality, which may be found at river mouths on the Great Lakes, to specific land uses and practices.

Task D: Diagnosis of degree of impairment of water quality in the Great Lakes, including assessment of concentrations of contaminants of concern in sediments, fish and other aquatic resources.

PURPOSE

Background information on characteristic Basin properties such as land use and related materials usage, physical fabric, climate, population and related socio-economic data is required for developing the land use and water quality relationships and providing a foundation for assessment of trends in land use patterns and practices. Towards these ends the Reference Group felt that an inventory of land use and land use practices with emphasis on certain trends and projections to 1980 and 2020 is essential to assist in developing the planning and management of land to minimize the loss of pollutants into drainage water.

The objectives of the Task B effort are directed towards the following activities:

- To provide a general land use inventory of the Great Lakes Basin.
- To provide specific information concerning the nature and location of defined specialized land use categories in the Great Lakes Basin.
- To provide information on the physical fabric of the Great Lakes Basin including soils and their capability, hydrology, geomorphology, climate, mineral and gas resources, broad vegetation zones.
- To provide an inventory of various materials applied to land which may influence the quality of drainage waters.
- To provide a consistent and comprehensive set of forecasts for 1980 and 2020 relating to land uses and land use activities based upon socio-economic, technological and political developments.

SCOPE OF STUDY

In order to meet the Task B objectives for the U.S. portion of the Great Lakes, studies were agreed upon by the Task B members to provide an inventory for the following categories.

Physical Fabric

The objective of this activity is to provide background information and data on the physical fabric of the individual Great Lakes Basins focusing on the land drainage/water quality relationships and to provide a detailed description of the basin in terms of climate, population, and social-economic conditions.

Major Land Uses

The objective of this section is to gather information about the generalized land use patterns in the Great Lakes Basin. This information is determined from computer analysis of multispectral scanner (MSS) from the LANDSAT-1 program (formerly known as the Earth Resources Technology Satellite).

Specialized Land Uses

The objective of this activity is to provide specific information concerning the nature and location of specific land use categories in the Great Lakes Basin. The following specialized land uses comprise this section.

a. Disposal operations, liquid waste, solid waste, dredge spoil and artificial fills, and deepwell disposal

b. Erosion, lakeshore and riverbank

c. Intensive livestock operations

d. High-density, nonsewered residential areas

e. Recreational lands

Materials Usage

This activity provides an inventory of production and/or usage within the Great Lakes Basin of certain materials applied to lands with a potential for reaching the Great Lakes through land drainage. The materials to be inventoried include chemicals, animal wastes, commercial fertilizers, agricultural lime, and road salts.

Future Trends

The objective in this section is to identify and assess future trends in major land uses, specialized land uses, material usage, and related information which may affect the drainage of pollutants into the Great Lakes for the target years 1980, 2000, and 2020.

In order to facilitate the organization of information into usable format, the U.S. Task B has been organized into five volumes and a summary. Each volume addresses one of the five Great Lakes Basins. The information within each volume has been subdivided into individual planning subareas representing the major drainage basins in each lake. Basic information for each planning subarea is presented on a county basis. Figures 1 and 2 indicate the area of study for this volume on the Lake Ontario basin.

GENERAL SUMMARY

The Task B effort is aimed at providing an inventory of various categories affecting land drainage or pollutional materials to the Great Lakes. In generating data necessary to complete the inventory, a variety of sources were utilized, including state agencies, recognized experts in the field, published reports and documents, in addition to information contained in the Task A Reports. Some background information has been compiled as supporting data for this inventory. This material is available for review at the Great Lakes Basin Commission in Ann Arbor, Michigan.

Because most of the data collected reflects conditions between 1970 and 1972, it may not reflect exactly the current situation. However, it seems reasonable to assume that no major changes have occurred in the last three years to significantly alter the general picture this information attempts to portray. Ideally a continuous updating of this information would be of significant utility to researchers, planners and those involved with managing the water resources of the Great Lakes.

Physical Fabric

Physical fabric information considered important to land drainage/water quality relationships includes geology, soils, minerals, climate, surface and ground water, vegetation, and wildlife. Demographic and economic characteristics were also considered as they relate to the human adaptation and use of this physical environment.

The Lake Ontario basin physiography provides one of the most scenic areas in the Great Lakes Basin. Glaciation produced less extensive deposition of material but developed a more rugged landscape. Bedrock exposures of poor permeability are quite common. With the exception of the narrow lake plains, soils are typically poor, with high acidity.

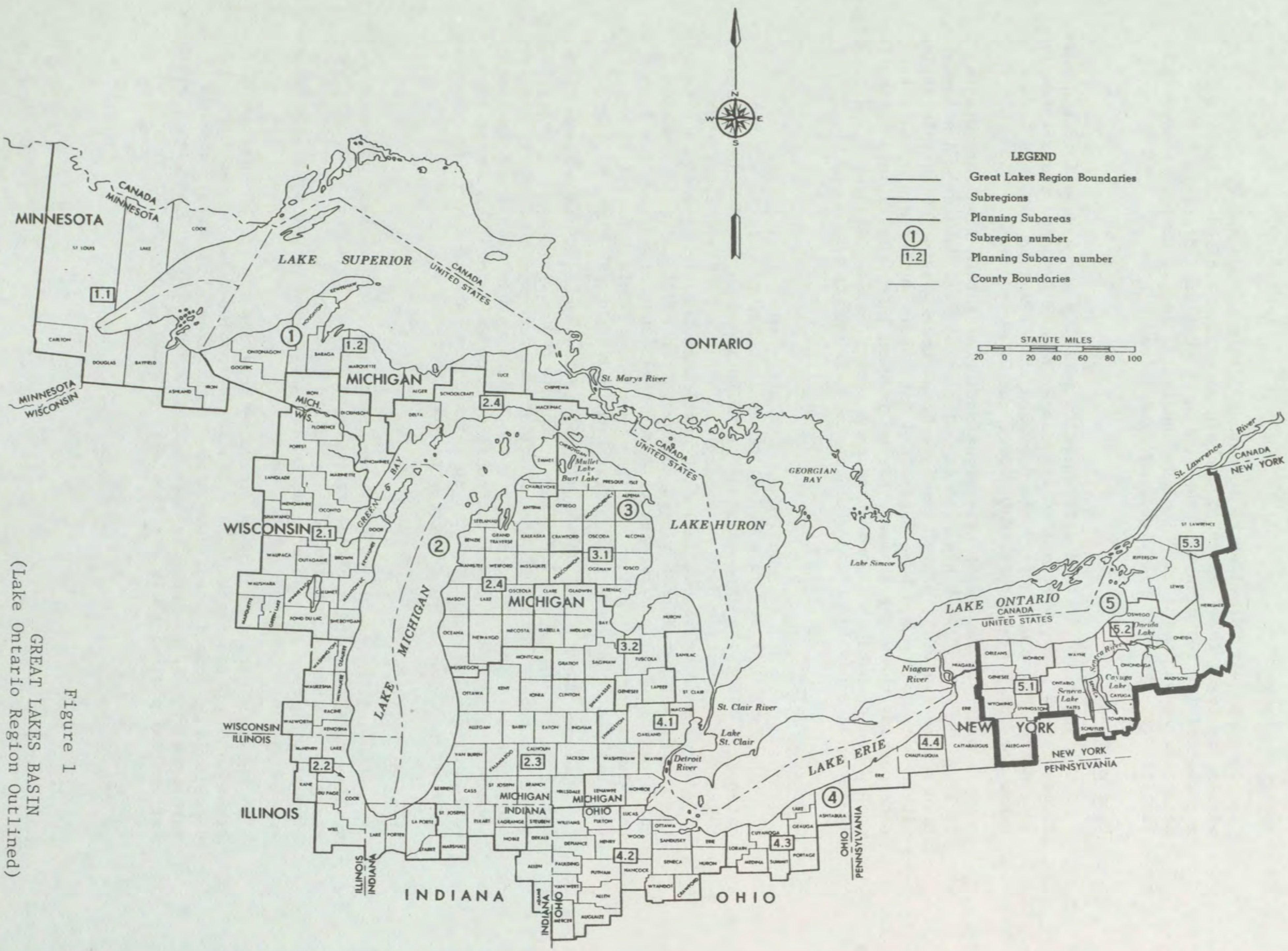


Figure 1
GREAT LAKES BASIN
(Lake Ontario Region Outlined)

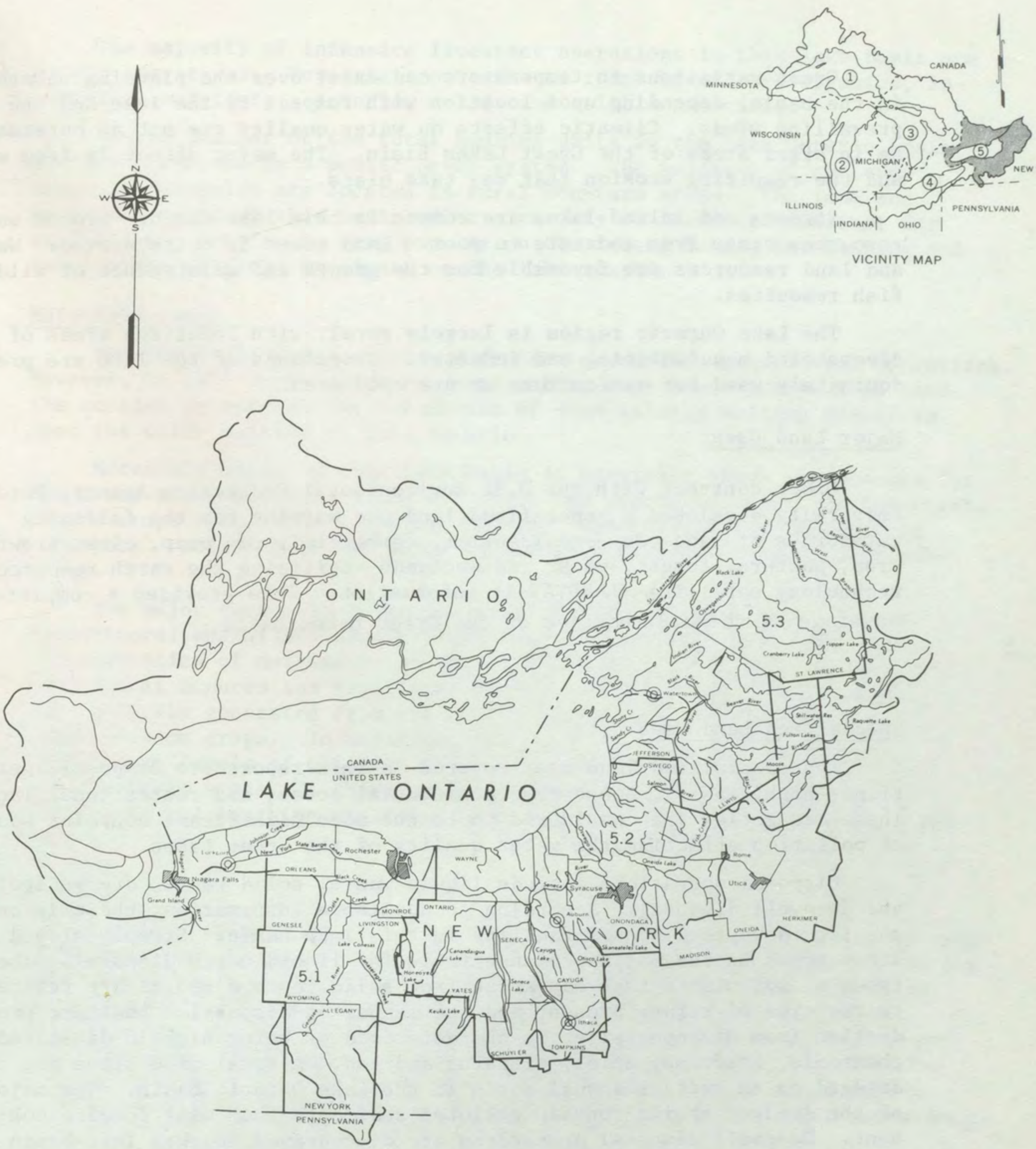


Figure 2

LAKE ONTARIO BASIN

Great variations in temperature can exist over the planning subareas in the basin, depending upon location with respect to the lake and the prevailing winds. Climatic effects on water quality are not as outstanding as in other areas of the Great Lakes Basin. The major effect is from wind and the resulting erosion that may take place.

Streams and inland lakes are common in this lake basin. Ground water resources range from moderate to poor. Land cover is quite varied. Water and land resources are favorable for the growth and maintenance of wildlife fish resources.

The Lake Ontario region is largely rural, with localized areas of diversified manufacturing and industry. Shorelands of the lake are predominately used for agriculture or are open area.

Major Land Uses

Under contract with the U.S. Environmental Protection Agency, Purdue University developed a generalized land use mapping for the following categories of land use --residential, commercial, row crop, close grown crop, pasture, forest, water and wetlands--utilizing the earth resource technology satellite (LANDSAT-1) information. This provided a complete coverage of the U.S. portion of the Great Lakes Basin.

Specialized Land Uses

The specialized land uses covered in this report are disposal operations, high density, nonsewered residential areas, and recreational lands. These categories are considered to be the more significant nonpoint sources of pollution affecting the water quality of the Great Lakes.

Disposal operations include liquid waste, solid waste, dredge spoil, and deepwell disposal. According to available information, there is only one liquid waste disposal facility in this lake basin. Steeply sloped and stony areas in the basin are unsuitable for liquid waste disposal. The types of pollutants that may arise from solid waste disposal are related to the type of refuse present and the manner of disposal. Leachate production from disposal sites is characterized as being high in dissolved chemicals, hardness, acids, nitrates and bod. A total of 6 sites are dredged on an average annual basis in the Lake Ontario basin. The majority of the dredged spoils contain polluted sediments that will require confinement. Deepwell disposal operations are discouraged in this lake basin due to the existence of porous and fractured geological zones.

Erosion along the land-water interface occurs in two particular areas - lakeshore and riverbank zones. The shoreline of Lake Ontario consists principally of clay and silt bluffs and is easily eroded, particularly in the southwestern reaches. Riverbank erosion results in some siltation of reservoirs in the Lake Ontario basin and increases the amount of harbor dredging. About 4 percent of all riverbanks are subject to some form of erosion.

The majority of intensive livestock operations in this lake basin are cattle operations. Potential contaminants from run-off are organics, inorganics, nutrients, bacteria, solids and soluble materials.

Thirty percent of the total housing units in the Lake Ontario basin are not connected to a public sewer system. The majority of the non-sewered households are located in rural non-farm areas. The land and water resources of this basin offer a variety of features important for recreation. Boating is very popular on the inland lakes, but boating and beach areas are less prominent on the lake itself.

Materials Usage

The Materials Usage section addresses primarily agricultural operations. However, an additional category, road salts, have been incorporated into the section to address the influences of road deicing salting practices upon the water quality of Lake Ontario.

Materials usage in this lake basin is generally above the average for the Great Lakes Basin as a whole. Fruit and vegetable crops are important, as are crops such as corn grains, and hay, which primarily support the livestock. Dairying is the major livestock enterprise in all three subareas.

The major residuals generated from the various materials used in agricultural operations are nutrients and industrial chemical materials. The generation of nutrients, primarily nitrogen and phosphorus, results from animal manures and fertilizer usage. Chemical residual materials are primarily generated from the use of herbicides, insecticides, and fungicides on crops. In addition, road deicing salts can generate significant levels of chloride concentrations in localized ground and surface water areas. A third component, although relatively modest in nature, is the leaching of liming materials into ground and surface water areas.

Trends

The Lake Ontario basin will experience moderate changes in its current population levels over the next several decades. By 2020, depending on the OBERS series used, population may increase about 50 to 70 percent, with Planning Subarea 5.2 experiencing the greatest growth. Economically, the Lake Ontario basin is projected to move above the national income-per-capita average. The specific mix of economic sectors is not expected to change significantly, except for the service sector, which is likely to increase in importance and manufacturing, which will decrease in importance.

Land use patterns will see a shift towards more urban use and less in the other categories. Because of changing technologies, and legal and administrative regulations, specialized land uses are not expected to be influenced in direct proportion to population and economic changes. The projections for materials usage indicate moderate growth in the use of various chemicals and commercial fertilizer, while manure production from livestock will remain relatively stable. Road salting practices may or may not fluctuate significantly, depending on the construction of new roadways in this lake basin. Given moves toward higher fuel prices, possibilities of mass transportation options, and problems associated with chloride contamination of ground water supplies, the growth in salting practices probably will not be as great as economic and demographic projections alone might indicate.

PHYSICAL FABRIC

LAKE ONTARIO BASIN CHARACTERISTICS

Approximately 83,100 square kilometers (32,100 square miles) of land and water encompassing part of the Province of Ontario, and parts of the States of New York and Pennsylvania are included in the Lake Ontario basin. The United States portion of the basin is defined to include the United States portion of the Lake Ontario basin and areas draining to the St. Lawrence River which lie entirely within the United States. Lake Ontario is the fourth largest of the Great Lakes with a total surface area of 19,000 square kilometers (7,340 square miles), 8,960 square kilometers (3,460 square miles) in the United States, and a volume of 1,639 cubic kilometers (393 cubic miles). The lake is 311 kilometers (193 miles) long and 85 kilometers (53 miles) wide.

The United States portion of the Lake Ontario basin covers 43,500 square kilometers (16,800 square miles), and the St. Lawrence drainage area adds an additional 12,652 square kilometers (4,885 square miles), for a total of 56,164 square kilometers (21,685 square miles).

Table 1

LAKE ONTARIO AREA MEASUREMENT 1/

		Basin (Hydrologic Area)		Region (County Area)	
Area	State	Sq Km	Sq Mi	Sq Km	Sq Mi
5.1	New York	8,858	3,420	10,023	3,870
	Pennsylvania	246	95	-	-
5.2	New York	17,656	6,817	22,997	8,879
5.3	New York	19,005	7,338	14,413	5,565
Total					
5.0	New York	45,765	17,575	47,433	18,314
	Pennsylvania	246	95	-	-
		46,011	17,670	47,433	18,314

1/ Land and water area

Land Resources

Physiography, Geology and Topography

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 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 outlet 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 which, along with the outlet of the Basin, give the Lake Ontario basin great extremes in altitude--from nearly 1,220 meters (4,000 feet) to 45 meters (150 feet) above sea level. Much of the basin has rugged topography, with the deeply incised valleys of the Appalachian Plateau and the severely eroded Adirondack Mountains.

The Lake Ontario basin physiography provides for one of the most scenic areas within the Great Lakes Basin. With Niagara Falls and its gorge, the beautiful historic Finger Lakes region, the forested, lake-dotted Adirondack Mountains, and the Thousand Islands area of the St. Lawrence River, the basin includes many scenic areas much desired by both the basin's citizenry and recreation seekers from throughout the nation.

In contrast to the upper Great Lakes Basin, glaciation in the Lake Ontario region involved less extensive deposition of material but developed a more rugged landscape. Ice movement from the north was inhibited by the highlands of the Adirondack and Appalachian Plateau regions. Many glacial features include drumlin fields in Ontario and Wayne Counties; numerous waterfalls in the Finger Lakes region; kame, kettle, and esker topography in the Adirondack Foothills and Tug Hill areas; meltwater channels, caves, solution channels, and disappearing streams in the lowlands of the Black and St. Lawrence Rivers; and many fossiliferous bedrock exposures throughout the basin.

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, up to 300 meters (1,000 feet), but much of the deposits are composed of fine-grained material. Glacial movement was southward against the uplands, so meltwater was generally ponded in front of the melting ice front. Material settled into the water-filled deep valleys as the glacier retreated. There was little chance for outwash to form extensive well-sorted deposits. Local delta deposits were created on the valley wells from drainage flowing into the lakes. A thin veneer of lake clays, silts, and fine sands mantles the central lowland province areas.

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, in the Appalachian Plateau, they dip gently southward.

These geologic conditions have affected both land use and water quality characteristics in the lake basin. The lowlands bordering Lake Ontario have soils combined of sedimentary deposits and limestone mixed with glacial till, and are agriculturally productive. However, the plateau areas have acid, infertile soils of sand and stone, making these regions agriculturally poor.

Water quality effects are not as pronounced as in other lake basins; however, the shoreline geology which consists principally of clay and silt bluffs is easily eroded, which may cause problems of sedimentation and agricultural runoff.

Soils

With the exception of the narrow Lake Plains area in the basin, soils are typically poor, with high acidity, and of a mixture of sand, gravel, and stones. Swamps are common in the basin's headlands. Bedrock outcrops and glacial till deposits over the basin make poor soil constituents. More information about soils is contained in the subarea section.

Minerals

The distribution of rocks and glacial debris of geologic eras represented in the Lake Ontario basin define the type and location of mineral resources within the region. Precambrian and cenozoic formations produce significant quantities of iron ore, lead, talc, and marble, limestone, and dolomite. Unconsolidated glacial and lake plain deposits provide the basis for the extraction of sand and gravel, peat, marl and salt.

Water Resources

Climate

The combination of three factors determine the climatic character of the Lake Ontario basin:

(1) the presence of large bodies of water - Lake Erie and Ontario;

(2) the existence of relatively high mountains in and adjacent to the eastern reaches of the basin; and

(3) the westerly direction of the prevailing winds.

Lakes Erie and Ontario act as vast reservoirs for the storage and subsequent exchange of heat energy with the atmosphere. They can significantly moderate the temperature ranges over adjacent land areas, creating a semi-maritime climate. When this heat storing capacity acts in conjunction with the prevailing winds, this can cause great differences in weather conditions and temperatures over the basin's planning subareas.

Prevailing winds are from west to east in the summer and from southwest to northeast in the winter. These winds as they pass over the lake 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 81 centimeters (32 inches) along the lake shore to 132 centimeters (52 inches) in the eastern portion of the basin. In winter much of this precipitation is in the form of snow, accounting for the 163 centimeters (64 inches) annual average reported along the shoreline and 325 centimeters (128 inches) of snow which accumulates in the northeastern portion of the basin. Although winter temperatures range as low as -48°C (-55°F) in the Adirondack region, temperatures in most areas are less severe. The mean daily January temperatures range from -8°C (17°F) in the Upper St. Lawrence Valley to -4°C (25°F) along the western Lake Ontario shoreline. Ice usually begins to form on the lake by mid-December and lasts until the first of May.

The mean daily July temperature ranges from 26° to 29°C (78°to 84°F) and rarely does the temperature exceed 38°C (100°F). The number of frost-free days vary from 160-200 along the lake shore to 120-160 in the interior. Although the wind velocity of the basin averages about 16 kilometers per hour (10 miles per hour), velocities as high as 117 kilometers per hour (73 miles per hour) have been recorded in the basin.

Climatic effects on water quality are not as outstanding as in other areas of the Great Lakes Basin. Precipitation is not a major input into Lake Ontario as it is in the upper Great Lakes, and does not affect this lake as much. The major climatic effect is from wind, and the resulting erosion that may take place. Leiches occur on Lake Ontario, although not to the extent found in Lake Erie, and cause serious erosion and sedimentation problems along the shore.

Table 2

LAKE ONTARIO BASIN CLIMATIC SUMMARY[(2)]

Temperature (°F)		Precipitation (in)		Frost-Free Period		Wind (Speed & Direction)	
Mean Minimum:	17-25°	Annual:	32-52	Minimum:	120-160 days	Summer:	3.7-13.9 W
Mean Maximum:	78-84°	Snowfall:	64-128	Maximum:	160-200 days	Winter:	5.6-16.4 SW

Ranges are an indication of latitude and/or location relative to the lake.

To Convert From	To	Multiply By
Inches (in)	Centimeters (cm)	2.54
Miles (mi)	Kilometers (km)	1.609
Fahrenheit (°F)	Centigrade (°C)	°C=5/9 (°F-32)

Surface Water Hydrology

Average annual inflow to Lake Ontario through the Niagara River and the Welland Canal is 5,720 cubic meters per second (202,000 cubic feet per second). Average annual outflow into the St. Lawrence River is 6,800 cubic meters per second (239,000 cubic feet per second).

The net increase in flow of 1,000 cubic meters per second (37,000 cubic feet per second) is generated by the natural inflow from the drainage basin and is affected by man-made conditions within the Lake Ontario basin.

Climatic, topographic, and geological factors influence the flow and runoff of basin streams. The basin contains more than 45,000 kilometers (28,000 miles) of rivers and streams. Average runoff increases from about 38 centimeters (15 inches) to 102 centimeters (40 inches) annually, in the northeastern portion of the basin. Many regional streams have their origins in the highland regions of the Adirondacks, the Tug Hill Plateau, and the Appalachians. They exhibit flashy, steep gradients with 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 181,800 hectares (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 380 inland lakes, most of which are located in St. Lawrence County. The central section (Planning Subarea 5.2) has more lakes (over 500), covering over 97,100 hectares (240,000 acres). The Finger Lakes occupy a series of nearly parallel troughs in the southwestern portion of the Oswego River basin. The lakes range in size from 80 square kilometers (30 square miles) to Lake Oneida's 200 square kilometers (80 square miles). The numerous natural lakes in the Lake Ontario basin provide a high degree of natural flood control.

Although much of the water in Lake Ontario comes either from Lake Erie or from the Toronto-Hamilton area, the lake has somewhat better water quality than might be expected. This is largely due to the volume of the lake, which is second only to Lake Superior. Even so, improvements in water quality must be achieved due to the poor overall quality of the water today. The only way to improve that quality is action on upstream lakes, combined with action within the Lake Ontario basin itself. Primary problems on Lake Ontario reflect the influence of Lake Erie, and include the build-up of chemical constituents (sulfates, chlorides) and nutrient supply. Major problem areas are the urban-industrial complex from Hamilton to Toronto and Rochester. Projected problems include further over-enrichment and toxic element contamination near the urban areas. Biotic changes, including fisheries, are similar to those of Lake Erie.

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 in 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 Planning Subarea 5.3 has the greatest estimated ground water yield of the basin and one of the greatest in the entire Great Lakes Basin.

Water-critical areas occur along the entire Lake Ontario Lowland from Niagara Falls to the Black River. The bedrock aquifers are low yielding, and, in addition, saline water is present in much of the lowland south of the lake. Sustained droughts create severe water shortages in the dairy counties of the Ontario Lowland and more so in the Black River Valley. Locally, the sand and gravel aquifers are very productive.

The high runoff areas of the Adirondacks and Tug Hill present a challenge to water managers. Conjunctive use of surface and ground water will be a necessity to adequately serve the water needs of the area.

Vegetation Zones and Wildlife Habitat

Land cover in the region is highly variable in nature. Northern hardwoods predominate (maples, beeches, birches) with many varieties of conifers intermixed. Red spruce and balsam fir characterize the Adirondack region, while white pine, hemlock, and northern white cedar are also present in the Tug Hill Plateau.

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 common to the basin. Cold and warmwater fishing in the basin is most productive with muskellunge, northern pike, bass, walleyed pike, salmon, brook, lake and rainbow trout and favorite fish game species.

The Niagara River is an important waterfowl loafing and feeding area during migration. Scattered small wetlands are found mostly near the Lake Ontario shore, but none are of great waterfowl importance. Figure 3 indicates these areas.

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 for the basin. 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.

Demographic and Economic Characteristics

Population

The Lake Ontario basin, with 9 percent of the total Great Lakes Basin population in 1970 (over 2.5 million), ranked third in population among the five lake basins--smaller than Lake Michigan and Lake Erie and larger than Lake Huron and Lake Superior. The 1970 overall basin population density of 143 persons per square mile is one of the lowest in the region.

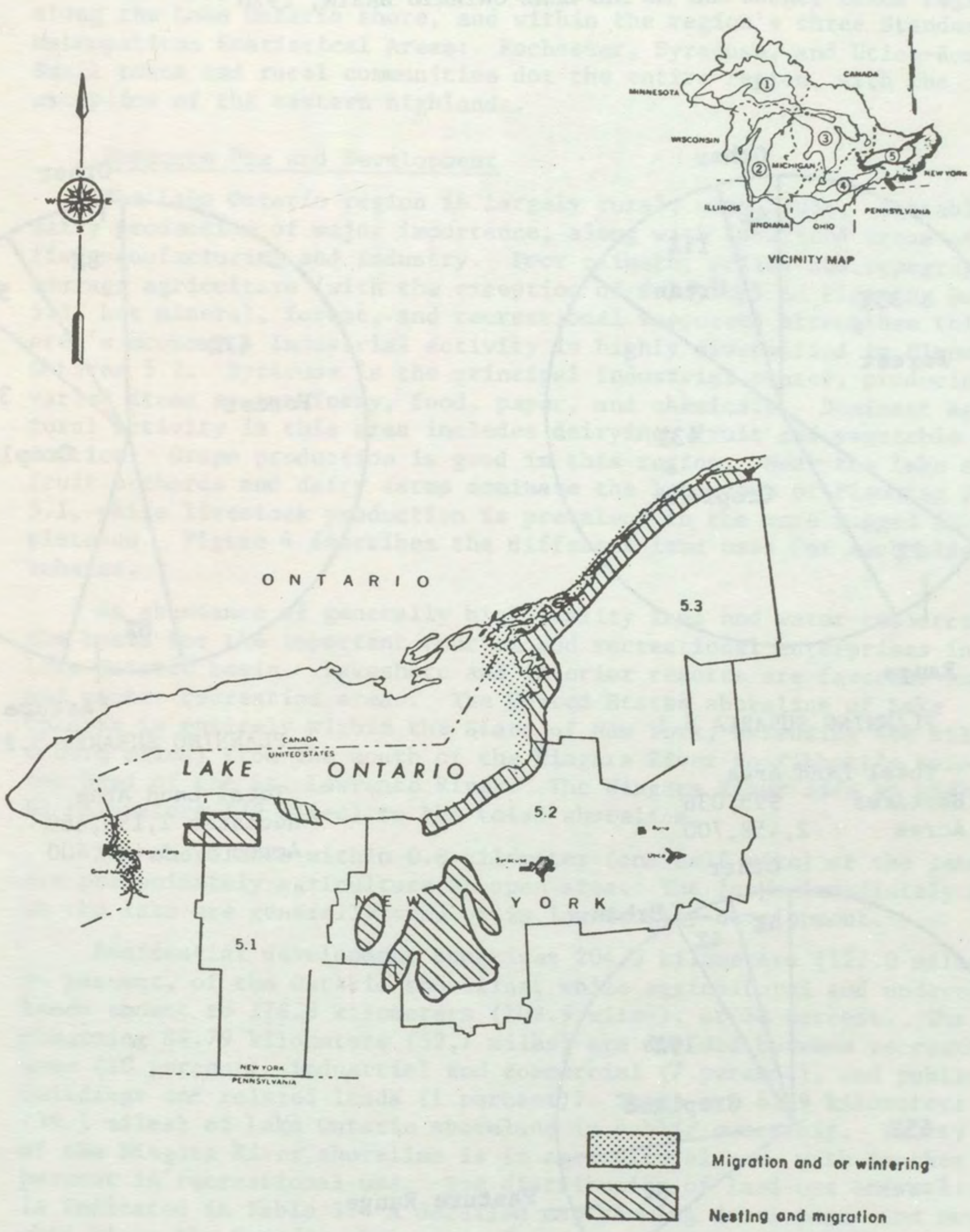
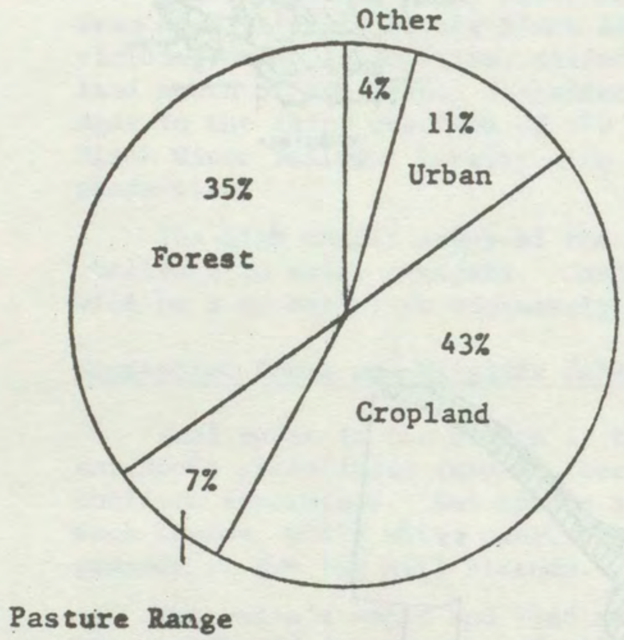


Figure 3

PRIMARY WATERFOWL USE AREAS- LAKE ONTARIO BASIN[3]

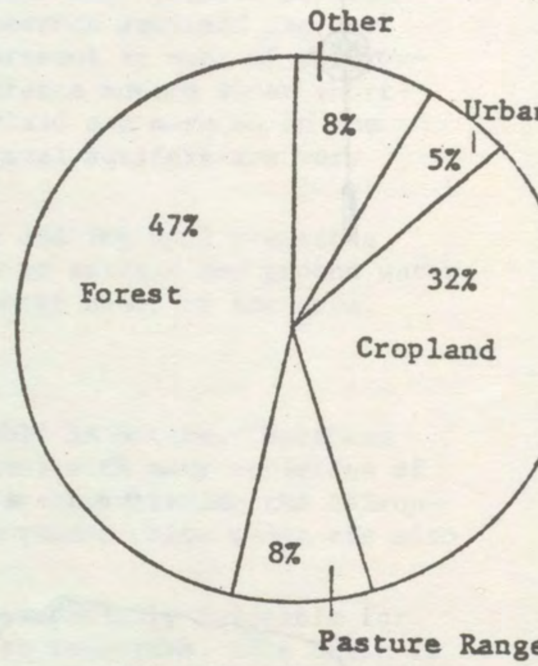
Figure 4

LAND USE IN THE LAKE ONTARIO BASIN, 1970[5]



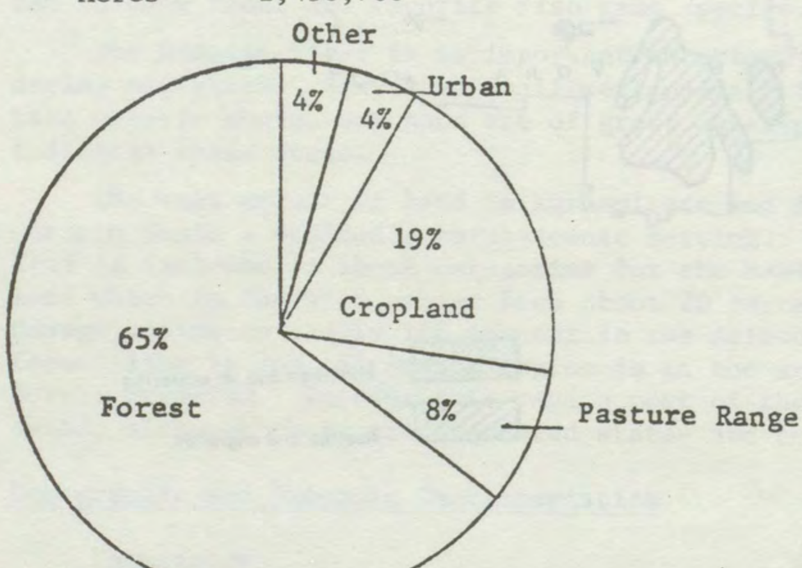
PLANNING SUBAREA 5.1

Total Land Area	
Hectares	995,036
Acres	2,458,700



PLANNING SUBAREA 5.2

Total Land Area	
Hectares	2,196,469
Acres	5,427,400



PLANNING SUBAREA 5.3

Total Land Area	
Hectares	1,370,152
Acres	3,385,500

Major population concentrations occur in the Finger Lakes region, along the Lake Ontario shore, and within the region's three Standard Metropolitan Statistical Areas: Rochester, Syracuse, and Utica-Rome. Small towns and rural communities dot the entire region, with the exception of the eastern highlands.

Resource Use and Development

The Lake Ontario region is largely rural, with fruit, vegetable, and dairy production 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 Planning Subarea 5.3, but mineral, forest, and recreational resources strengthen this area's economy. Industrial activity is highly diversified in Planning Subarea 5.2. Syracuse is the principal industrial center, producing such varied items as machinery, food, paper, and chemicals. Dominant agricultural activity in this area includes dairying, fruit and vegetable production. Grape production is good in this region. Near the lake shores fruit orchards and dairy farms dominate the landscape of Planning Subarea 5.1, while livestock production is prevalent in the more rugged inland plateaus. Figure 4 describes the different land uses for each planning subarea.

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. Lakeshore and interior resorts are favorite summer and winter recreation areas. The United States shoreline of Lake Ontario is entirely within the State of New York, extending 466 kilometers (289.6 miles) from the mouth of the Niagara River to Tibbett's Point at the head of the St. Lawrence River. The Niagara River adds an additional 63 kilometers (39 miles) to the total shoreline.

The shorelands within 0.8 kilometer (one-half mile) of the lake shore are predominately agriculture or open area. The lands immediately adjacent to the lake are generally open or in low-density development.

Residential development comprises 204.3 kilometers (127.0 miles), or 44 percent, of the Ontario shoreline, while agricultural and undeveloped lands amount to 176.8 kilometers (109.9 miles), or 38 percent. The remaining 84.79 kilometers (52.7 miles) are divided between recreational uses (10 percent), industrial and commercial (7 percent), and public buildings and related lands (1 percent). There are 62.9 kilometers (39.1 miles) of Lake Ontario shoreland in public ownership. Thirty percent of the Niagara River shoreline is in agricultural use, with another 22 percent in recreational use. The distribution of land use and ownership is indicated in Table 3. A detailed map showing development and ownership along the Ontario shorelands is given in Figure 5.

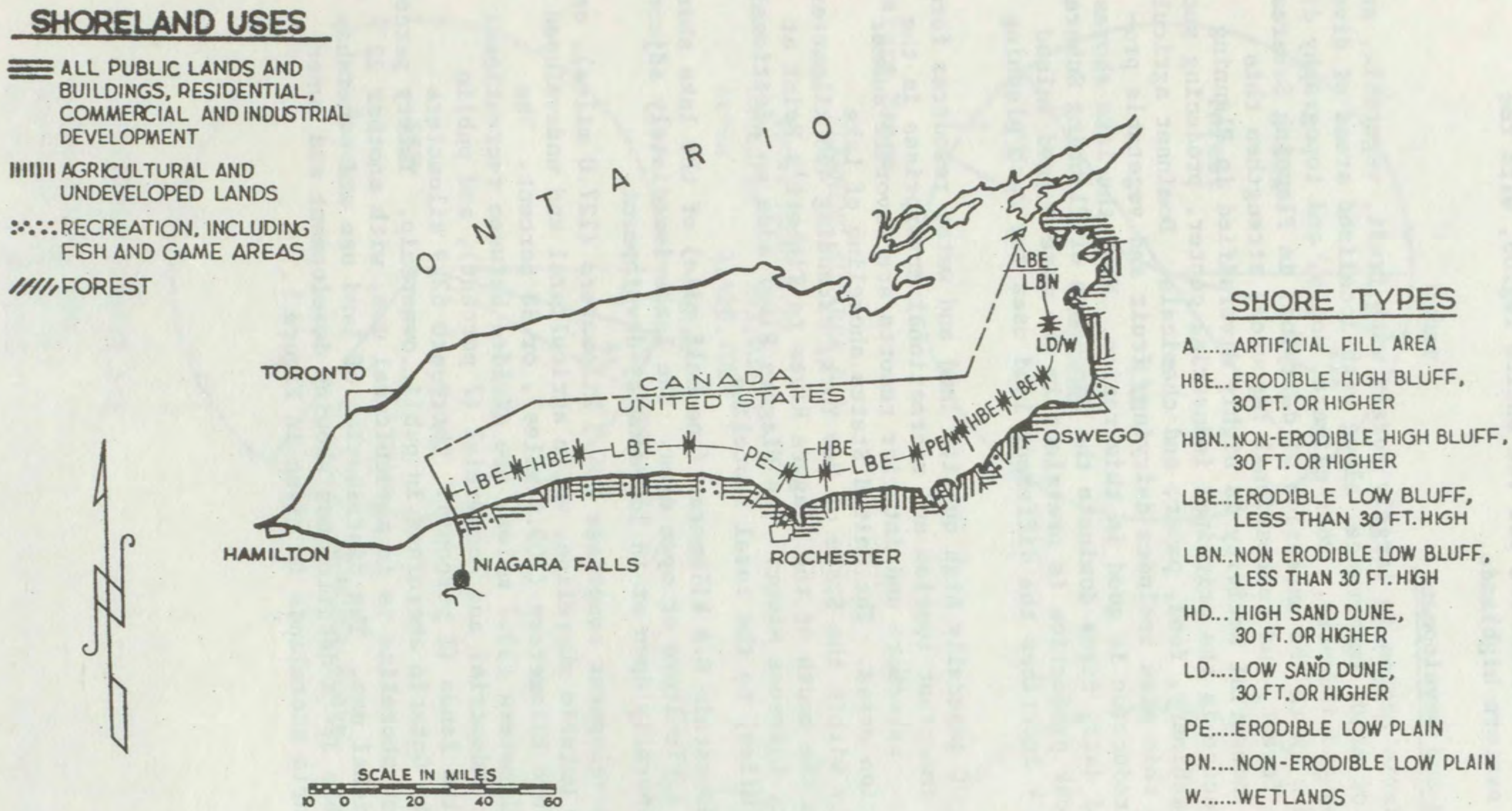


Figure 5

SHORELANDS OF LAKE ONTARIO AND THE NIAGARA RIVER, 1970 (6)

Table 3

LAKE ONTARIO AND NIAGARA RIVER SHORELAND USE AND OWNERSHIP 1970[6]
(in miles)

Shoreland Use	Lake	River	Total
Residential	127.0	4.2	131.2
Industrial & commercial	20.8	6.6	27.4
Public Lands & buildings	1.7	7.9	9.6
Agricultural and undeveloped	109.9	11.7	121.6
Recreational	30.2	8.6	38.8
Wildlife	0	0	0
Forest	0	0	0
Shoreland Ownership			
Federal	0		0
Non-Federal public	31.9		(31.9)
Private	257.7		(257.7)

To Convert From	To	Multiply By
Miles (mi)	Kilometers (km)	1.609

PLANNING SUBAREA 5.1

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 9,104 square kilometers (3,515 square miles) of New York and Pennsylvania land. Figure 6 locates the subarea counties and depicts major drainage areas. Table 4 presents pertinent information on the subarea.

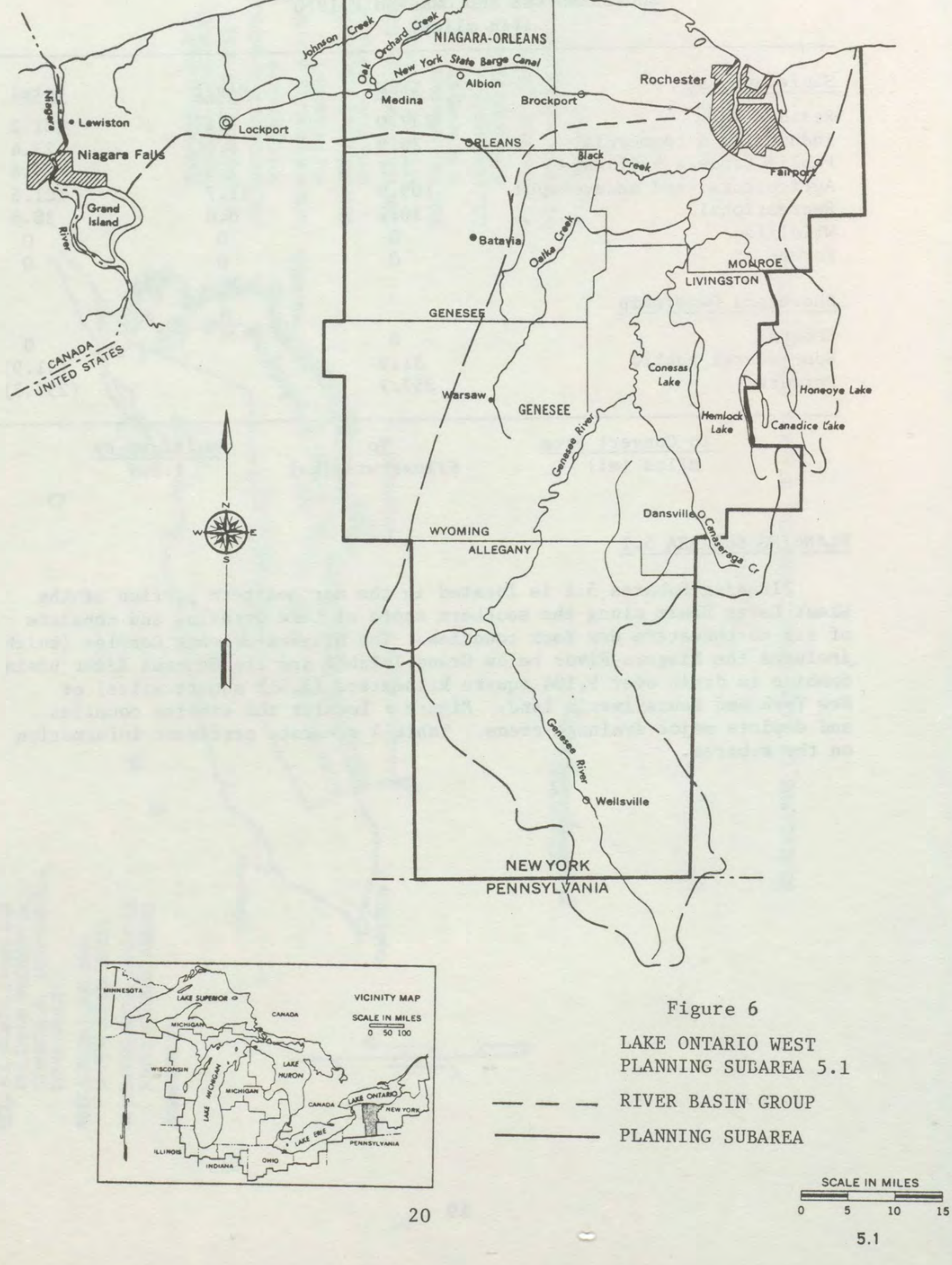


Figure 6

LAKE ONTARIO WEST
PLANNING SUBAREA 5.1

— — — RIVER BASIN GROUP

——— PLANNING SUBAREA

Table 4

LAKE ONTARIO WEST PLANNING SUBAREA 5.1

Drainage Area		Population	1960	1970
square kilometers	9,104	Total	797,364	946,131
Square Miles	3,515	Farm	38,361	22,483
		Non-Farm	759,003	923,648
States				
Pennsylvania	2.7%	SMSA		
New York	97.3%	Rochester	732,588	882,667
Land Use and Water Area	(Acres) (1970)	Employment	305,998	378,954
Total Area	2,476,800	Agriculture,		
Water Area	18,100	Forestry,		
Land Area	2,458,700	Fishery	4.1%	2.3%
Urban	270,457	Mining	.3%	.2%
Cropland	1,054,782	Manufacturing	41.5%	38.1%
Pasture-Range	162,274	Other	54.1%	59.4%
Forest Land	872,839			
Other Land Area	98,348	Income		(1967 $)
		Total Personal Income		3,634,497,000
Lake Ontario Shoreline		Per Capita Income		3,837
Kilometers	131.3			
Miles	81.6			

To convert from	To	Multiply by
Acres (acres)	Hectacres (ha)	0.405

Land Resources

Topography and Geology

This area consists of a series of terraces descending northward from the Allegheny Plateau to Lake Ontario and separated by northward facing escarpments. The Allegheny Plateau has its northern edge at the Portage Escarpment which crosses the broadest part of the basin on an east-west line north of Mount Morris. Its face is deeply indented by the valleys of north flowing streams. This area consists of broad valleys at elevations of 300 to 600 meters (1,000 to 2,000 feet) above sea level, rising to the south and separated by rounded ridges rising up to 150 meters (500 feet) above the valley floor. North of the Portage Escarpment, the Genesee River flows across two plain areas, known as the Erie and Huron Plains. The poorly defined Onondaga Escarpment, separating these areas, crosses the basin north of LeRoy and Honeoye Falls. The plains are areas of undulating terrain in which elevations rise unevenly from 150 meters (500 feet) near Rochester to 300 meters (1,000 feet) near the Portage Escarpment. Finally, near Lake Ontario, cutting through the city of Rochester, the Niagara Escarpment separates the Huron Plain from the Ontario Plain. The escarpment is well defined with several falls at Rochester. Elevations in the Ontario Plain range from 150 meters (500 feet) above sea level to about 75 meters (250 feet) just above Lake Ontario.

The Niagara Escarpment cuts the Niagara-Orleans complex from east to west largely separating distinctive topographic regions. The Ontario Lake Plain, north of the escarpment, is dominated by lacustrine features. A region of low relief, elevations generally are less than 150 meters (500 feet) above sea level.

Bedrock formations in the Genesee River basin deposited as clay, lime, or sand in ancient Devonian and Siberrian seas, and compacted into shales, limestones and sandstones, dip gently to the south at an average of 12 to 18 meters per mile (40 to 60 feet per mile). Thickness of these layers exceeds 30 meters (100 feet) in most places. Glacial deposits of sand, clay, and gravel top these bedrock formations. Though these glacial remains are generally less than 15 meters (50 feet) thick on the uplands, thickness in the valleys is commonly between 30 and 90 meters (100 and 300 feet). Bedrock deposits in the Niagara-Orleans complex consist largely of sandstones, limestones, and shales. Glacial and lacustrine deposits blanket these formations.

Soils [7]

This planning subarea rises gradually from Lake Ontario, where there is a narrow lake plain, to the highland in the Allegheny Plateau. Immediately south of the lake plain is a rolling belt of medium textured, permeable glacial drift. This belt is 20 to 30 miles in width and contains some of the best soils in New York State. Beyond this belt, the land rises into the Allegheny Plateau regions where elevations average 1700 to 2000 feet above Lake Ontario and the soils are developed in a heavy textured glacial drift and in shale and sandstone bedrock. Characteristics of soils in the subarea are shown on Table 5, and soil associations are shown on Figure 7.

Minerals

The mineral commodities produced in the six New York counties comprising Planning Subarea 5.1 include gypsum, salt, sand and gravel, petroleum and natural gas, and stone (limestone, dolomite, and sandstone). From 1960 to 1968, sand and gravel, salt, and crushed and broken stone increased in both output and value while gypsum declined. Dimension stone increased in value but decreased in output during this time period.[1]

A total of 41 nonmetallic mineral operations and an estimated 3,535 oil and gas wells were producing in 1968. All counties except Wyoming had sand and gravel operations, and all counties except Orleans had producing natural gas wells. Limestone quarries were active in three counties, gypsum and salt mines in two counties each, and oil wells and a sandstone quarry in one county each. Selected operations are shown in Figure 8.

Water Resources

Surface Water Hydrology

Principal streams draining the region include the Genesee River and its tributaries - Oak Orchard Creek, Eighteen Mile Creek, and Johnson Creek. Average annual runoff totals about 36 centimeters (14 inches) with a range from 30 to 50 centimeters (12 to 20 inches) increasing from northeast to southeast. Total surface water yield from the basin has been estimated at 5,700 million liters per day (1,500 million gallons per day). Typically, about 50 percent of the annual runoff occurs during the February-April snowmelt months, June through August.

The Genesee River varies from a flashy, steep gradient stream in its headwaters (slopes to 30 meters, or 100 feet, per mile) to a sluggish, meandering stream in its flow over flat alluvial plains (slopes averaging 0.2 meters, or 0.8 feet, per mile). Streams in the Niagara-Orleans complex are not steep, and their flows are relatively stable.

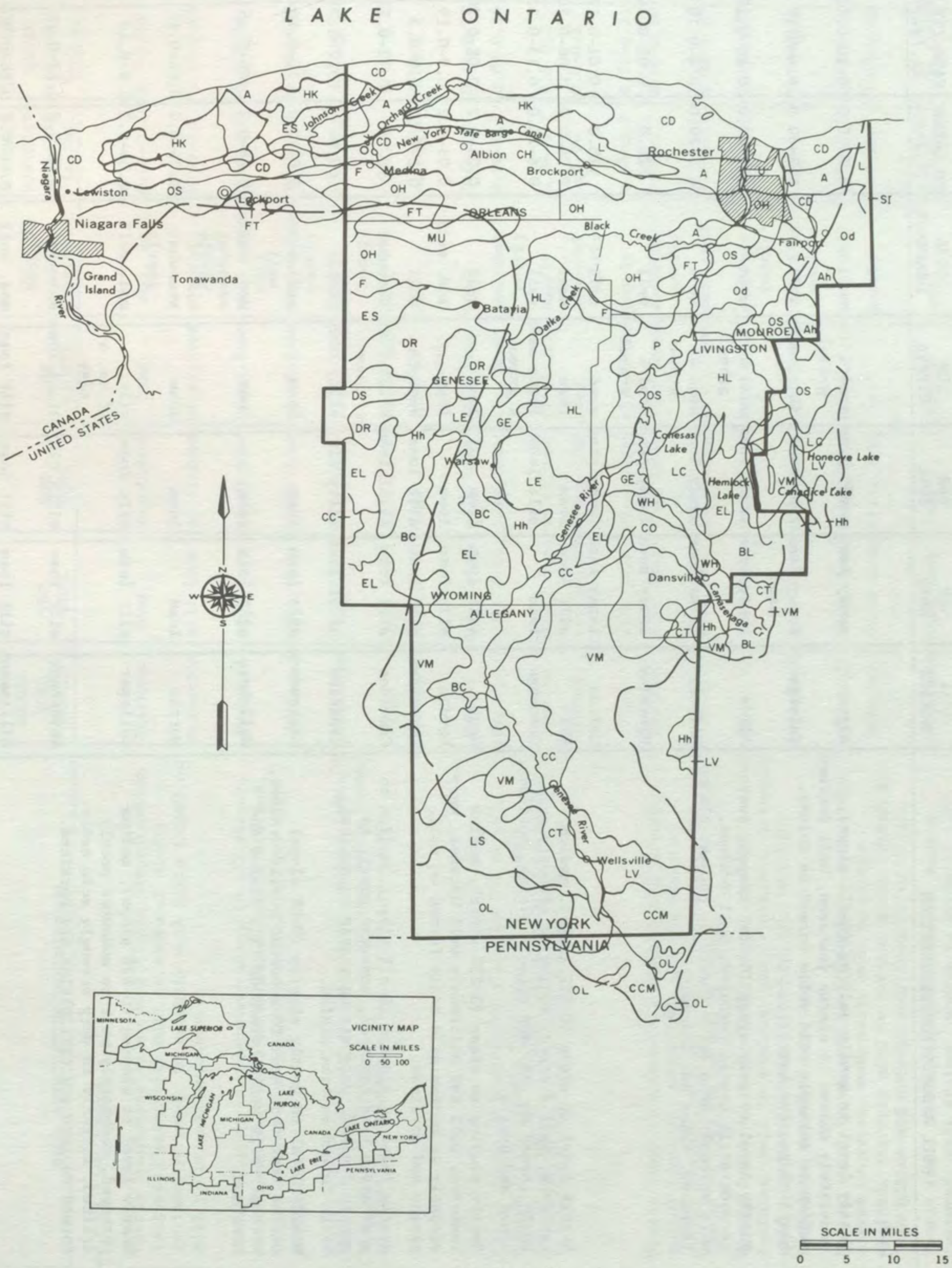


Figure 7

PLANNING SUBAREA 5.1 - SOIL ASSOCIATIONS

Table 5

SOIL CHARACTERISTICS - PLANNING SUBAREA 5.1

SOIL ASSOCIATION NUMBER	SOIL ASSOCIATION DESCRIPTION	MAJOR SOIL SERIES	SOIL TEXTURE: TOP SOIL	SOIL TEXTURE: SUB SOIL	SOIL TEXTURE: SUB STRATA	NATURAL SOIL DRAINAGE	PERMEABILITY OF MOST RESTRICTED LAYER in./hr.	AVAILABLE WATER CAPACITY in./in.[1]	(K) FACTOR	NATURAL FERTILITY	REMARKS
	New York										
A	Nearly level to gently rolling (0-12% slope), moderately coarse to coarse textured, well drained, medium to strongly acid soils formed on deltas, beach ridges and kames.	Alton	sandy loam	sandy loam	sand & gravel	well	6.3-20.0	0.10-0.12	.20	low	
		Colonie	loamy fine sand	fine sand	fine sand	well	6.3-20.0	0.4-0.10	.24	low	
AH	Nearly level to very steep (0-26+% slope), coarse to moderately coarse textured, well drained, very strongly acid soils formed on outwash plains, terraces, kames and eskers.	Alton	sandy loam	sandy loam	sand & gravel	well	6.3-20.0	0.10-0.12	.20	low	
		Colosse	fi.sa.loam	sandy loam	sand & gravel	well	6.3-20.0	0.4-0.10	.17	low	
		Hinckley	loamy sand	loamy sand	sand & gravel	well	>20.0	0.01-0.10	.17	low	
		Colton	loamy sand	loamy sand	sand	well	>20.0	0.01-0.12	.17	low	
BC	Nearly level to steep (0-25% slope), medium textured, well drained, medium to strongly acid soild formed on till and outwash plains, moraines, kames and eskers.	Bath	silt loam	loam	loam	well	0.06-0.20	0.08-0.20	.24	medium	fragipan[2]
		Chenango	loam	silt loam	loamy sand & gravel	well	0.6-20.0	0.13-0.22	.24	medium	
BL	Gently sloping to steep (3-25% slope), medium textured, well and moderately well drianed, very strongly to medium acid soils formed on till plains and moraines.	Bath	silt loam	loam	loam	well	0.06-0.2	0.08-0.20	.24	medium	fragipan[2]
		Mardin	silt loam	loam	loam	mod. well	0.06-0.2	0.9-0.19	.28	low	fragipan[2]
		Lordstown	silt loam	silt loam	bedrock	well	0.2-0.60	0.9-0.2	.28	medium	
CC	Nearly level to sloping (0-12% slope), medium to moderately fine textured, somewhat poorly to poorly drained, very strongly acid to neutral soils formed on lake plains.	Caneadea	silt loam	si.cl.loam	si.cl.loam	somewhat poorly	<0.06	0.12-0.21	.49	low	
		Canadice	si.cl.loam	silty clay	silty clay	poorly	<0.06	0.12-0.21	.49	low	
CCM	Nearly level to gently sloping (0-6% slope), medium textured, well to somewhat poorly drained, strongly acid soils formed on till plains and moraines.	Lackawanna	silt loam	loam	loam	well & mod. well	0.06-0.2	0.10-0.16	.24	medium	fragipan[2]
		Wellsboro	silt loam	loam	loam	mod. well, somewhat poorly	0.06-0.2	0.06-0.16	.28	medium	fragipan[2]
		Morris	loam	loam	loam	somewhat poorly	0.06-0.2	0.06-0.16	.24	medium	fragipan[2]
CD	Nearly level to sloping (0-12% slope), medium textured, moderately well to somewhat poorly drained, slightly to very strongly acid soils formed on lake and till plains and moraines.	Collamer	silt loam	silt loam	silt, fi.sa. & clay	mod. well	0.06-0.2	0.8-0.16	.49	high	
		Rhinebeck	silt loam	silty clay	si.cl.loam	somewhat poorly	0.06-0.2	0.12-0.21	.49	high	
		Williamson	silt loam	silt loam	silt loam, v.fi.sa.loam	mod. well	0.06-0.2	0.10-0.20	.49	medium	fragipan[2]

Table 5 - Contd.

SOIL ASSOCIATION NUMBER	SOIL ASSOCIATION DESCRIPTION	MAJOR SOIL SERIES	SOIL TEXTURE: TOP SOIL	SUB SOIL	SUB STRATA	NATURAL SOIL DRAINAGE	PERMEABILITY OF MOST RESTRICTED LAYER in./hr.	AVAILABLE WATER CAPACITY in./in.[1]	(K) FACTOR	NATURAL FERTILITY	REMARKS
	New York (continued)										
CH	Gently undulating to sloping (3-12% slope) medium textured, moderately well to somewhat poorly drained, strongly to slightly acid soils formed on till plains and moraines.	Clarkson	loam	sa.cl.loam	loam	mod. well	0.06-0.2	0.9-0.16	.24	medium	fragipan[2]
		Hulberton	silt loam	si.cl.loam	si.cl.loam	somewhat poorly	0.06-0.2	0.10-0.22	.37	medium	fragipan[2]
CO	Gently sloping to moderately steep (3-18% slope), medium textured, well to somewhat poorly drained, medium acid to neutral soils formed on lake and till plains.	Cazenovia	silt loam	si.cl.loam	si.cl.loam	well & mod. well	0.06-0.2	0.9-0.16	.43	high	
		Ovid	silt loam	si.cl.loam	si.cl.loam	somewhat poorly	0.06-0.2	0.10-0.22	.37	high	
CT	Nearly level to steep (0-25% slope), medium textured, well drained, strongly acid to neutral soils formed on flood and outwash plains, kames and eskers.	Chenan go	loam	silt loam	loamy sand & gravel	well	0.6-20.0	0.13-0.22	.24	medium	
		Tioga	silt loam	silt loam	loamy sand	well	0.6-2.0	0.14-21	.32	high	
		Howard	loam	loam	sand & gravel	well	0.6-2.0	0.05-0.2	.24	medium	
		Hamlin	silt loam	silt loam	silt loam	well	0.6-2.0	0.17-0.19	.32	high	
DR	Nearly level to moderately steep (0-18% slope), medium to moderately fine textured, somewhat poorly to poorly drained, strongly acid to neutral soils formed on till plains and moraines.	Darien	silt loam	clay loam	clay loam	somewhat poorly	0.06-0.2	0.09-0.16	.32	medium	
		Romulus	si.cl.loam	si.cl.loam	si.cl.loam	poorly	0.06-0.2	0.8-0.2	.43	medium	
		Remsen	si.cl.loam	silty clay	clay	somewhat poorly	<0.06	0.8-0.2	.49	medium	
		Ilion	silt loam	si.cl.loam	si.cl.loam	poorly	0.06-0.2	0.12-0.21	.49	medium	
DS	Nearly level to moderately steep (0-18% slope), medium textured, moderately well to somewhat poorly drained, strongly acid to neutral soils formed on till plains and moraines.	Darien	silt loam	clay loam	clay loam	somewhat poorly	0.06-0.2	0.09-0.16	.32	medium	
		Danley	silt loam	si.cl.loam	si.cl.loam	mod. well	0.06-0.2	0.09-0.20	.32	medium	
EL	Nearly level to steep (0-25% slope), medium textured, well to somewhat poorly drained, strongly acid to neutral soils formed on lake and till plains and moraines.	Erie	silt loam	silt loam	silt loam	somewhat poorly	<0.06	0.08-0.20	.32	medium	fragipan[2]
		Langford	silt loam	silt loam	silt loam	well & mod. well	<0.06	0.9-0.19	.28	medium	fragipan[2]
ES	Nearly level to sloping (0-12% slope), moderately coarse textured, moderately well to poorly drained, strongly acid to neutral soils formed on lake plains and outwash over lacustrine clays.	Elmwood	fi.sa.loam	sa.cl.loam	si.cl.loam	mod. well	0.06-0.2	0.09-0.25	.32	high	
		Swanton	fi.sa.loam	si.cl.loam	clay	poorly	<0.06	0.09-0.25	.32	medium	
F	Nearly level to sloping (0-12% slope), medium textured, well drained, medium to slightly acid soil formed in drift over bedrock.	Farmington	silt loam	loam	bedrock	well	0.06-0.2	0.06-0.20	.28	medium	

Table 5 - Contd.

SOIL ASSOCIATION NUMBER	SOIL ASSOCIATION DESCRIPTION	MAJOR SOIL SERIES	SOIL TEXTURE: TOP SOIL	SOIL TEXTURE: SUB SOIL	SOIL TEXTURE: SUB STRATA	NATURAL SOIL DRAINAGE	PERMEABILITY OF MOST RESTRICTED LAYER in./hr.	AVAILABLE WATER CAPACITY in./in.[1/]	(K) FACTOR	NATURAL FERTILITY	REMARKS
	New York (continued)										
FT	Nearly level to gently sloping (0-6% slope), moderately fine and fine textured, somewhat poorly and very poorly drained, medium acid to neutral soils formed on lake and outwash plains.	Fulton	si.cl.loam	silty clay	silty clay	somewhat poorly	0.06-0.2	0.08-0.18	.49	high	
		Toledo	silty clay	silty clay	silty clay	very poorly	0.06-0.2	0.12-0.18	.49	high	
GE	Nearly level (0-2% slope), medium textured, well to moderately well drained, neutral to mildly alkaline soils formed on flood plains.	Genesee	silt loam	loam	loam, sandy loam silt loam	well	0.6-2.0	0.17-0.24	.32	high	
		Eel	silt loam	silt loam	loam, si.cl.loam sandy loam	mod. well	0.6-2.0	0.17-0.24	.32	high	
Hh	Nearly level to steep (0-25% slope), moderately coarse to medium textured, well drained, strongly acid to neutral soils formed on outwash plains, kames, eskers and deltas.	Howard	loam	loam	sand & gravel	well	0.6-2.0	0.05-0.2	.24	medium	
		Hoosic	sandy loam	sandy loam loamy sand	sand & gravel	well	6.3-20.0	0.02-0.18	.24	medium	
		Chenango	loam	silt loam	loamy sand & gravel	well	0.6-20.0	0.13-0.22	.24	medium	
		Arkport	v.fi.sa. loam	v. fi.sa. loam	fine sand	well	2.0-6.3	.08-0.18	.24	medium	
Hk	Nearly level to gently sloping (0-6% slope), medium textured, moderately well drained, strongly acid to neutral soil formed on till plains.	Hilton	loam	loam	loam	mod. well	0.06-0.2	0.08-0.2	.32	medium	
HL	Nearly level to rolling (0-12% slope), medium textured, well and moderately well drained, medium acid to neutral soils formed on till plains.	Honeoye	loam	clay loam	loam	well	0.06-0.20	0.08-0.2	.32	high	
		Lima	loam	loam	loam	mod. well	0.6-2.0	0.7-0.2	.32	high	
L	Nearly level to gently sloping (0-6% slope), moderately fine textured, somewhat poorly drained, medium acid to neutral soils formed on till plains and moraines.	Lockport	si.cl.loam	silty clay	bedrock	somewhat poorly	<0.06	0.09-0.2	.43	medium	
LC	Nearly level to steep (0-25% slope), medium textured, well and moderately well drained, strongly acid to neutral soils formed on till plains.	Lansing	silt loam	silt loam	loam	well	0.6-2.0	0.09-0.2	.32	high	
		Conesus	silt loam	silt loam	loam	mod. well	0.6-0.2	0.8-0.20	.32	high	
LE	Nearly level to moderately steep (0-18% slope), medium textured, well to somewhat poorly drained, strongly acid to neutral soils formed on till plains and moraines.	Langford	silt loam	silt loam	silt loam	well & mod. well	<0.06	0.9-0.19	.28	medium	fragipan [2/]
		Erie	silt loam	silt loam	silt loam	somewhat poorly	<0.06	0.08-0.20	.32	medium	fragipan [2/]

Table 5 - Contd.

SOIL ASSOCIATION NUMBER	SOIL ASSOCIATION DESCRIPTION	MAJOR SOIL SERIES	SOIL TEXTURE: TOP SOIL	SOIL TEXTURE: SUB SOIL	SOIL TEXTURE: SUB STRATA	NATURAL SOIL DRAINAGE	PERMEABILITY OF MOST RESTRICTED LAYER in./hr.	AVAILABLE WATER CAPACITY in./in.[1]	(K) FACTOR	NATURAL FERTILITY	REMARKS
	New York (continued)										
LS	Gently sloping to steep (3-25% slope), medium textured, well drained, strongly acid soils formed on till over bedrock.	Lordstown	silt loam	silt loam	bedrock	well	0.2-0.60	0.9-0.2	.28	medium	
LV	Gently sloping to steep (3-25% slope), medium textured, deep to shallow, well to somewhat poorly drained, very strongly to medium acid soils formed on till plains and moraines.	Lordstown	silt loam	silt loam	bedrock	well	0.2-0.60	0.9-0.2	.28	medium	
		Mardin	silt loam	loam	loam	mod. well	0.06-0.2	0.9-0.19	.28	low	fragipan[2]
		Volusia	silt loam	loam	loam	somewhat poorly	<0.06	0.1-0.19	.32	low	fragipan[2]
MU	Nearly level (0-2% slope), organic soils, very poorly drained, slightly to extremely acid, formed in depressions.	Organic	muck	muck	muck	very poorly	5.0-10.0	0.5	.17	low	
Od	Gently undulating to sloping (3-12% slope), medium textured, well drained, strongly acid to neutral soil formed on till plains and drumlins.	Ontario	loam	loam	loam	well	0.6-2.0	0.08-0.20	.32	medium	
OH	Gently undulating to rolling (3-12% slope), medium textured, well and moderately well drained, strongly acid to neutral soils formed on till plains and drumlins.	Ontario	loam	loam	loam	well	0.6-2.0	0.08-0.20	.32	medium	
		Hilton	loam	loam	loam	mod. well	0.06-0.2	0.08-0.18	.32	medium	
OL	Gently sloping to moderately steep (3-18% slope), medium textured, well drained, strongly to very strongly acid soils formed on till plains and moraines.	Oquaga	silt loam	silt loam	bedrock	well	0.6-2.0	0.4-0.17	.24	medium	
OS	Nearly level to moderately steep (0-18% slope), medium to moderately fine textured, well to somewhat poorly drained, medium acid to neutral soils formed on lake plains and moraines.	Odessa	silt loam	silty clay	silty clay	somewhat poorly	<0.06	0.12-0.21	.49	medium	
		Schoharie	si. cl.loam	silty clay	silty clay	mod. well to well	0.06-0.2	0.8-0.2	.49	medium	
		Rhinebeck	silt loam	silty clay	si.cl.loam	somewhat poorly	0.06-0.2	0.12-0.21	.49	medium	
		Hudson	silt loam	silty clay	clay & fine silt	mod. well	0.06-0.2	0.12-0.21	.49	medium	
P	Nearly level to steep (0-25% slope), medium to moderately coarse textured, well drained, very strongly acid to neutral soils developed on outwash and till plains, kames and eskers.	Palmyra	loam	sa.cl.loam	sand & gravel	well	0.6-2.0	0.12-0.16	.24	medium	
		Kars	sandy loam	sandy loam	sand & gravel	well	2.0-6.3	0.02-0.2	.24	medium	
		Wampsville	silt loam	clay loam	sand & gravel	well	0.6-2.0	0.07-0.19	.24	high	

Table 5 - Contd.

SOIL ASSOCIATION NUMBER	SOIL ASSOCIATION DESCRIPTION	MAJOR SOIL SERIES	SOIL TEXTURE: TOP SOIL	SOIL TEXTURE: SUB SOIL	SOIL TEXTURE: SUB STRATA	NATURAL SOIL DRAINAGE	PERMEABILITY OF MOST RESTRICTED LAYER in./hr.	AVAILABLE WATER CAPACITY in./in.[1/]	(K) FACTOR	NATURAL FERTILITY	REMARKS
	New York (continued)										
SI	Nearly level to steep (0-25% slope), medium to moderately coarse textured, well and moderately well drained soils formed on till plains, moraines and drumlins.	Sodus	loam	v.fi.sa. loam	v.fi.sa. loam	well	0.06-0.2	0.10-0.19	.20	medium	fragipan[2/]
		Ira	fi.sa.loam	fi.sa.loam	fi.sa.loam	mod. well	<0.06	0.08-0.15	.24	medium	fragipan[2/]
U	Urban areas where original soil conditions have been greatly modified by excavation.	Undifferentiated Urban Land			not applicable						
VM	Gently sloping to moderately steep (3-18% slope), medium textured, moderately well to somewhat poorly drained, very strongly to medium acid soils formed on till plains and moraines.	Volusia	silt loam	loam	loam	somewhat poorly	<0.06	0.1-0.19	.32	low	fragipan[2/]
		Mardin	silt loam	loam	loam	mod. well	0.06-0.2	0.9-0.19	.28	medium	fragipan[2/]
WH	Nearly level (0-2% slope), medium textured, moderately well to very poorly drained, strongly acid to neutral soils formed on flood plains.	Wayland	silt loam	silt loam	silt loam & fi.sa. loam	poorly & very poorly	0.06-0.2	0.11-0.22	.24	high	
		Eel	silt loam	silt loam	loam, si.cl.loam sandy loam	mod. well	0.6-2.0	0.17-0.24	.32	high	
		Papakating	silt loam	si.cl.loam	si.cl.loam	very poorly to poorly	0.06-0.2	0.11-0.22	.43	high	
		Middlebury	silt loam	silt loam	silt loam	mod. well, somewhat poorly	0.6-2.0	0.10-0.21	.28	high	

To Convert From	To	Multiply By
Inches (in)	Cemtimeters (cm)	2.54

1/ Expressed as a ratio - same in metric form
2/ Fragipan - A loamy subsurface layer with restricted permeability

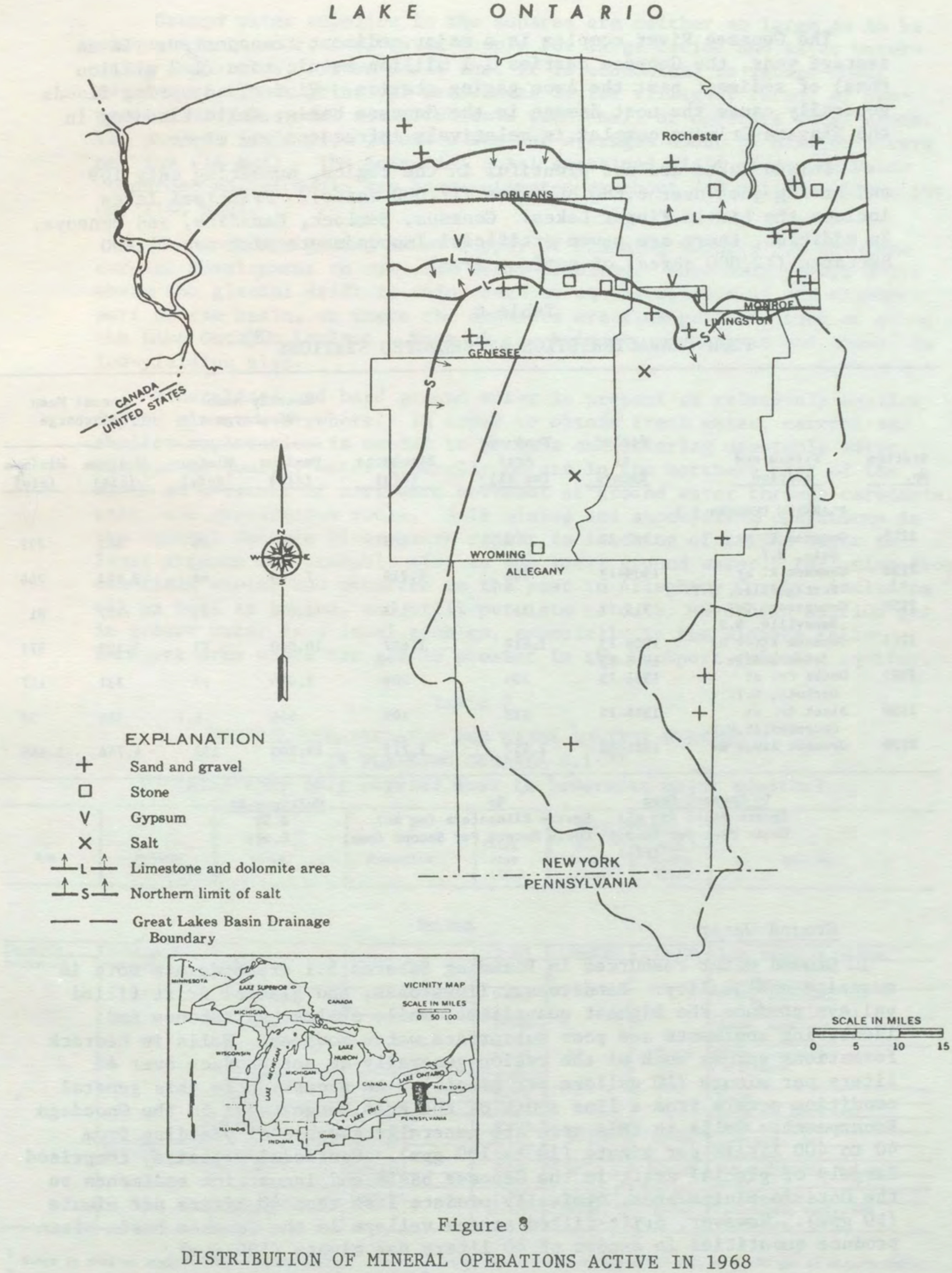


Figure 8

DISTRIBUTION OF MINERAL OPERATIONS ACTIVE IN 1968 AND MAJOR MINERAL RESOURCE AREAS (1)

The Genesee River complex is a major sediment transporter. In an average year, the Genesee carries 1.1 million metric tons (1.2 million tons) of sediment past the Avon gaging station. Winter and spring floods generally cause the most damage in the Genesee basin, while flooding in the Niagara-Orleans complex is relatively infrequent and minor.

Inland lakes are not plentiful in the region, numbering only 109 and having just over 6,880 hectares (17,000 acres). Principal lakes include the Little Finger Lakes: Conesus, Hemlock, Canadice, and Honeoye. In addition, there are seven artificial impoundments with over 4,800 hectares (12,000 acres) of surface area.

Table 6

FLOW CHARACTERISTICS AT SELECTED STATIONS(8)

Station No.	Stream and Station	Period of Record	Drainage Area (sq mi)	Discharge (cfs)	Monthly Mean Discharge Maximum (cfs)	Monthly Mean Discharge Minimum (cfs)	Annual Mean Discharge Maximum (cfs)	Annual Mean Discharge Minimum (cfs)
	PLANNING SUBAREA 5.1							
2215	Genesee R. at Scio, N.Y.	1917-72	308	382	2,620	16	602	227
2230	Genesee R. at Portageville, N.Y.	1909-73	981	1,218	7,780	64	2,162	766
2250	Canasarega Cr. near Dansville, N.Y.	1911-73	153	152	1,030	15	277	81
2275	Genesee River at Jones Bridge	1909-13 1916-73	1,417	1,617	10,000	83	3,109	972
2305	Oatka Cr. at Garbutt, N.Y.	1946-73	204	200	1,070	17	331	117
2310	Black Cr. at Churchville,N.Y.	1946-73	123	109	664	1.7	184	52
2320	Genesee River at	1921-72	2,457	2,712	14,300	152	4,746	1,666

To Convert From	To	Multiply By
Square Miles (sq mi)	Square Kilometers (sq km)	2.59
Cubic Feet Per Second (cfs)	Cubic Meters Per Second (cms)	0.028

Ground Water

Ground water resources in Planning Subarea 5.1 are moderate both in quantity and quality. Sandstones, limestones, and glacial drift-filled valleys produce the highest quantities, while shales, siltstones and lacustrine sediments are poor subsurface water sources. Wells in bedrock formations across much of the region generally do not produce over 40 liters per minute (10 gallons per minute). An exception to this general condition occurs from a line south of the Erie Barge Canal to the Onondaga Escarpment. Wells in this area are generally capable of yielding from 40 to 400 liters per minute (10 to 100 gpm). Surficial deposits, comprised largely of glacial drift in the Genesee basin and lacustrine sediments on the Ontario Plains area, typically produce less than 40 liters per minute (10 gpm). However, drift-filled stream valleys in the Genesee basin often produce quantities in excess of 40 liters per minute (100 gpm).

Ground water supplies in the subarea are neither so large as to be adequate sole sources of water supply for large cities and major water-using industries, nor so small that it is economical to ignore their existence. Their principal usefulness is for villages, farms, or commercial or industrial establishments with small or moderate water needs. The present basin-wide ground water use averages about 68 million liters per day (18 mgd). The potential total sustained yield of ground water resources in the basin has been estimated at about 740 million liters per day (195 mgd).

The moderate ground water supply of Planning Subarea 5.1 requires careful development to overcome local problems. Poor well yields occur where the glacial drift is thin, such as on the uplands of the southern part of the basin, or where the deposits are fine-grained, such as along the Lake Ontario Lowland. Most of the bedrock, carbonates and shale, is low-yielding also.

Mineralized and hard ground water is present at relatively shallow depths almost everywhere. In order to obtain fresh water, careful and shallow exploration is needed to prevent encountering unpotable water. The poorer quality water generally occurs in the northern part of the basin as a result of northward movement of ground water through carbonate, salt, and gypsiferous rocks. Salt mining and stockpiling operations in the central Genesee River basin result in leaching of saline water to local streams and probably also to the local ground water. Pollution from oil-field wastes has occurred in the past in Allegheny County, including oil as well as brines, and still persists to date. Hydrogen sulfide gas in ground water is a local problem, especially in the Niagara Falls-Lockport area where the gas is present in the Lockport dolomite aquifer.

Table 7

GENERAL STRATIGRAPHY AND MAJOR AQUIFER SYSTEMS IN PLANNING SUBAREA 5.1(9)

(Stratigraphy only carried down to lowermost major aquifer)

Era	System	Group	Formation	Thickness (ft.)	Major aquifers: Well yields (gpm)[1]	Major aquifers: Well depths (ft.)[2]	Remarks
New York							
Cenozoic	Quaternary			0-645	50-1000	10-320	Sand, gravel in valleys.
Paleozoic	Devonian	Conewango		0-520			Shale, sandstone, and conglomerate.
		Conneaut		0-625			Shale, sandstone, and siltstone.
		Canadaway		0-1450			Shale, sandstone, and siltstone. Oil.
		Java		0-200	< 40	20-350	Shale, sandstone, and siltstone.
		West Falls		0-1200			
		Sonyea		0-225			Shale.
		Genesee		0-175			Shale and limestone.
		Hamilton		0-600			Shale and limestone. Gas.
			Onondaga	0-150	50-150	40-300	Limestone. Gas.
	Silurian	Bertie	Akron	0-110			Dolomite.
		Salina	Camilius	0-600	< 50	20-250	Shale, dolomite, and salt.
			Vernon				Shale.
			Lockport	0-300	50-300[3]	25-300	Carbonates.
		Clinton		80-190	50-125[4]	10-240	Carbonates, shale, and sandstone.

1 Range is that of typical high-capacity wells.

2 Range is that of all wells.

3 Upper part of Lockport yields as much as 2,200 gpm at Niagara Falls.

4 Highest yields in upper sandstone of Rochester Shale of Clinton Group.

Table 8

CHEMICAL QUALITY CHARACTERISTICS OF THE MAJOR AQUIFER SYSTEMS IN PLANNING SUBAREA 5.1 (9)

(Numerical ranges represent typical values and do not include unusually high or low values)

Aquifer system	Hardness (mg/l)	Sulfate (mg/l)	Chloride (mg/l)	Iron (mg/l)	Total dissolved solids (mg/l)	Temperature (°F)	Remarks
				New York			
Quaternary	160-1220 [1]	0.6-990 [2]	5-160	0.2-1.3	80-1600 [3]	45-53	Increasing mineralization northward.
Devonian (Shale-sandstone)	55-335	1.4-4.3	8-180	0.6-1.2	160-510	---	
Silurian-Devonian (Carbonates)	245-545	45-180	4-90	0.1-0.6	315-745	---	
Silurian (Salina)	380-1540	65-1150	5-95	0.4-0.19	510-2000	50	Higher iron in Rochester area.
Silurian (Lockport)	165-800	60-185	5-25	0.02-0.89	330-540	53-54	Hydrogen sulfide common. Saline in lower zones.
Ordovician-Silurian [4] (Queenston-Clinton)	110-1200	40-135	10-275	0.05-0.85	550	47-53	Saline at depth.

1 Allegany County upper range is only 365.

2 Allegany County upper range is only 56.

3 Allegany County upper range is only 365.

4 Rochester area only.

To Convert From	To	Multiply By
Fahrenheit (°F)	Centigrade (°C)	°C=5/9 (°F-32)

Vegetation Zones and Wildlife Habitat

Forests cover about 28 percent of Planning Subarea 5.1 land. Commercial forest land accounts for over 93 percent of the total 352,400 hectares (870,700 acres) of forested land in the region. Allegheny County led the subarea with 61 percent of the county forested, while only 16 percent of Monroe County is forested. Forest land in the plains areas are scattered. The Allegheny Uplands generally support alternating forests and farmland with acreage devoted to farmland roughly equal to that devoted to forests. American elm, red maple, and northern hardwoods dominate the plains region, while species of oak and northern hardwoods are most common in the plateau.

Forest game populations in the southern half of the planning subarea including white-tailed deer, black bear, turkey and snowshoe hare and are of low to medium density with turkey increasing. Although high quality forest habitat exists here, the bobcat is not found.

Farm game is doing well in the lowland portion of the planning subarea with high pheasant populations and medium populations of cottontail rabbits, mourning doves, and squirrels. Woodcock populations are also of medium density. High pheasant populations are unusual in the basin and may indicate that changes in farming practices which are detrimental to habitat have not occurred here as extensively as they have elsewhere.

Most furbearers occur at medium densities in the shore marshes and the inland river associated marshes and streams.

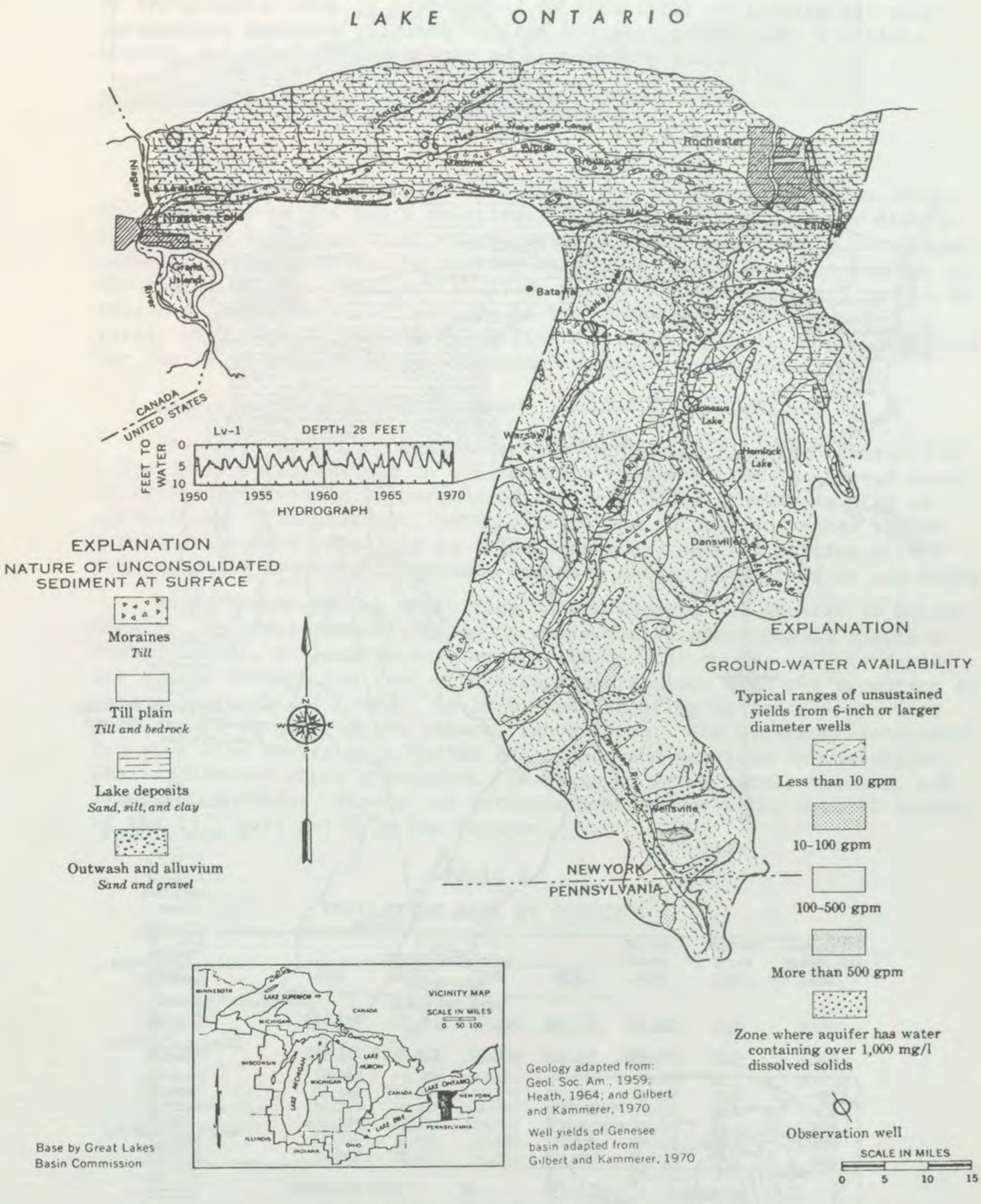


Figure 9

GROUND WATER IN THE UNCONSOLIDATED SEDIMENTS IN PLANNING SUBAREA 5.1[9]

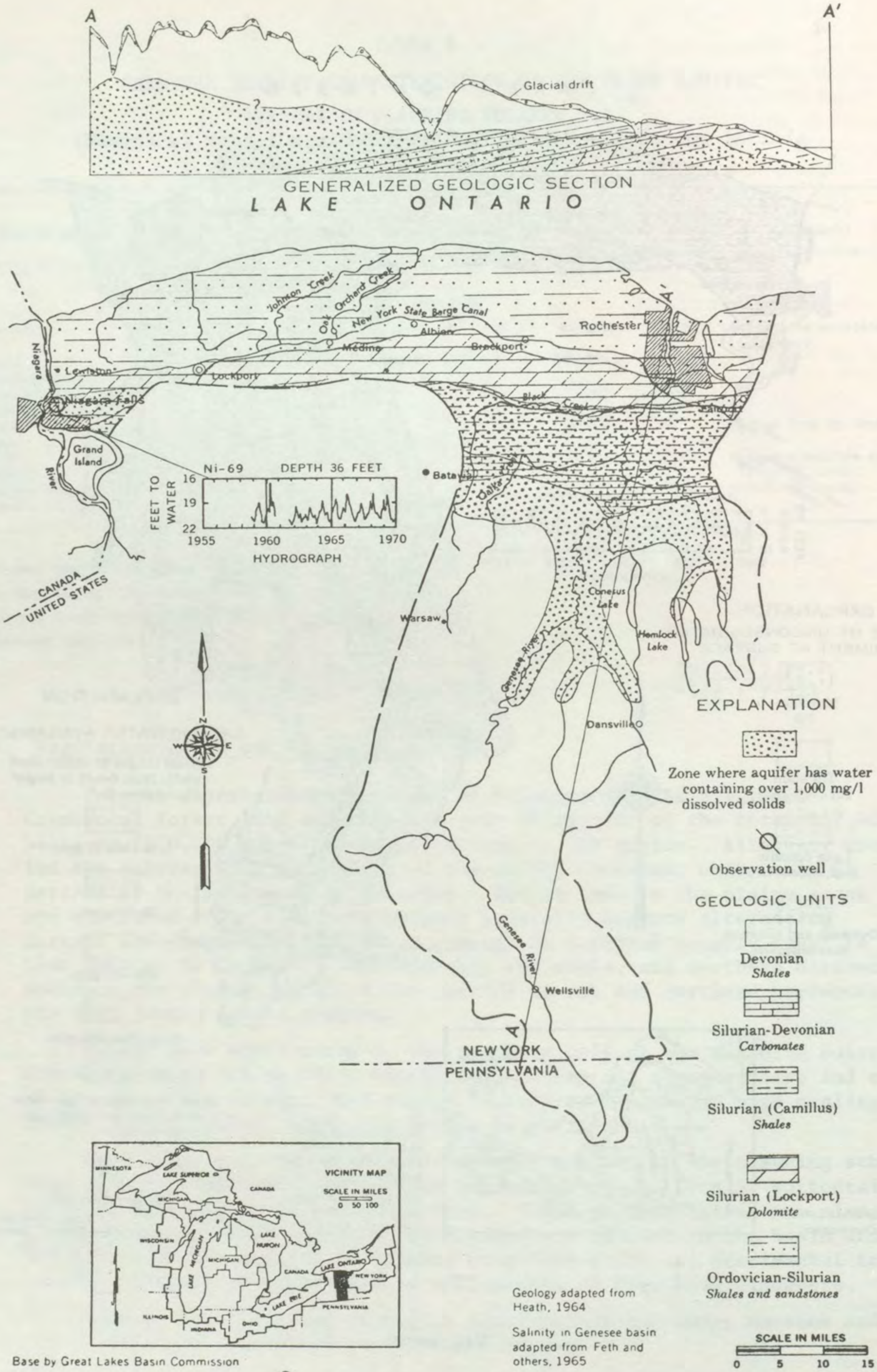


Figure 10

BEDROCK GEOLOGY AND AREAS OF MINERALIZED GROUND WATER IN PLANNING SUBAREA 5.1 (9)

Urban encroachment into valuable wildlife habitat is the most important of the lowland problems. Land use changes such as conversion of agricultural land to residential or industrial activities not only permanently destroys wildlife habitat but also effectively restricts hunting and wildlife management on surrounding lands.

Demographic and Economic Characteristics

Population

With the exception of Monroe County (Rochester metropolitan area), Planning Subarea 5.1 has a relatively sparse population, evenly distributed, with few significant urban centers. The predominantly rural landscape is broken only by the rapidly expanding Rochester urban complex on the shores of Lake Ontario. In 1970, nearly 950,000 persons lived in the region. Approximately 25 percent of the 1970 total was classified as rural, with some 73 percent classified as urban. Monroe County accounted for nearly 90 percent of the Planning Subarea's urban population.

Resource Use and Development

The large amount of land in agriculture gives Planning Subarea 5.1 a decidedly rural setting in all counties except Monroe (Rochester area). In 1970 approximately 50 percent of the area counties were devoted to agriculture. Pasture land, both forested and unforested, makes up the greatest share of farm land in the southern and central portion of the region, while harvested croplands dominate the northern half of the basin.

Major manufacturing activities in the subarea are located in Monroe County. Rochester manufacturing is dominated by photographic supplies and equipment, scientific instruments and optical goods. Manufacturing activities through the rest of the region are minor with the exception of mining in localized areas. In 1970, manufacturing activities provided jobs for 38 percent of the subarea labor force. The Rochester metropolitan area also serves as a center for trades and services in the region. Smaller centers occur throughout the basin to serve rural, tourist, and vacationist needs. Trades and services provided jobs for over 40 percent of the 1970 work force in the subarea.

Table 9

POPULATION DATA BY COUNTY (10)

County Name	Total Population 1940	1950	1960	1970	Number Urban 1970	Percent Urban 1970	Land Area Square Mi. 1970
Planning Subarea 5.1							
TOTAL	620,056	681,911	797,364	946,131	692,875	73.0	3,855
New York	620,056	681,911	797,364	946,131	692,875	73.0	3,855
Allegany	39,681	43,784	43,978	46,568	9,619	20.7	1,047
Genesee	44,481	47,584	53,994	58,722	22,458	38.2	501
Livingston	38,510	40,257	44,053	54,041	17,827	33.0	638
Monroe	438,230	487,632	586,387	711,917	620,368	87.1	675
Orleans	27,760	29,832	34,159	37,305	11,537	30.9	396
Wyoming	31,394	32,822	34,793	37,688	11,066	29.4	598

To Convert From	To	Multiply By
Square Miles (sq mi)	Square Kilometers (sq km)	2.59

Table 10

AGRICULTURAL LAND USE, PLANNING SUBAREA 5.1 (11)

Crop	Current Normal 3/ Acres 2/	Hectares 2/
Wheat	55.0	22.3
Oats	75.6	30.6
Rye	2.5	1.0
Barley	1.2	.5
Misc. Small Grains	-	-
Corn for Grain	54.3	22.0
Corn Silage	58.6	23.7
Soybean	0.1	-
Dry E.D. Beans	35.1	14.2
Sugar Beets	-	-
Potatoes	11.8	4.8
Fruits	30.4	12.3
Comm. Vegetables	46.2	18.7
Comm. Sod	0.4	.2
Alfalfa Hay	172.1	69.6
Clover & Timothy Hay	101.0	40.9
Cropland Pasture	13.3	5.4
Idle Cropland	397.5	160.9
Total Cropland	1,055.1	427.1
Improved Pasture	46.8	18.9
Improvable Pasture	116.1	47.0
N. Improv. Pasture	-	-
Total Pasture	162.9	65.9
Total Ag. Land 1/	1,218.0	493.0

Less Than 100 Units.

1/ Totals may not add due to rounding.

2/ Measurement is in thousands of acres or hectares.

3/ Current Normal represents present yield estimates based on 1958-1972 average.

Table 11

POPULATION, EMPLOYMENT, PERSONAL INCOME, AND EARNINGS BY INDUSTRY IN 1970, PLANNING SUBAREA 5.1 (11)

Item	1970
Population, midyear	947,185
Per capita income (1967$)	3,837
Per capita income Rel. (U.S.=1.00)	1.10
Total employment	380,750
Employment/population ratio	.40
Total personal income	3,634,497
Total earnings	2,959,463
Agriculture, forestry & fisheries	73,279a
Agriculture	-
Forestry and Fisheries	-
Mining	4,617c
Metal	-
Coal	-
Crude petroleum & natural gas	-
Nonmetallic, except fuels	-
Contract construction	145,626
Manufacturing	1,393,826
Food & kindred products	-
Textile mill products	-
Apparel & other fabric products	-
Lumber products & furniture	-
Paper and allied products	-
Printing and publishing	-
Chemicals and allied products	-
Petroleum refining	-
Primary metals	-
Fabricated metals & ordinance	-
Machinery, excluding electrical	-
Electrical machinery & supplies	-
Motor vehicles & equipment	-
Transportation equip., excl. mtr. vehs	-
Other manufacturing	-
Trans., comm. & public utilities	119,541
Wholesale and retail trade	378,446
Finance, insurance & real estate	99,873
Services	359,103
Government	378,190
Federal government	35,804
State and local government	333,725
Armed forces	8,661

a-represents 80.0 to 99.9 percent of the true value

b-represents 60.0 to 79.9 percent of the true value

PLANNING SUBAREA 5.2

Planning Subarea 5.2, located within the north central portion of New York State, presents a unique mix of urban, rural, and recreational environments. The 12 county region is bounded by Lake Ontario and the Black River on the north, the Mohawk basin to the east, and the Susquehanna and Genesee River basins on the south and west. The basin has a length of over 160 kilometers (100 miles) from east to west and extends some 190 kilometers (120 miles) from north to south. The drainage area is approximately 17,200 square kilometers (6,650 square miles).

Table 12 and Figure 11 present pertinent information about the area.

Table 12

LAKE ONTARIO CENTRAL PLANNING SUBAREA 5.2

Drainage Area		Population	1960	1970
Square Kilometers	17,656.5	Total	1,236,359	1,361,673
Square Miles	6,817.2	Farm	78,796	49,069
		Non-Farm	1,157,563	1,312,604
States				
New York	100%	SMSAs		
		Syracuse	563,781	636,507
Land Use and Water Area (1970 Acres)		Utica-Rome	330,771	340,670
Total Area	5,682,600			
Water Area	255,200	Employment	456,508	523,900
Land Area	5,427,400			
Urban	249,660	Agriculture, Forestry, Fishery	5.5%	3.3%
Cropland	1,758,478			
Pasture-Range	445,047			
Forest Land	2,545,450	Mining	.2%	.2%
Other Land Area	428,765	Manufacturing	33.1%	28.9%
		Other	61.2%	67.6%
Lake Ontario Shoreline		Income		(1967$)
Kilometers	213.2	Total Personal Income		4,427,043,000
Miles	132.5	Per Capita Income		3,329

To Convert From	To	Multiply By
Acres (acre)	Hectares (ha)	0.405

Land Resources

Topography and Geology

Planning Subarea 5.2 drainage basins have been extensively glaciated by the movement of ice masses out of Canada. The glaciers left a layer of soil composed of silt, clay, sand and gravel overlying a series of southward sloping bedrock formations. Sedimentary rocks, ranging in age from Ordovician to Devonian and composed of limestone, dolomite, sandstone, and shale locally interbedded with gypsum and salt layers, comprise the bedrock strata. Barriers of glacial debris left by the retreating ice form the drainage divides in the subarea.

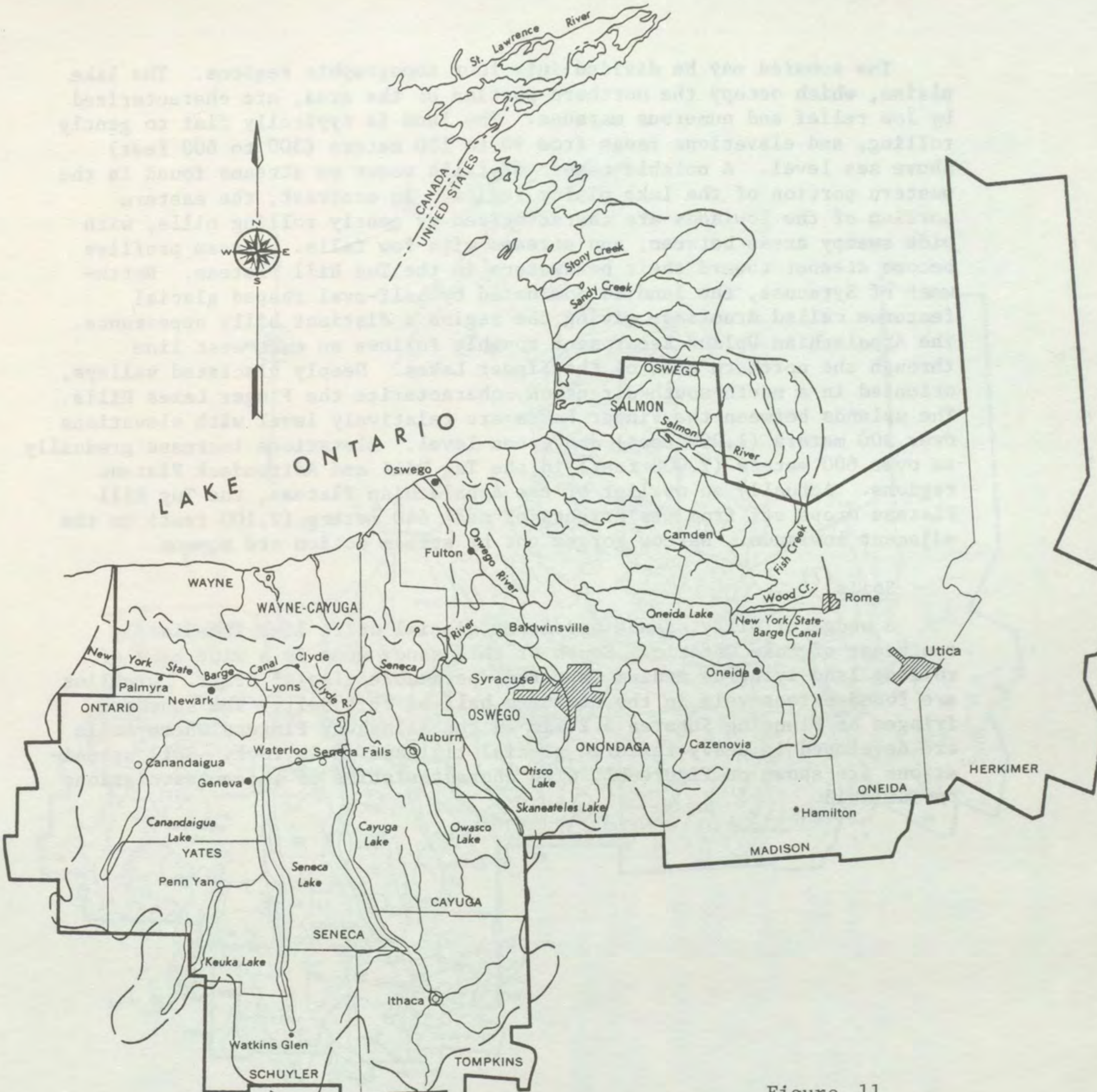


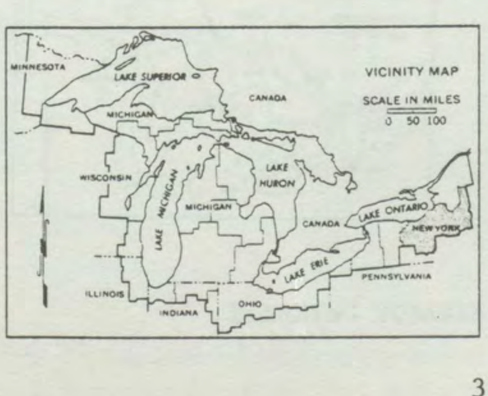
Figure 11

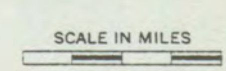
LAKE ONTARIO CENTRAL

PLANNING SUBAREA 5.2

— — — RIVER BASIN GROUP

———— PLANNING SUBAREAS





5.2

The subarea may be divided into four topographic regions. The lake plains, which occupy the northern portion of the area, are characterized by low relief and numerous marshes. The land is typically flat to gently rolling, and elevations range from 90 to 180 meters (300 to 600 feet) above sea level. A notable number of falls occur on streams found in the western portion of the lake plains region. In contrast, the eastern portion of the lowlands are characterized by gently rolling hills, with wide swampy areas between, and streams with few falls. Stream profiles become steeper toward their headwaters in the Tug Hill Plateau. Northwest of Syracuse, the land is dominated by half-oval shaped glacial features called drumlins, giving the region a distinct hilly appearance. The Appalachian Upland Escarpment roughly follows an east-west line through the northern ends of the Finger Lakes. Deeply glaciated valleys, oriented in a north-south direction, characterize the Finger Lakes Hills. The uplands between the Finger Lakes are relatively level with elevations over 300 meters (1,000 feet) above sea level. Elevations increase gradually to over 600 meters (2,000 feet) in the Tug Hill and Adirondack Plateau regions. Actually an outlier of the Appalachian Plateau, the Tug Hill Plateau drops off from its heights of near 640 meters (2,100 feet) to the adjacent lowlands. Narrow gorges cut by stream action are common.

Soils[7]

A wedge of hilly, sandy and stony glacial drift lies immediately southeast of Lake Ontario. South of this sandy zone is a wide band of rolling land lying on medium textured, permeable glacial drift. Drumlins are found extensively in the northern half of this belt. The southern fringes of Planning Subarea 5.2 lie on the Allegheny Plateau where soils are developed in heavy textured glacial till and shale rock. Soil associations are shown on Figure 12, with characteristics of these associations on Table 13.

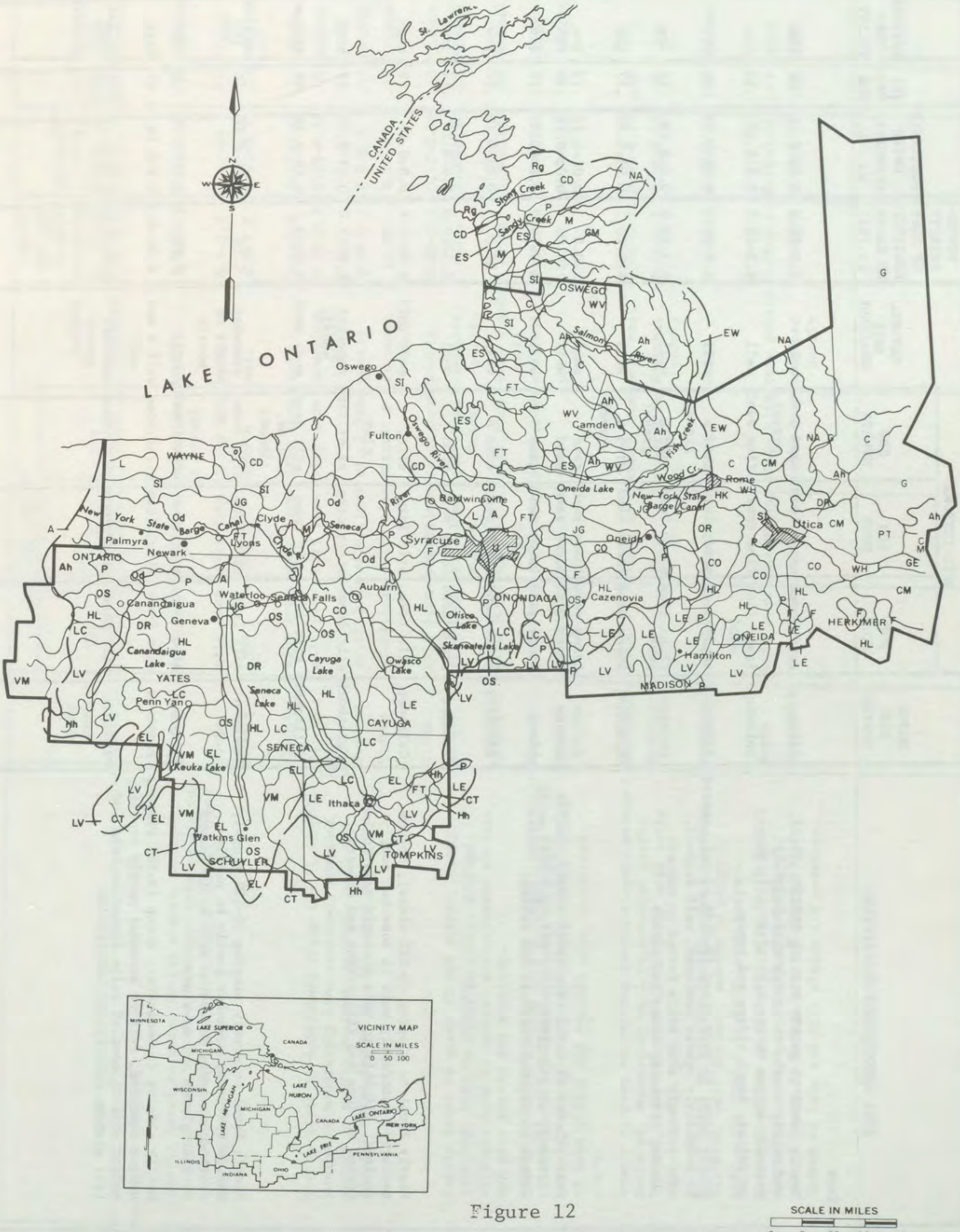


Figure 12

PLANNING SUBAREA 5.2 - SOIL ASSOCIATIONS

Table 13

SOIL CHARACTERISTICS - PLANNING SUBAREA 5.2

SOIL ASSOCIATION NUMBER	SOIL ASSOCIATION DESCRIPTION	MAJOR SOIL SERIES	SOIL TEXTURE: TOP SOIL	SUB SOIL	SUB STRATA	NATURAL SOIL DRAINAGE	PERMEABILITY OF MOST RESTRICTED LAYER in./hr.	AVAILABLE WATER CAPACITY in./in.[1]	(K) FACTOR	NATURAL FERTILITY	REMARKS
New York											
A	Nearly level to gently rolling (0-12% slope), moderately coarse to coarse textured, well drained, medium to strongly acid soils formed on deltas, beach ridges and kames.	Alton	sandy loam	sandy loam	sand & gravel	well	6.3-20.0	0.10-0.12	.20	low	
		Colonie	loamy fine sand	fine sand	fine sand	well	6.3-20.0	0.4-0.10	.24	low	
AH	Nearly level to very steep (0-26+% slope), coarse to moderately coarse textured, well drained, very strongly acid soils formed on outwash plains, terraces, kames and eskers.	Alton	sandy loam	sandy loam	sand & gravel	well	6.3-20.0	0.10-0.12	.20	low	
		Colosse	fi.sa.loam	sandy loam	sand & gravel	well	6.3-20.0	0.4-0.10	.17	low	
		Hinckley	loamy sand	loamy sand	sand & gravel	well	>20.00	0.01-0.10	.17	low	
		Colton	loamy sand	loamy sand	sand	well	>20.0	0.01-0.12	.17	low	
C	Nearly level to undulating (0-6% slope), coarse textured, well drained, very strongly acid soils formed on outwash terraces and deltas.	Colton	loamy sand	loamy sand	sand	well	>20.0	0.01-0.12	.17	low	
		Adams	loamy sand	loamy sand, sand	sand	well	6.3-20.0	0.8-0.10	.17	low	
		Hinckley	loamy sand	loamy sand & sand	sand & gravel	well	20.0	0.01-0.10	.17	low	
		Windsor	loamy sand	loamy sand & sand	sand	well	6.3-20.0	0.8-0.10	.17	low	
CD	Nearly level to sloping (0-12% slope), medium textured, moderately well to somewhat poorly drained, slightly to very strongly acid soils formed on lake and till plains and moraines.	Collamer	silt loam	silt loam	silt, fi.sa. & clay	mod. well	0.06-0.2	0.8-0.16	.49	high	
		Rhinebeck	silt loam	silty clay	si.cl.loam	somewhat poorly	0.06-0.2	0.12-0.21	.49	high	
		Williamson	silt loam	silt loam	silt loam, v.fi.sa. loam	mod. well	0.06-0.2	0.10-0.20	.49	medium	fragipan[2]
CM	Nearly level to gently sloping (0-12% slope), medium textured, somewhat poorly to poorly drained, strongly to medium acid soils formed on till plains and moraines.	Camroden	silt loam	silt loam	silt loam	somewhat poorly to poorly	<.06	0.16-0.18	.28	low	fragipan[2]
		Marcy	silt loam	silt loam	silt loam	poorly	<.06	0.16-0.18	.28	low	fragipan[2]
CO	Gently sloping to moderately steep (3-18% slope), medium textured, well to somewhat poorly drained, medium acid to neutral soils formed on lake and till plains.	Cazenovia	silt loam	si.cl.loam	si.cl.loam	well & mod. well	0.06-0.2	0.9-0.16	.43	high	
		Ovid	silt loam	si.cl.loam	si.cl.loam	somewhat poorly	0.06-0.2	0.10-0.22	.37	high	

Table 13 - Contd.

SOIL ASSOCIATION NUMBER	SOIL ASSOCIATION DESCRIPTION	MAJOR SOIL SERIES	SOIL TEXTURE: TOP SOIL	SUB SOIL	SUB STRATA	NATURAL SOIL DRAINAGE	PERMEABILITY OF MOST RESTRICTED LAYER in./hr.	AVAILABLE WATER CAPACITY in./in.[1]	(K) FACTOR	NATURAL FERTILITY	REMARKS
	New York (continued)										
CT	Nearly level to steep (0-25% slope), medium textured, well drained, strongly acid to neutral soils formed on flood and outwash plains, kames and eskers.	Chenanao	loam	silt loam	loamy sand & gravel	well	0.6-20.0	0.13-0.22	.24	medium	
		Tioga	silt loam	silt loam	loamy sand	well	0.6-2.0	0.14-21	.32	high	
		Howard	loam	loam	sand & gravel	well	0.6-2.0	0.05-0.2	.24	medium	
		Hamlin	silt loam	silt loam	silt loam	well	0.6-2.0	0.17-0.19	.32	high	
DR	Nearly level to moderately steep (0-18% slope), medium to moderately fine textured, somewhat poorly to poorly drained, strongly acid to neutral soils formed on till plans and moraines.	Darien	silt loam	clay loam	clay loam	somewhat poorly	0.06-0.2	0.09-0.16	.32	medium	
		Romulus	si.cl.loam	si.cl.loam	si.cl.loam	poorly	0.06-0.2	0.8-0.2	.43	medium	
		Remsen	si.cl.loam	silty clay	clay	somewhat poorly	<0.06	0.8-0.2	.49	medium	
		Ilion	silt loam	si.cl.loam	si.cl.loam	poorly	0.06-0.2	0.12-0.21	.49	medium	
EL	Nearly level to steep (0-25% slope), medium textured, well to somewhat poorly drained, strongly acid to neutral soils formed on lake and till plains and moraines.	Erie	silt loam	silt loam	silt loam	somewhat poorly	<0.06	0.08-0.20	.32	medium	fragipan[2]
		Langford	silt loam	silt loam	silt loam	well & mod. well	<0.06	0.9-0.19	.28	medium	fragipan[2]
ES	Nearly level to sloping (0-12% slope), moderately coarse textured, moderately well to poorly drained, strongly acid to neutral soils formed on lake plains and outwash over lacustrine clays.	Elmwood	fi.sa.loam	sa.cl.loam	si.cl.loam	mod. well	0.06-0.2	0.09-0.25	.32	high	
		Swanton	fi.sa.loam	si.cl.loam	clay	poorly	<0.06	0.09-0.25	.32	medium	
EW	Gently sloping to rolling (3-12% slope), medium textured, moderately well to somewhat poorly drained, very strongly to slightly acid soils formed on till plains.	Empeyville	loam	sandy loam	sandy loam	mod. well	0.06-0.2	0.08-0.19	.28	low	fragipan[2]
		Westbury	loam	loam	sandy loam	somewhat poorly	0.06-0.2	0.02-0.18	.28	low	fragipan[2]
F	Nearly level to sloping (0-12% slope), medium textured, well drained, medium to slightly acid soils formed in drift over bedrock.	Farmington	silt loam	loam	bedrock	well	0.6-2.0	0.06-0.20	.28	medium	
FT	Nearly level to gently sloping (0-6% slope), medium textured, somewhat poorly to very poorly drained, medium acid to neutral soils formed on lake and till plains and moraines.	Fonda	silt loam	silty clay	silty clay	very poorly	0.06-0.2	0.12-0.21	.43	high	
		Rhinebeck	silt loam	silty clay	si.cl.loam	somewhat poorly	0.06-0.2	0.12-0.21	.49	high	

Table 13 - Contd.

SOIL ASSOCIATION NUMBER	SOIL ASSOCIATION DESCRIPTION	MAJOR SOIL SERIES	SOIL TEXTURE: TOP SOIL	SOIL TEXTURE: SUB SOIL	SOIL TEXTURE: SUB STRATA	NATURAL SOIL DRAINAGE	PERMEABILITY OF MOST RESTRICTED LAYER in./hr.	AVAILABLE WATER CAPACITY in./in.[1/]	(K) FACTOR	NATURAL FERTILITY	REMARKS
New York (continued)											
G	Nearly level to moderately steep (0-18% slope), moderately coarse textured, well drained, very strongly acid soils formed on till plains and moraines.	Gloucester	sandy loam	sandy loam loamy sand	loamy sand	well	6.3-20.0	0.01-0.20	.17	low	
		Essex	sandy loam	loamy sand	sand & gravel	well	0.06-0.2	0.2-0.16	.20	low	fragipan[2/]
		Rockland			not applicable						
		Hermon	sandy loam	sandy loam	sand & gravel	well	2.0-6.3	0.02-0.2	.17	low	
		Becket	fi.sa.loam	fi.sa.loam	sand & gravel	well	0.06-0.6	0.05-0.23	.20	low	fragipan[2/]
GE	Nearly level (0-2% slope), medium textured, well to moderately well drained, neutral to mildly alkaline soild formed on flood plains.	Genesee	silt loam	loam	loam sandy loam silt loam	well	0.6-2.0	0.17-0.24	.32	high	
		Eel	silt loam	silt loam	loam, si.cl.loam sandy loam	mod. well	0.6-2.0	0.17-0.24	.32	high	
Hh	Nearly level to steep (0-25% slope), moderately coarse to medium textured, well drained, strongly acid to neutral soils formed on till plains.	Howard	loam	loam	sand & gravel	well	0.6-2.0	0.05-0.2	.24	medium	
		Hoosic	sandy loam	sandy loam loamy sand	sand & gravel	well	6.3-20.0	0.02-0.18	.24	medium	
		Chenango	loam	silt loam	loamy sand & gravel	well	0.6-20.0	0.13-0.22	.24	medium	
		Arkport	v.fi.sa. loam	v.fi.sa. loam	fine sand	well	2.0-6.3	0.08-0.18	.24	medium	
HK	Nearly level to gently sloping (0-6% slope), medium textured, moderately well drained, strongly acid to neutral soil formed on till plains.	Hilton	loam	loam	loam	mod. well	0.06-0.2	0.08-0.18	.24	medium	
HL	Nearly level to rolling (0-12% slope), medium textured, well and moderately well drained, medium acid to neutral soils formed on till plains.	Honeoye	loam	clay loam	loam	well	0.06-0.20	0.08-0.2	.32	high	
		Lima	loam	loam	loam	mod. well	0.6-2.0	0.7-0.2	.32	high	
JG	Nearly level (0-2% slope), coarse textured, somewhat poorly to poorly drained, medium acid to neutral soils formed on lake and outwash plains.	Junius	loamy fine sand	fine sand	fine sand	poorly & somewhat poorly	2.0-6.0	0.04-0.16	.17	low	
		Granby	loamy sand	sand	sand	poorly	5.0-10.0	0.04-0.10	.17	low	

Table 13 - Contd.

SOIL ASSOCIATION NUMBER	SOIL ASSOCIATION DESCRIPTION	MAJOR SOIL SERIES	SOIL TEXTURE TOP SOIL	 SUB SOIL	 SUB STRATA	NATURAL SOIL DRAINAGE	PERMEABILITY OF MOST RESTRICTED LAYER in./hr.	AVAILABLE WATER CAPACITY in./in.[1/]	(K) FACTOR	NATURAL FERTILITY	REMARKS
New York (continued)											
L	Nearly level to gently sloping (0-6% slope), moderately fine textured, somewhat poorly drained, medium acid to neutral soil formed on till plains and moraines.	Lockport	si.cl.loam	silty clay	bedrock	somewhat poorly	<0.06	0.09-0.2	.43	high	
LC	Nearly level to steep (0-25% slope), medium textured, well and moderately well drained, strongly aicd to neutral soils formed on till plains.	Lansing	silt loam	silt loam	loam	well	0.6-2.0	0.9-0.20	.32	high	
		Conesus	silt loam	silt loam	loam	mod. well	0.6-0.2	0.8-0.20	.32	high	
LE	Nearly level to moderately steep (0-18% slope), medium textured, well to somewhat poorly drained, strongly acid to neutral soils formed on till plains and moraines.	Langford	silt loam	silt loam	silt loam	well & mod. well	<0.06	0.9-0.19	.28	medium	fragipan[2/]
		Erie	silt loam	silt loam	silt loam	somewhat poorly	<0.06	0.08-0.20	.32	medium	fragipan[2/]
LV	Gently sloping to steep (3-25% slope), medium textured, deep to shallow, well to somewhat poorly drained, very strongly to medium acid soils formed on till plains and moraines.	Lordstown	silt loam	silt loam	bedrock	well	0.2-0.60	0.9-0.2	.28	medium	
		Mardin	silt loam	loam	loam	mod. well	0.06-0.2	0.9-0.19	.28	low	fragipan[2/]
		Volusia	silt loam	loam	loam	somewhat poorly	<0.06	0.1-0.19	.32	low	fragipan[2/]
M	Gently undulating to steep (3-25% slope), moderately coarse to medium textured, well and moderately well drained, strongly acid to neutral soils formed on lake and till plains, moraines and drumlins.	Madrid	fi.sa.loam	loam	fi.sa.loam	well	0.6-2.0	0.8-0.16	.32	medium	
		Bombay	loam	loam	fi.sa.loam	mod. well	0.2-0.6	0.6-0.18	.32	medium	
		Collamer	silt loam	silt loam	silt, fi.sa & clay	mod. well	0.06-0.2	0.8-0.16	.49	high	
MU	Nearly level (0-2% slope), organic soils, very poorly drained, slightly to extremely acid, formed in depressions.	Organic	muck	muck	muck	very poorly	5.0-10.0	0.5-	.17	low	
NA	Gently sloping to steep (3-25% slope), medium textured, well and moderately well drained, neutral to strongly acid soils formed on till plains.	Nellis	loam	loam	loam	well	0.6-2.0	0.06-0.16	.28	high	
		Amenia	silt loam	loam	fi.sa.loam	mod. well	0.6-2.0	0.9-0.18	.28	medium	
		Lowville	silt loam	fi.sa.loam	fi.sa.loam	well	0.6-2.0	0.8-0.16	.49	medium	
Od	Gently undulating to sloping (3-12% slope), medium textured, well drained, strongly acid to neutral soil formed on till plains and drumlins.	Ontario	loam	loam	loam	well	0.6-2.0	0.8-0.18	.32	medium	
OR	Nearly level to sloping (0-12% slope), medium to moderately fine textured, somewhat poorly to poorly drained, slightly acid to neutral soils developed on till plains and moraines.	Ovid	silt loam	si.cl.loam	si.cl.loam	somewhat poorly	0.06-0.2	0.10-0.22	.37	high	
		Romulus	si.cl.loam	si.cl.loam	si.cl.loam	poorly	0.06-0.2	0.8-0.2	.43	high	

Table 13 - Contd.

SOIL ASSOCIATION NUMBER	SOIL ASSOCIATION DESCRIPTION	MAJOR SOIL SERIES	SOIL TEXTURE: TOP SOIL	SOIL TEXTURE: SUB SOIL	SOIL TEXTURE: SUB STRATA	NATURAL SOIL DRAINAGE	PERMEABILITY OF MOST RESTRICTED LAYER in./hr.	AVAILABLE WATER CAPACITY in./in.[1]	(K) FACTOR	NATURAL FERTILITY	REMARKS
New York (continued)											
OS	Nearly level to moderately steep (0-18% slope), medium to moderately fine textured, well to somewhat poorly drained, medium acid to neutral soils formed on lake plains and moraines.	Odessa	silt loam	silty clay	silty clay	somewhat poorly	<0.06	0.12-0.21	.49	high	
		Schoharie	si.cl.loam	silty clay	silty clay	mod. well to well	0.06-0.2	0.8-0.2	.49	high	
		Rhinebeck	silt loam	silty clay	si.cl.loam	somewhat poorly	0.06-0.2	0.12-0.21	.49	high	
		Hudson	silt loam	silty clay	clay & fine silt	mod. well	0.06-0.2	0.12-0.21	.49	high	
P	Nearly level to steep (0-25% slope), medium to moderately coarse textured, well drained, very strongly acid to neutral soils developed on outwash and till plains, kames and eskers.	Palmyra	loam	sa.cl.loam	gravel & sand	well	0.6-2.0	0.12-0.16	.24	medium	
		Kars	sandy loam	sandy loam	sand & gravel	well	2.0-6.3	0.02-0.2	.24	medium	
		Wampsville	silt loam	clay loam	sand & gravel	well	0.6-2.0	0.07-0.19	.24	high	
PT	Nearly level to rolling (0-12% slope), medium textured, well to somewhat poorly drained, strongly acid to neutral soils formed on till plains.	Lansing	silt loam	silt loam	loam	well	0.6-2.0	0.09-0.2	.32	high	
		Appleton	loam	Loam	loam	somewhat poorly	0.2-0.6	0.14-0.16	.32	medium	
		Mohawk	silt loam	silt loam	loam	well & mod. well	0.2-0.6	0.9-0.20	.32	high	
		Manheim	silt loam	si.cl.loam	silt loam	somewhat poorly	0.06-0.2	0.10-0.16	.32	high	
Rg	Nearly level to sloping (0-6% slope), limestone, sandstone and granitic rock outcrops and intervening shallow soils formed from till.	Rockland			not	applicable					
SI	Nearly level to steep (0-25% slope), medium to moderately coarse textured, well and moderately well drained soils formed on till plains, moraines and drumlins.	Sodus	loam	v.fi.sa. loam	v.fi.sa. loam	well	0.06-0.2	0.10-0.19	.20	medium	fragipan[2]
		Ira	fi.sa.loam	fi.sa.loam	fi.sa.loam	mod. well	<0.06	0.08-0.15	.24	medium	fragipan[2]
U	Urban areas where original soil conditions have been greatly modified by excavation.	Undifferentiated Urban Land			not	applicable					
VM	Gently sloping to moderately steep (3-18% slope), medium textured, moderately well to somewhat poorly drained, very strongly to medium acid soils formed on till plains and moraines.	Volusia	silt loam	loam	loam	somewhat poorly	<0.06	0.1-0.19	.32	low	fragipan[2]
		Mardin	silt loam	loam	loam	mod. well	0.06-0.2	0.9-0.19	.28	low	fragipan[2]

Table 13 - Contd.

SOIL ASSOCIATION NUMBER	SOIL ASSOCIATION DESCRIPTION	MAJOR SOIL SERIES	SOIL TEXTURE: TOP SOIL	SOIL TEXTURE: SUB SOIL	SOIL TEXTURE: SUB STRATA	NATURAL SOIL DRAINAGE	PERMEABILITY OF MOST RESTRICTED LAYER in./hr.	AVAILABLE WATER CAPACITY in./in.[1]	(K) FACTOR	NATURAL FERTILITY	REMARKS
New York (continued)											
WH	Nearly level (0-2% slope), medium textured, moderately well to	Wayland	silt loam	silt loam	silt loam, fi.sa.loam	poorly & very poorly	0.06-0.2	0.11-0.22	.24	high	
		Eel	silt loam	silt loam	loam, si.cl.loam sandy loam	mod. well	0.6-2.0	0.17-0.24	.32	high	
		Papakating	silt loam	si.cl.loam	si.cl.loam	very poorly & poorly	0.06-0.2	0.10-0.22	.43	high	
		Middlebury	silt loam	silt loam	silt loam	mod. well, somewhat poorly	0.6-2.0	0.10-0.21	.28	high	
WV	Gently sloping to hilly (3-18% slope), moderately coarse to medium textured, well to somewhat poorly drained, very strongly acid soils formed on till plains.	Worth	sandy loam	silt loam	loam	well	0.06-0.2	0.02-0.16	.17	low	fragipan [2]
		Empeyville	loam	sandy loam	sandy loam	mod. well	0.06-0.2	0.08-0.19	.28	low	fragipan [2]
		Westbury	loam	loam	sandy loam	somewhat poorly	0.06-0.2	0.02-0.18	.28	low	fragipan [2]

1/ Expressed as a ratio - same in metric form
2/ Fragipan - A loamy subsurface layer with restricted permeability

To Convert From	To	Multiply By
Inches (in)	Centimeters (cm)	2.54

Minerals

Clay and shale, natural gas, peat, salt, sand and gravel, and stone (limestone, dolomite, and sandstone) are produced in the 12 New York counties which comprise Planning Subarea 5.2. From 1960 to 1968, sand and gravel, salt, and crushed and broken stone increased in both output and value. Cement, lime, peat, and dimension stone decreased in output and value during this time, while clay and shale increased in value but decreased in output. The production of iron oxide pigments was discontinued in 1960.[1]

A total of 89 nonmetallic mineral operations and an estimated 103 natural gas wells were producing in 1968. All counties except Seneca County had sand and gravel operations. Stone quarries were active in 9 counties, natural gas wells in 6 counties, salt mines in 3 counties, peat bogs in 2 counties, and clay and shale pits in 1 county. Selected operations are shown in Figure 13.

Water Resources

Surface Water Hydrology

Planning Subarea 5.2 is rich in surface water resources with a quality suitable for domestic, agricultural and industrial uses. Annual runoff volumes range from an average of 25 centimeters (10 inches) per year in the west to an average of 100 centimeters (40 inches) in the northeast section of the subarea. The total annual average runoff in the subarea is estimated at over 8,140 billion liters (2,150 billion gallons). Variation in stream flow differs greatly between and within the basins.

Typically the spring months bring over 40 percent of the annual runoff. The Finger Lakes region provides a natural regulatory effect on the peak flows of the Oswego River. Minimum daily recorded flows range from 0 to 0.003 cubic meters per second (0 to 0.11 cfs) per square mile. For example, zero-flow conditions consistently occur on Flint Creek for periods up to twenty days, while Oneida Creek has a minimum recorded flow of .003 cubic meters per second (0.11 cfs).

The Barge Canal makes use of the Oswego River and its two major tributaries. Where the Seneca, Oneida, and Oswego River have been canalized, the dependable supply is equal to the low flow of the river.

The greatest surface water asset of the subarea is its profusion of large inland lakes. In addition to frontage on Lake Ontario, area water resources include over 593 inland lakes with total surface area exceeding 97,120 hectare (240,000 acres). The Oswego basin contains nine major lakes in the Finger Lakes region, which control some 8,800 square kilometers (3,400 square miles) of drainage area. These natural reservoirs make possible a dependable yield of over 25.5 cubic meters per second, or 2,195 million liters per day (900 cfs or 580 mgd). Some eleven man-made reservoirs, having approximately 72,850 hectares (180,000 acres) of water surface, also dot the area counties.

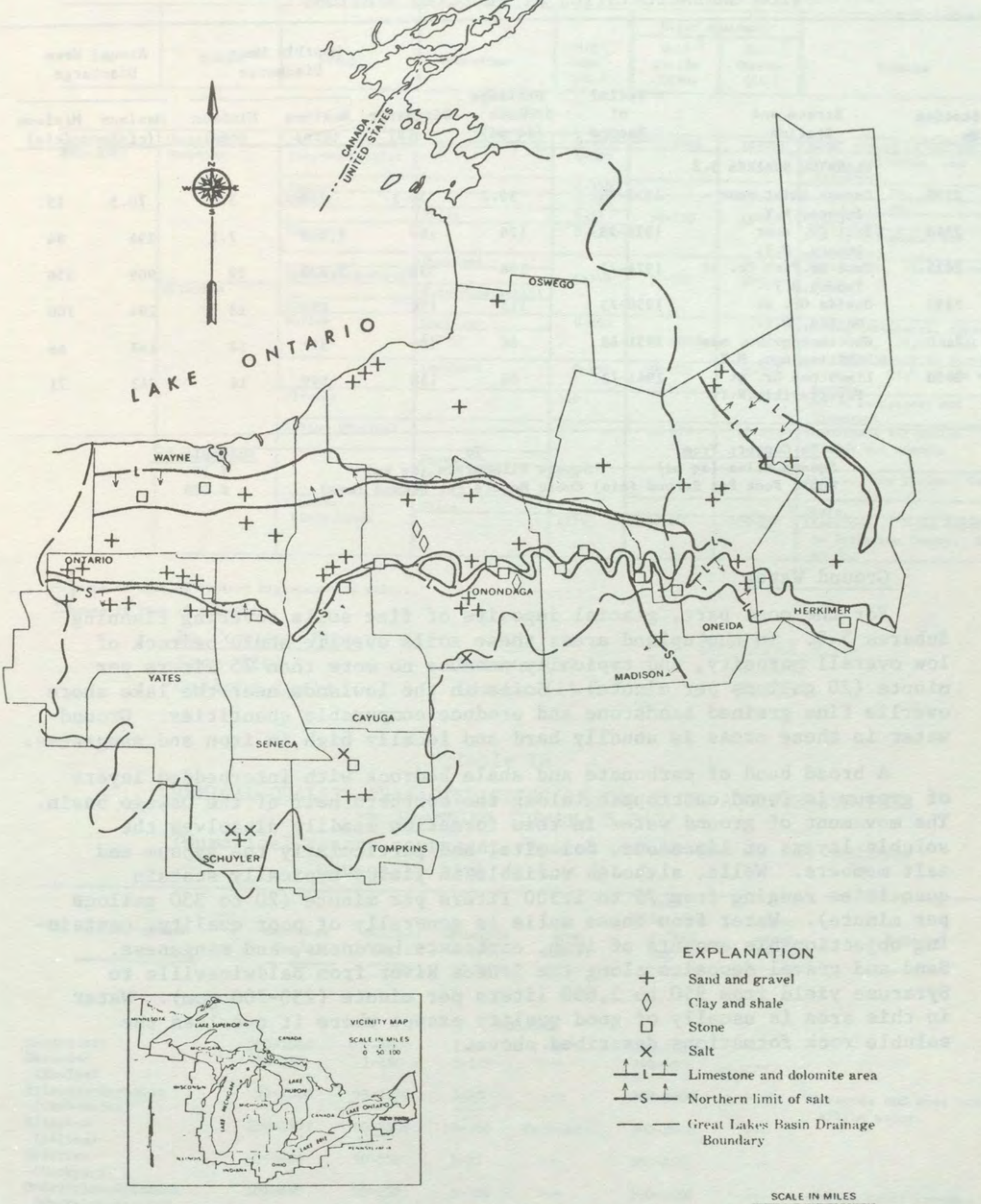


Figure 13

PLANNING SUBAREA 5.2

DISTRIBUTION OF MINERAL OPERATIONS ACTIVE IN 1968
AND MAJOR MINERAL RESOURCE AREAS [1]

Table 14

FLOW CHARACTERISTICS AT SELECTED STATIONS[8]

Station No.	Stream and Station	Period of Record	Drainage Area (sq mi)	Discharge (cfs)	Monthly Mean Discharge Maximum (cfs)	Monthly Mean Discharge Minimum (cfs)	Annual Mean Discharge Maximum (cfs)	Annual Mean Discharge Minimum (cfs)
	PLANNING SUBAREA 5.2							
2330	Cayuga Inlet near Ithaca, N.Y.	1938-73	35.2	38.1	248	3.0	70.5	15
2340	Fall Cr. near Ithaca, N.Y.	1926-73	126	182	1,040	7.1	294	84
2425	East Br.Fish Cr. at Taberg,N.Y.	1924-73	188	532	2,730	29	909	356
2435	Oneida Cr. at Oneida, N.Y.	1950-73	113	154	626	18	294	100
2440	Chittenango Cr. near Chittenango, N.Y.	1951-68	66	106	577	14	147	66
2450	Limestone Cr. at Fayetteville,N.Y.	1941-73	86	138	599	16	243	71

To Convert From	To	Multiply By
Square Miles (sq mi)	Square Kilometers (sq km)	2.59
Cubic Feet Per Second (cfs)	Cubic Meters Per Second (cms)	0.028

Ground Water

For the most part, glacial deposits of fine soils covering Planning Subarea 5.2. In the upland areas these soils overlie shale bedrock of low overall porosity, and typically produce no more than 75 liters per minute (20 gallons per minute). Soils in the lowlands near the lake shore overlie fine grained sandstone and produce comparable quantities. Ground water in these areas is usually hard and locally high in iron and manganese.

A broad band of carbonate and shale bedrock with interbedded layers of gypsum is found outcropping along the northern half of the Oswego basin. The movement of ground water in this formation readily dissolves the soluble layers of limestone, dolomite, and particularly the gypsum and salt members. Wells, although variable in yield, typically sustain quantities ranging from 75 to 1,300 liters per minute (20 to 350 gallons per minute). Water from these wells is generally of poor quality, containing objectionable amounts of iron, carbonate hardness, and manganese. Sand and gravel deposits along the Seneca River from Baldwinsville to Syracuse yield from 950 to 2,650 liters per minute (250-700 gpm). Water in this area is usually of good quality except where it overlies the soluble rock formations described above.

Table 15

GENERAL STRATIGRAPHY AND MAJOR AQUIFER SYSTEMS IN PLANNING SUBAREA 5.2(9)

(Stratigraphy only carried down to lowermost major aquifer)

Era	System	Group	Formation	Thickness (ft.)	Major aquifers: Well yields[1] (gpm)	Major aquifers: Well depths[2] (ft.)	Remarks
			New York				
Cenozoic	Quaternary			0-1000	50-2000	10-325	Sand, gravel in valleys.
Paleozoic	Devonian	Java-West Falls		0-700			Shale, siltstone, and sandstone.
		Sonyea		0-350			Do.
		Genesee		0-700			Do.
			Tully	0-25	50-100	15-325	Limestone.
		Hamilton		0-1200			Shale, siltstone, and limestone.
			Onondaga	0-340	50-500	20-275	Carbonates. Yields generally low.
		Helderberg-Ulster					
	Silurian		Akron-Cobleskill				
		Bertie					
		Salina	Camillus	0-850			
			Vernon		50-1000	30-200	Shale, carbonates, gypsum, and salt. High yields in north adjacent to streams.
			Lockport	0-150	50-300	10-210	Dolomite. High yields not common.
		Clinton		250			Shale, sandstone, and limestone.
		Albion (Medina)		500	50-600	20-390	Sandstones and shales. High yields not common.
	Ordovician		Oswego				
			Lorraine	800			Shales. Low yields. Gas.
		Trenton-Black River	Utica				Shale.
				125+	50-200	100-150	Limestones. Fresh water only in Jefferson County. Gas to south.

1/ Range is that of typical high-capacity wells.
2/ Range is that of all wells.

To Convert From	To	Multiply By
Feet (ft)	Meters (m)	0.3048
Gallons (gal)	Liters (1)	3.785

Table 16

CHEMICAL QUALITY CHARACTERISTICS OF THE MAJOR AQUIFER SYSTEMS IN PLANNING SUBAREA 5.2(9)

(Numerical ranges represent typical values and do not include unusually high or low values)

Aquifer system	Hardness (mg/1)	Sulfate (mg/1)	Chloride (mg/1)	Iron (mg/1)	Total dissolved solids (mg/1)	Temperature (°F)	Remarks
				New York			
Quaternary	200-1000	1-1000	1-300	---	300-2000	---	
Devonian (Shales)	50-500	1-150	1-125	---	300-900	---	
Silurian-Devonian (Carbonates)	50-1500	35-1250	3-75	---	300-2900	---	Syracuse and east has shallowest saline water.
Silurian (Salina)	250-1600	50-1500	10-350	Highest	300-2000	---	
Silurian (Lockport)	100-600	30-350	5-25	---	300-800	---	
Ordovician-Silurian (Shale-sandstone)	100-800	20-200	5-300	---	200-2000	---	Saline water common.

5/ No iron data available, all aquifers reportedly have iron-water problems.
6/ The Ontario lowland generally has saline water at shallow depth.

To Convert From	To	Use
Fahrenheit (°F)	Centigrade (°C)	°C=5/9(°F-32)

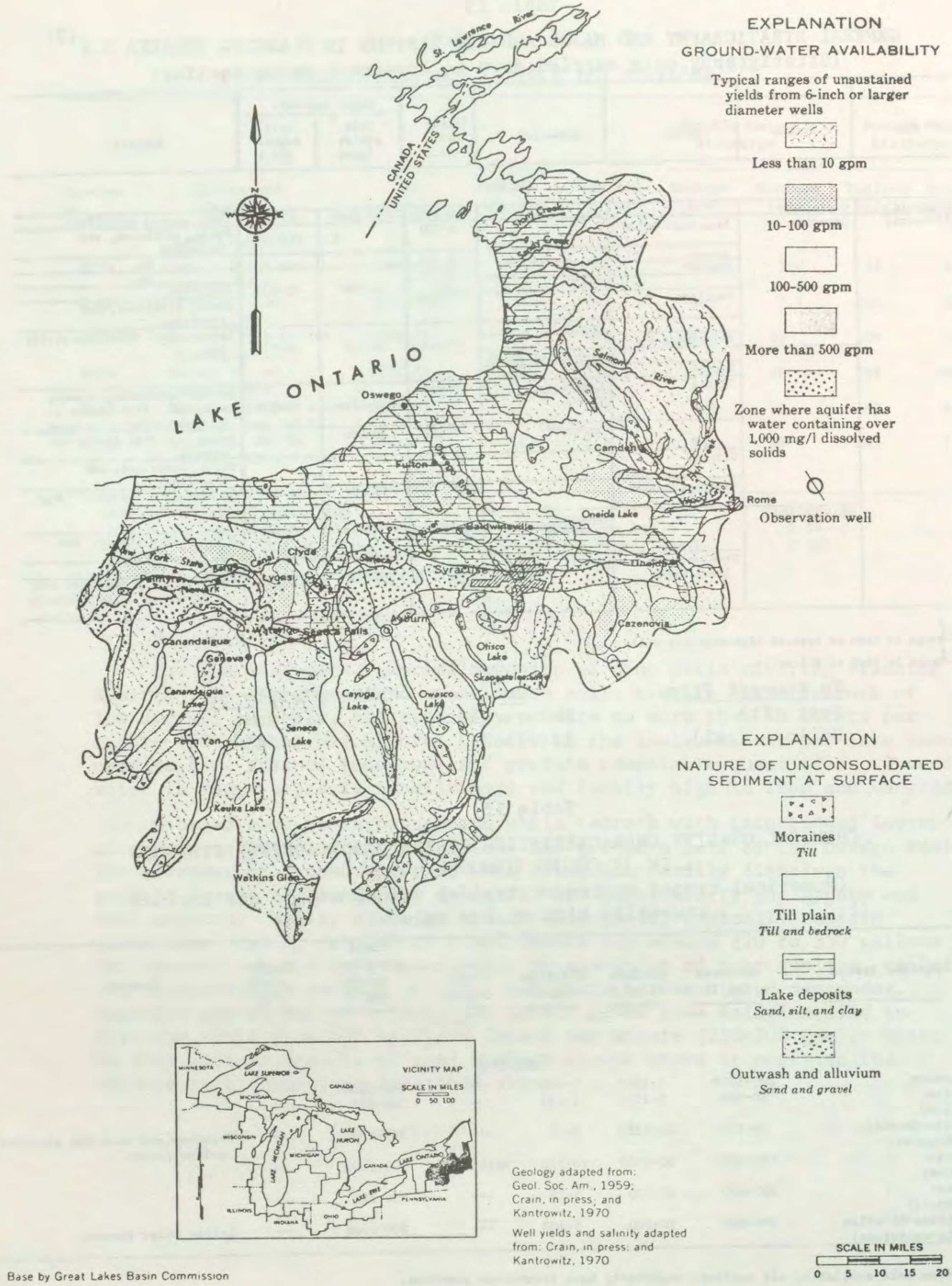


Figure 14

GROUND WATER IN THE UNCONSOLIDATED SEDIMENTS IN PLANNING SUBAREA 5.2 (9)

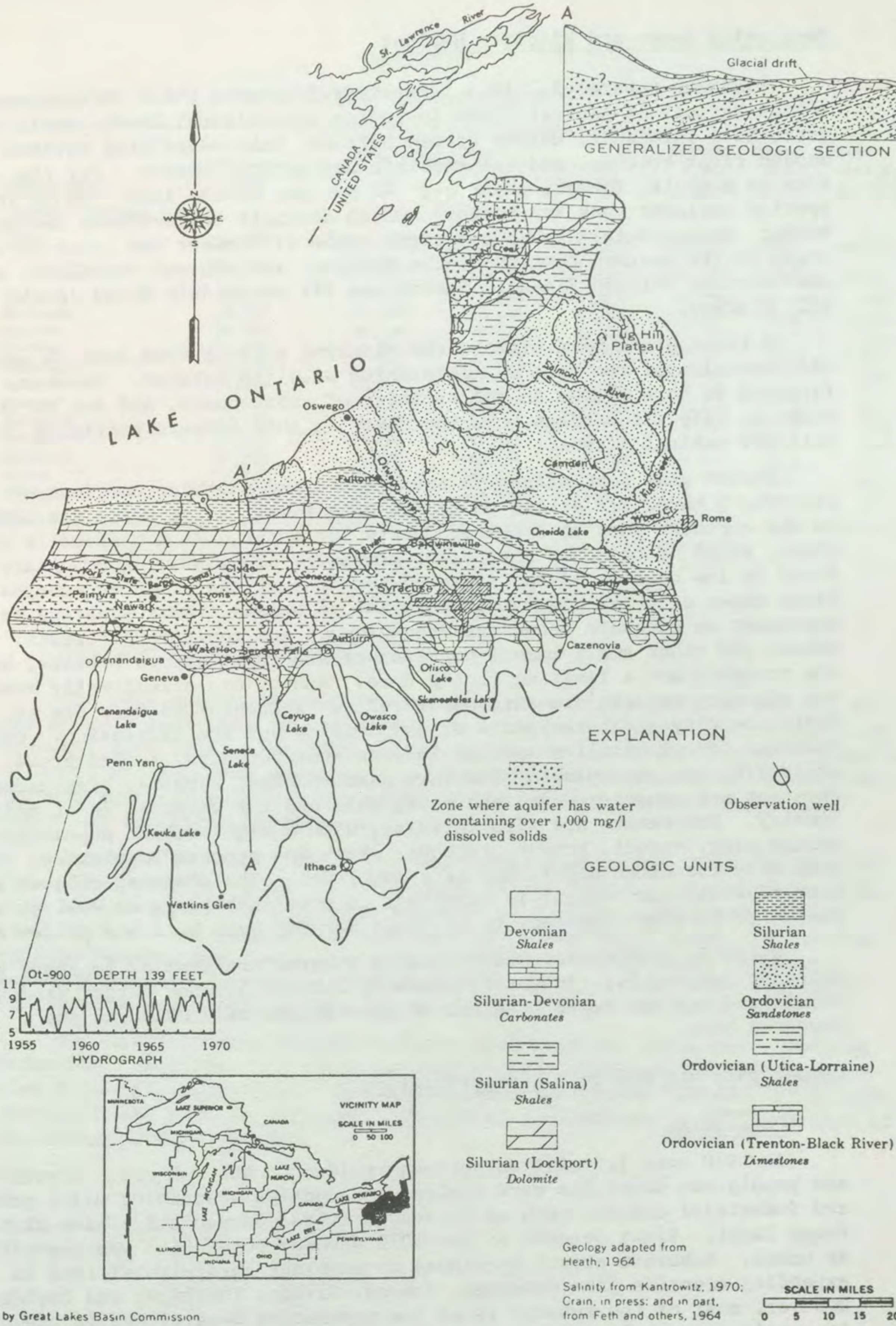


Figure 15

BEDROCK GEOLOGY AND AREAS OF MINERALIZED GROUND WATER[9]
PLANNING SUBAREA 5.2

Vegetation Zones and Wildlife Habitat

Planning Subarea 5.2 is a large sprawling area which encompasses a wide variety of habitat types including agricultural lands, small woodlots, idle farmlands, marshy stream bottoms, lake associated marshes, wooded river bottoms, and intermediate and mature forests. For the subarea as a whole, forests cover over 47 percent of the land. Major forest species include: oak and hickory, which dominate the southern Oswego basin; predominately beech and sugar maple with alder and larch in wet areas in the eastern portion of the subarea; and elm and red maple, which dominate the Ontario Plains. Spruce and fir are widely found in the Tug Hill Plateau.

A broad urban belt bisects the planning subarea from east to west, and expansion of the zone is diminishing wildlife habitat. However, idle farmland is more common in the vicinity of urban areas, and due to its value as wildlife habitat, the increases in this acreage partially compensate for habitat losses.

Forest game populations in the eastern and southern portions of the planning subarea are at low to medium densities. Black bears are common in the northern part of Herkimer County but occur only occasionally elsewhere, which is probably due to the proximity of humans. Bobcats are also found in low numbers in the forested portions of the planning subarea. Since these cats are moderately tolerant of humans, their presence is dependent on adequate second growth hardwood and coniferous forests. Rodent and other small mammal populations are important to bobcats, but are probably not a limiting factor here. Marten are occasionally seen in the planning subarea's coniferous forests. White-tailed deer are at medium density and turkeys are at low density but are increasing. Other resident forest wildlife species include snowshoe hare, ruffed grouse, squirrels, and porcupines. The farm game species, rabbits, ring-necked pheasant and mourning dove, are doing well and the woodcock is at medium density. Furbearers are also thriving, with a high muskrat population, medium mink, weasel, beaver, raccoon, skunk and opossum populations and with only the otter and fisher at a low level. The planning subarea's plentiful wetland habitat is important to most furbearers as well as waterfowl. It is also important to the occasionally seen bald and golden eagles.

Wildlife problems in this planning subarea are similar to those of Planning Subarea 5.1. However, Planning Subarea 5.2 has larger tracts of rural land and has fewer problems of interaction of people and the resource base.

Demographic and Economic Characteristics

Population

In 1970 over 1.3 million persons resided in the subarea. Growth rates and population densities were highest in counties sustaining major urban and industrial centers such as Syracuse, Utica, Oswego and cities along the Barge Canal. Sixty percent of the 1970 subarea population was classified as urban. Suburban growth continues to supplant agricultural land in expanding counties like Onondaga, Seneca, Cayuga, Tompkins, and Oneida. However, most of the subarea is of low population density and is expected to continue as such. Population levels are not excessive along the Lake Ontario shore. The population pressure increases seasonally with summer vacationists supplementing the year round resident total.

Table 17

POPULATION DATA BY COUNTY[10]

County Name	TOTAL POPULATION 1940	1950	1960	1970	Number Urban 1970	Percent Urban 1970	Land Area Sq. Mi. 1970
PLANNING SUBAREA 5.2							
TOTAL	940,138	1,057,179	1,236,359	1,361,673	812,613	60.0	8,517
New York	940,138	1,057,179	1,236,359	1,361,673	812,613	60.0	8,517
Cayuga	65,508	70,136	73,942	77,439	34,599	44.7	698
Herkimer	59,527	61,407	66,370	67,633	36,017	53.4	1,435
Madison	39,598	46,214	54,635	62,864	26,963	42.9	661
Oneida	203,636	222,855	264,401	273,037	185,960	68.1	1,223
Onondaga	295,108	341,719	423,028	472,835	385,522	81.6	794
Ontario	55,307	60,172	68,070	78,849	27,281	34.6	651
Oswego	71,275	77,181	86,118	100,897	40,464	40.1	964
Schuyler	12,979	14,182	15,044	16,737	2,716	16.2	330
Seneca	25,732	29,253	31,984	35,083	13,212	37.7	330
Tompkins	42,340	59,122	66,164	77,064	31,967	41.6	482
Wayne	52,747	57,323	67,989	79,404	22,744	28.6	606
Yates	16,381	17,615	18,614	19,831	5,168	26.1	343

To Convert From	To	Multiply By
Square Miles (sq mi)	Square Kilometers (sq km)	2.59

Resource Use and Development

The vast amount of land in agriculture, approximately 40 percent of the subarea land area in 1970, gives the region a decidedly rural setting. However, farm lands have been increasingly made available for such purposes as urban and suburban development, reforestation, and outdoor recreation. The dominant agricultural activities in the subarea are dairying, and fruit and vegetable production.

Industry is highly developed and diversified across Planning Subarea 5.2. The economic center of the region is the rapidly growing industrial city of Syracuse. In addition, a number of smaller industrial centers from Utica on the east extend westerly along the Barge Canal and include Auburn, Geneva, and Newark, as well as Ithaca in the south. Subarea economic development is also influenced by nearby cities like Rochester on the west and Elmira on the south.

The manufacturing of high quality machinery and other metal working industries prevails, but there is also a considerable amount of diversified industrial activity. Food processing, some paper manufacturing, and chemicals are also significant. Manufacturing employed over 29 percent of the working force in 1970.

Table 18

AGRICULTURAL LAND USE, PLANNING SUBAREA 5.2[11]

Crop	Current Normal[3/] Acres[2/]	Hectares[2/]
Wheat	63.4	25.7
Oats	133.1	53.9
Rye	4.1	1.7
Barley	1.8	.7
Misc. Small Grains	6.4	2.6
Corn for Grain	95.0	38.4
Corn Silage	122.2	49.5
Soybean	2.1	.8
Dry E.D. Beans	52.4	21.2
Sugar Beets	0	-
Potatoes	11.5	4.6
Fruits	71.0	28.7
Comm. Vegetables	63.2	25.6
Comm. Sod	0.1	-
Alfalfa Hay	334.9	135.5
Clover & Timothy Hay	222.6	90.1
Cropland Pasture	63.3	25.6
Idle Cropland	512.0	207.2
Total Cropland	1,759.0	711.8
Improved Pasture	119.0	48.2
Improvable Pasture	272.5	110.3
N. Improv. Pasture	52.2	21.1
Total Pasture	443.7	179.6
Total Ag. Land[1/]	2,202.8	891.4

Less Than 100 Units.

1/ Totals may not add due to rounding.

2/ Measurement is in thousands of acres or hectares.

3/ Current normal represents present yield estimate based on 1958-1972 average.

Table 19

POPULATION, EMPLOYMENT, PERSONAL INCOME, AND EARNINGS BY INDUSTRY IN 1970, PLANNING SUBAREA 5.2 (11)

Item	1970
Population, midyear	1,362,600
Per capita income (1967$)	3,329
Per capita income Rel. (U.S.=1.00)	.96
Total employment	523,900
Employment/population ratio	.39
Total personal income	4,427,043
Total earnings	3,453,800
Agriculture, forestry & fisheries	80,300a
Agriculture	-
Forestry and Fisheries	-
Mining	7,300b
Metal	-
Coal	-
Crude petroleum & natural gas	-
Nonmetallic, except fuels	-
Contract construction	202,500
Manufacturing	1,009,400
Food & kindred products	-
Textile mill products	-
Apparel & other fabric products	-
Lumber products & furniture	-
Paper and allied products	-
Printing and publishing	-
Chemicals and allied products	-
Petroleum refining	-
Primary metals	-
Fabricated metals & ordinance	-
Machinery, excluding electrical	-
Electrical machinery & supplies	-
Motor vehicles & equipment	-
Transportation equip., excl. mtr. vehs	-
Other manufacturing	-
Trans., comm. & public utilities	262,400
Wholesale and retail trade	578,500
Finance, insurance & real estate	136,500a
Services	516,448
Government	637,300
Federal government	95,200
State and local government	500,400
Armed forces	41,500

a-represents 80.0 to 99.9 percent of the true value

b-represents 60.0 to 79.9 percent of the true value

PLANNING SUBAREA 5.3

Planning Subarea 5.3 is a sparsely populated region whose water and land resources provide an excellent base for recreation. Located along the St. Lawrence River and the northeast shore of Lake Ontario, its economic and hydrologic boundaries totally encompass three counties and drain nearly 1.9 million hectares (4.7 million acres) of New York lands. The area is bordered on the north and west by the St. Lawrence River and the eastern end of Lake Ontario and short tributaries thereto, on the south by the Salmon River Basin, and on the east by the Adirondack Mountains.

The area includes rivers in the United States which drain to the St. Lawrence River where it forms the international boundary.

Table 20 and Figure 16 describe this planning subarea.

Table 20

LAKE ONTARIO EAST PLANNING SUBAREA 5.3

Drainage Area		Population	1960	1970
Square Kilometers	19,004.1	Total	222,323	224,143
Square Miles	7,337.5	Farm	30,162	21,483
		Non-Farm	192,161	202,660
States				
New York	100%	SMSA		
		none		
Land Use and Water Area (Acres)(1970)				
Total Area	3,561,600	Employment	72,079	75,840
Water Area	176,000	Agriculture, Forestry, Fishery	13.2%	8.1%
Land Area	3,385,600			
Urban	145,581			
Cropland	633,107	Mining	2.2%	1.7%
Pasture-Range	253,920	Manufacturing	23.7%	22.5%
Forest	2,217,568	Other	60.9%	67.7%
Other Land Area	135,424			
		Income		1967$
Lake Ontario Shoreline		Total Personal Income		623,561,000
Kilometers	121.5	Per Capita Income		2,779
Miles	75.5			

To Convert From	To	Multiply By
Acres (acre)	Hectares (ha)	0.405

Land Resources

Topography and Geology

Millions of years of geologic activity helped shape several distinctive land forms in Planning Subarea 5.3. Geologic and glacial action played dominant roles in forming the region's topography. The St. Lawrence Marine Plain is a flat to gently rolling strip along the St. Lawrence River whose elevations range from about 90 meters (300 feet) along its

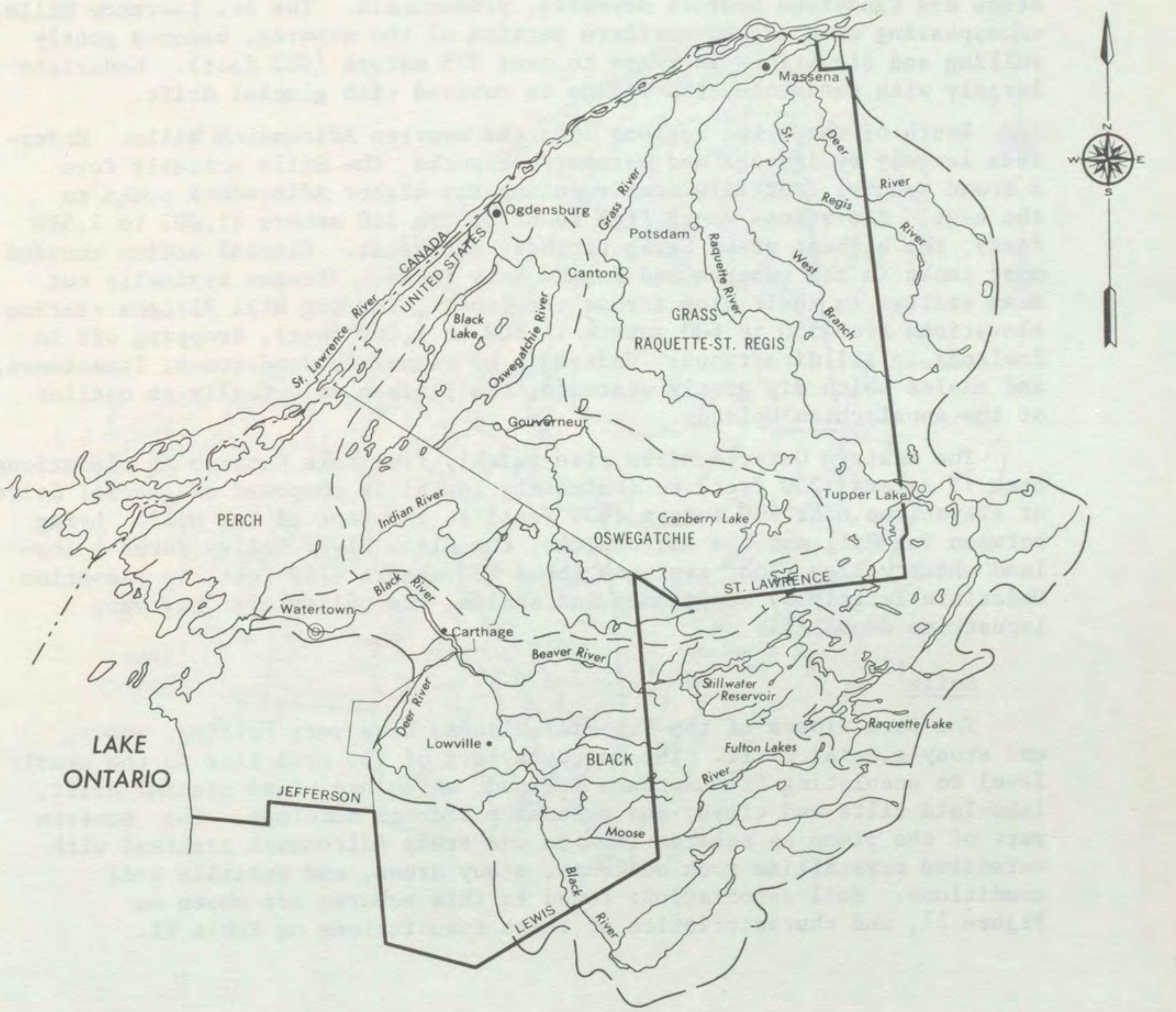


Figure 16

LAKE ONTARIO EAST

PLANNING SUBAREA 5.3

-----River Basin Group (RBG)
_____Planning Subareas (PSA's)

SCALE IN MILES
0 5 10 15 20

5.3

banks to 150 meters (500 feet) inland. Marine clays, underlain by limestone and sandstone bedrock deposits, predominate. The St. Lawrence Hills, encompassing much of the northern portion of the subarea, becomes gently rolling and elevations increase to near 275 meters (900 feet). Underlain largely with sandstone, the region is covered with glacial drift.

South of these two regions lies the western Adirondack Hills. Underlain largely by igneous and metamorphic rocks, the Hills actually form a broad zone of foothills complementing the higher Adirondack peaks to the east. Elevations range from about 300 to 760 meters (1,000 to 2,500 feet), the highest peaks being farthest southeast. Glacial action rounded most peaks in the subarea and formed many lakes. Streams typically cut deep valleys in their flow across the land. The Tug Hill Plateau reaches elevations from 550 to 600 meters (1,800 to 2,000 feet), dropping off to lowlands in all directions. Underlain by Paleozoic sandstones, limestones, and shales which dip gently westward, the plateau is actually an outlier of the Appalachian Uplands.

The eastern Ontario hills rise quickly from Lake Ontario at elevations near 75 meters (250 feet) to dominantly low hills composed of glacial drift at elevations near 240 meters (800 feet) at the foot of Tug Hill. Lying between Tug Hill and the Adirondacks, the Black River Valley forms a lowland whose valley floor averages about 230 meters (750 feet) in elevation. Underlain largely by sandstones and shales, the valley also has many lacustrine deposits.

Soils[7]

The back slopes of the Tug Hill Plateau have very rolling, sandy, and stony glacial drift. The northern part of the area lies in the nearly level to undulating St. Lawrence lowland, which has mixed glacial drift, lake-laid silts and clays, and extensive bedrock outcrops. The eastern part of the planning subarea lies in the steep Adirondack highland with extensive crystalline rock outcrops, stony areas, and variable soil conditions. Soil associations found in this subarea are shown on Figure 17, and characteristics of these associations on Table 21.

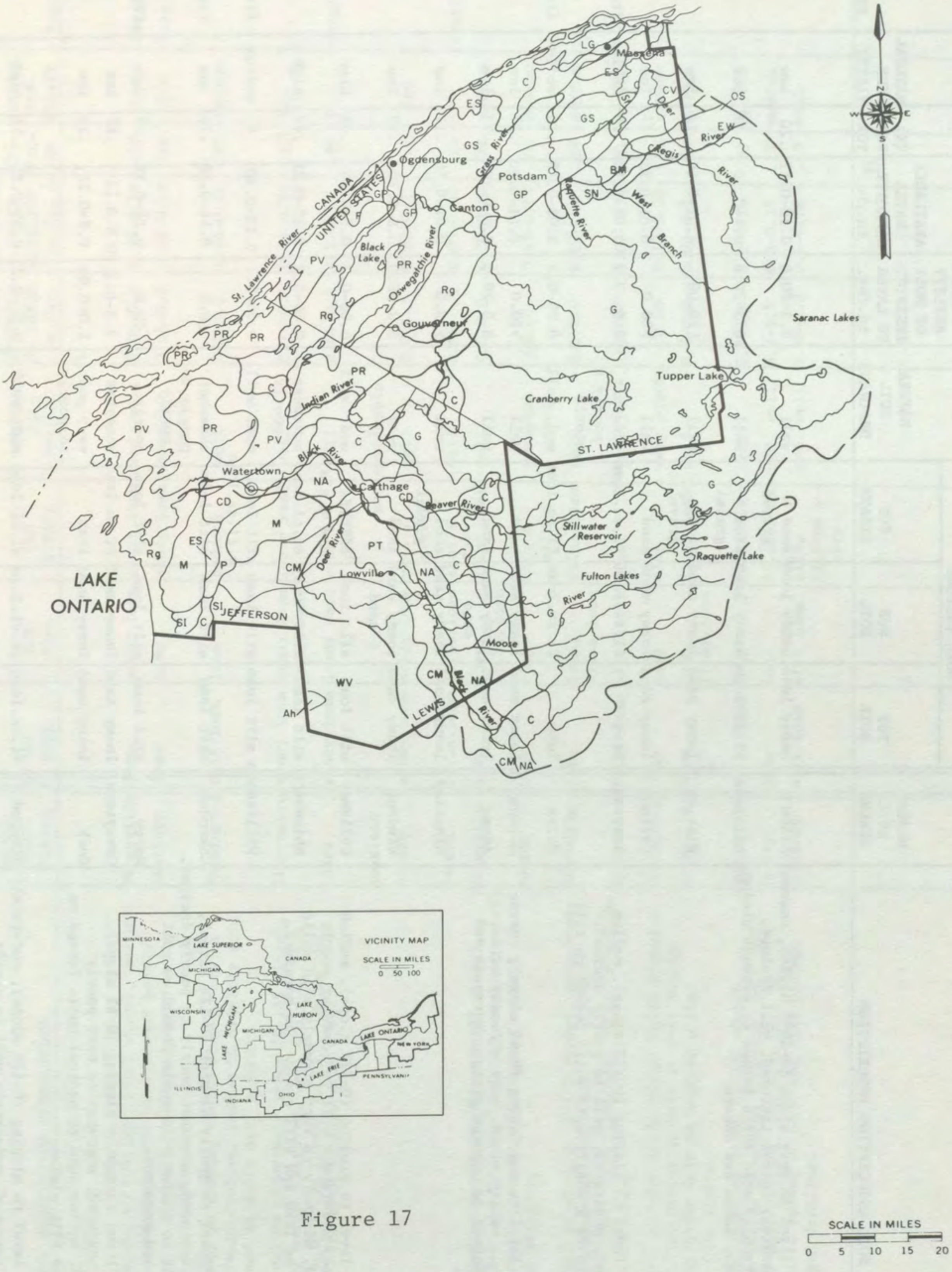


Figure 17

PLANNING SUBAREA 5.3 - SOIL ASSOCIATIONS

Table 21

SOIL CHARACTERISTICS - PLANNING SUBAREA 5.3

SOIL ASSOCIATION NUMBER	SOIL ASSOCIATION DESCRIPTION	MAJOR SOIL SERIES	SOIL TEXTURE: TOP SOIL	SOIL TEXTURE: SUB SOIL	SOIL TEXTURE: SUB STRATA	NATURAL SOIL DRAINAGE	PERMEABILITY OF MOST RESTRICTED LAYER in./hr.	AVAILABLE WATER CAPACITY in./in.[1]	(K) FACTOR	NATURAL FERTILITY	REMARKS
New York											
Ah	Nearly level to very steep (0-26+% slope), coarse to moderately coarse textured, well drained, very strongly acid soils formed on outwash plains, terraces, kames and eskers.	Alton	sandy loam	sandy loam	sand & gravel	well	6.3-20.0	0.10-0.12	.20	low	
		Colossee	fi.sa.loam	sandy loam	sand & gravel	well	6.3-20.0	0.4-0.10	.17	low	
		Hinkley	loamy sand	loamy sand	sand & gravel	well	>20.00	0.01-0.10	.17	low	
		Colton	loamy sand	loamy sand	sand	well	>20.0	0.01-0.12	.17	low	
BM	Nearly level to sloping (0-12% slope), medium textured, moderately well to poorly drained, slightly to strongly acid soils formed on till plains.	Brayton	loam	fi.sa.loam	fi.sa.loam	somewhat poorly & poorly	0.06-0.2	0.08-0.18	.28	medium	fragipan[2]
		Moira	loam	fi.sa.loam	fi.sa.loam	mod. well	0.06-0.2	0.08-0.18	.24	medium	fragipan[2]
C	Nearly level to undulating (0-6% slope), coarse textured, well drained, very strongly acid soils formed on outwash plains, terraces and deltas.	Colton	loamy sand	loamy sand	sand	well	>20.0	0.01-0.12	.17	low	
		Adams	loamy sand	loamy sand, sand	sand	well	6.3-20.0	0.8-0.10	.17	low	
		Hinckley	loamy sand	loamy sand	sand & gravel	well	>20.0	0.01-0.10	.17	low	
		Windsor	loamy sand	loamy sand & sand	sand	well	6.3-20.0	0.8-0.10	.17	low	
CD	Nearly level to sloping (0-12% slope), medium textured, moderately well to somewhat poorly drained, slightly to very strongly acid soils formed on lake and till plains and moraines.	Collamer	silt loam	silt loam	silt, fi. sand & clay	mod. well	0.06-0.2	0.8-0.16	.49	high	
		Rhinebeck	silt loam	silty clay	si.cl.loam	somewhat poorly	0.06-0.2	0.12-0.21	.49	high	
		Williamson	silt loam	silt loam	silt loam, v.fi.sa.loam	mod. well	0.06-0.2	0.10-0.20	.49	medium	fragipan[2]
CM	Nearly level to gently sloping (0-12% slope), medium textured, somewhat poorly to poorly drained, strongly to medium acid soils formed on till plains and moraines.	Camroden	silt loam	silt loam	silt loam	somewhat poorly to poorly	<0.6	0.16-0.18	.28	low	fragipan[2]
		Marcy	silt loam	silt loam	silt loam	poorly	<0.6	0.16-0.18	.28	low	fragipan[2]
CV	Nearly level to gently sloping (0-6% slope), coarse textured, somewhat to very poorly drained, medium acid to neutral soils formed on lake and till plains.	Coveytown	loamy sand	loamy sand	fi.sa.loam	somewhat	2.0-0.2	0.8-0.16	.17	low	
		Cook	loamy sand	loamy sand	loam	very poorly to poorly	2.0-0.06	0.8-0.16	.24	low	
ES	Nearly level to sloping (0-12% slope), moderately coarse textured, moderately well to poorly drained, strongly acid to neutral soils formed on lake plains and outwash over lacustrine clays.	Elmwood	fi.sa.loam	sa.cl.loam	si.cl.loam	mod. well	0.06-0.2	0.09-0.25	.32	high	
		Swanton	fi.sa.loam	si.cl.loam	clay	poorly	<0.06	0.09-0.25	.32	medium	

Table 21 - Contd.

SOIL ASSOCIATION NUMBER	SOIL ASSOCIATION DESCRIPTION	MAJOR SOIL SERIES	SOIL TEXTURE: TOP SOIL	SOIL TEXTURE: SUB SOIL	SOIL TEXTURE: SUB STRATA	NATURAL SOIL DRAINAGE	PERMEABILITY OF MOST RESTRICTED LAYER in./hr.	AVAILABLE WATER CAPACITY in./in.[1]	(K) FACTOR	NATURAL FERTILITY	REMARKS
	New York (continued)										
EW	Gently sloping to rolling (3-12% slope), medium textured, moderately well to somewhat poorly drained, very strongly to slightly acid soils formed on till plains.	Empeyville	loam	sandy loam	sandy loam	mod. well	0.06-0.2	0.08-0.19	.28	low	fragipan[2]
		Westbury	loam	loam	sandy loam	somewhat poorly	0.06-0.2	0.02-0.18	.28	low	fragipan[2]
F	Nearly level to sloping (0-12% slope), medium textured, well drained, medium to slightly acid soils formed in drift over bedrock.	Farmington	silt loam	loam	bedrock	well	0.6-2.0	0.06-0.20	.28	medium	
G	Nearly level to moderately steep (0-18% slope), moderately coarse textured, well drained, very strongly acid soils formed on till plains and moraines. The area is generally stony.	Gloucester	sandy loam	sandy loam, loamy sand	loamy sand	well	6.3-20.0	0.01-0.20	.17	low	
		Essex	sandy loam	loamy sand	sand & gravel	well	0.06-0.2	0.2-0.16	.20	low	fragipan[2]
		Rockland			not	applicable					
		Hermon	sandy loam	sandy loam	sand & gravel	well	2.0-6.3	0.02-0.2	.17	low	
		Becket	fi.sa.loam	fi.sa.loam	sand & gravel	well	0.06-0.6	0.05-0.23	.20	low	fragipan[2]
GP	Nearly level to gently sloping (0-12% slope), medium and fine textured, well and somewhat poorly drained, slightly acid soils formed on till plains and moraines.	Grenville	loam	loam, fi.sa.loam	fi.sa.loam	well	0.6-2.0	0.08-0.2	.24	medium	
		Panton	clay	clay	clay & silt	somewhat poorly	<0.06	0.15-0.19	.49	medium	
GS	Nearly level to sloping (0-12% slope), moderately coarse to medium textured, well to poorly drained, strongly acid to neutral soils formed on lake and till plains.	Grenville	loam	loam, fi.sa.loam	fi.sa.loam	well	0.6-2.0	0.08-0.2	.24	medium	
		Swanton	fi.sa.loam	si.cl.loam	clay	poorly	<0.06	0.09-0.25	.32	medium	
LG	Nearly level to moderately steep (0-18% slope), medium to fine textured, well to very poorly drained, slightly acid to neutral soils formed on till plains.	Livingston	clay	clay	clay	very poorly	<0.06	0.12-0.18	.49	medium	
		Grenville	loam	loam, fi.sa.loam	fi.sa.loam	well	0.6-2.0	0.08-0.2	.24	medium	
M	Gently undulating to steep (3-25% slope), moderately coarse to medium textured, well and moderately well drained, strongly acid to neutral soils formed on lake and till plains, moraines and drumlins.	Madrid	fi.sa.loam	loam	fi.sa.loam	well	0.6-2.0	0.8-0.16	.32	medium	
		Bombay	loam	loam	fi.sa.loam	mod. well	0.2-0.6	0.6-0.18	.32	medium	
		Collamer	silt loam	silt loam	silt, fi.sand & clay	mod. well	0.06-0.2	0.8-0.16	.49	high	

Table 21 - Contd.

SOIL ASSOCIATION NUMBER	SOIL ASSOCIATION DESCRIPTION	MAJOR SOIL SERIES	SOIL TEXTURE: TOP SOIL	SOIL TEXTURE: SUB SOIL	SOIL TEXTURE: SUB STRATA	NATURAL SOIL DRAINAGE	PERMEABILITY OF MOST RESTRICTED LAYER in./hr.	AVAILABLE WATER CAPACITY in./in.[1]	(K) FACTOR	NATURAL FERTILITY	REMARKS
	New York (continued)										
NA	Gently sloping to steep (3-25% slope), medium textured, well and moderately well drained, neutral to strongly acid soils formed on till plains.	Nellis	loam	loam	loam	well	0.6-2.0	0.06-0.16	.28	high	
		Amenia	silt loam	loam	fi.sa.loam	mod. well	0.6-2.0	0.9-0.18	.28	medium	
		Lowville	silt loam	fi.sa.loam	fi.sa.loam	well	0.6-2.0	0.8-0.16	.49	medium	
OS	Nearly level to moderately steep (0-18% slope), medium to moderately fine textured, well to somewhat poorly drained, medium acid to neutral soils formed on lake plains and moraines.	Odessa	silt loam	silty clay	silty clay	somewhat poorly	<0.06	0.12-0.21	.49	high	
		Schoharie	si.cl.loam	silty clay	silty clay	mod. well to well	0.06-0.2	0.8-0.2	.49	high	
		Rhinebeck	silt loam	silty clay	si.cl.loam	somewhat poorly	0.06-0.2	0.12-0.21	.49	high	
		Hudson	silt loam	silty clay	clay & fine silt	mod. well	0.06-0.2	0.12-0.21	.49	high	
PR	Nearly level (0-2% slope), fine textured, somewhat poorly drained, slightly acid soils formed on lake plains between areas of bedrock.	Panton	clay	clay	clay & silt	somewhat poorly	<0.06	0.15-0.19	.49	medium	
		Rockland				not applicable					
PT	Nearly level to rolling (0-12% slope), medium textured, well to somewhat poorly drained, strongly acid to neutral soils formed on till plains.	Lansing	silt loam	silt loam	loam	well	0.06-2.0	0.09-0.2	.32	high	
		Appleton	loam	loam	loam	somewhat poorly	0.2-0.6	0.14-0.16	.32	medium	
		Mohawk	silt loam	silt loam	loam	well to mod. well	0.2-0.6	0.9-0.20	.32	high	
		Manheim	silt loam	si.cl.loam	silt loam	somewhat poorly	0.06-0.2	0.10-0.16	.32	high	
PV	Nearly level to gently rolling (0-12% slope), fine textured, moderately well to somewhat poorly drained, strongly acid to neutral soils formed on lake plains.	Panton	clay	clay	clay & silt	somewhat poorly	<0.06	0.15-0.19	.49	medium	
		Vergennes	clay	clay	clay & silt	mod. well	0.06	0.15-0.19	.49	medium	
Rg	Nearly level to sloping (0-6% slope), limestone sandstone and granitic rock outcrops and intervening shallow soils formed from till.	Rockland				not applicable					
SI	Nearly level to steep (0-25% slope), medium to moderately coarse textured, well and moderately well drained soils formed on till plains, moraines and drumlins.	Sodus	loam	v.fi.sa. loam	v.fi.sa. loam	well	0.06-0.2	0.10-0.19	.20	medium	fragipan[2]
		Ira	fi.sa.loam	fi.sa.loam	fi.sa.loam	mod. well	<0.06	0.08-0.15	.24	medium	fragipan[2]

Table 21 - Contd.

SOIL ASSOCIATION NUMBER	SOIL ASSOCIATION DESCRIPTION	MAJOR SOIL SERIES	SOIL TEXTURE TOP SOIL	SUB SOIL	SUB STRATA	NATURAL SOIL DRAINAGE	PERMEABILITY OF MOST RESTRICTED LAYER in./hr.	AVAILABLE WATER CAPACITY in./in.[1]	(K) FACTOR	NATURAL FERTILITY	REMARKS
New York (continued)											
SN	Nearly level to sloping (0-12% slope), medium textured, well and moderately well drained, medium to very strongly acid soils formed on terraces and lake plains.	Salmon	v.fi.sa. loam	v.fi.sa. loam	v.fi.sa. loam	well	0.6-2.0	0.16-0.2	.49	medium	
		Nicholville	silt loam	silt loam, v.fi.sa. loam	loamy v.fi. sand	mod. well	0.6-2.0	0.8-0.16	.49	medium	
		Hartland	v.fi.sa. loam	v.fi.sa. loam	silt & v.fi.sa.	well	0.6-2.0	0.18-0.25	.49	medium	
		Belgrade	silt loam	silt loam	v.fi.sa. loam & silt loam	mod. well	0.6-2.0	0.8-0.18	.49	medium	
WV	Gently sloping to hilly (3-18% slope), moderately coarse to medium textured, well to somewhat poorly drained, very strongly acid soils formed on till plains.	Worth	sandy loam	silt loam	loam	well	0.06-0.2	0.02-0.16	.17	medium	fragipan[2]
		Empeyville	loam	sandy loam	sandy loam	mod. well	0.06-0.2	0.08-0.19	.28	medium	fragipan[2]
		Westbury	loam	loam	sandy loam	somewhat poorly	0.06-0.2	0.02-0.18	.28	medium	fragipan[2]

To Convert From	To	Multiply By
Inches (in)	Centimeters (cm)	2.54

1/ Expressed as a ratio - same in metric form

2/ Fragipan - A loamy subsurface layer with restricted permeability

Minerals

The mineral industries in the three New York counties which comprise Planning Subarea 5.3 produce iron ore, lead, sand and gravel, silver, stone (marble, limestone, and dolomite), talc, and zinc. From 1960 to 1968, dimension stone production ceased and only talc and lead increased in output while value gains were reported for talc, lead, silver, and zinc.[(1)]

A total of 37 mineral operations were active in 1968. All of the counties had stone quarries and sand and gravel operations while all of the iron ore, zinc, lead, silver, and talc mines were centered in the southern part of St. Lawrence County. The locations of the sites are shown in Figure 18.

Water Resources

Surface Water Hydrology

Surface water is in ample supply in Planning Subarea 5.3. Major streams in the subarea drain and have their origins in the highland regions of the Adirondacks and the Tug Hill Plateau. Typically the streams flow quickly in their upper reaches and become sluggish as they meander in the plains areas near their exits to the St. Lawrence or Lake Ontario. Average annual runoff, increasing from 50 centimeters (20 inches) on the plains to 100 centimeters (40 inches) in highland areas, is commonly highest in spring and lowest in late summer. Discharge is generally dependable, and only the Black River in its lower reaches faces serious flood problems.

Lakes, ponds, and swamps occur throughout all the drainage basins. Typically the upper reaches of the basins contain most of the lakes. St. Lawrence County ranks highest both in number of lakes and total surface acreage of all subarea counties. The total number for Planning Subarea 5.3 is 388 lakes having over 20,000 hectares (50,000 acres). Providing excellent scenic attractions and recreation facilities, some major lakes include the Fulton Chain of Lakes, Stillwater Reservoir, Raquette Lake, Long Lake, Tupper Lake, Carry Falls Reservoir, Lake of the Woods, and Black Lake. Stream flow regulation is common on the Black and Raquette Rivers. Existing reservoirs in the area total for over 13,760 hectares (34,000 acres) of surface water.

Planning Subarea 5.2

Figure 31 shows those counties contained in Planning Subarea 5.2. The major land uses in Planning Subarea 5.2 presented by county are shown in Table 36. Table 37 presents the major land uses for Planning Subarea 5.2 by state.

The land use tabulations presented in these tables were derived by LARS using 1974 state-of-the-art LANDSAT analyses technology. The areas shown may not match those in other tabulations of land use information due to differences in procedures used, land use category definitions, or the date of inventory.

The county boundaries and the area classified may not exactly agree since the area chosen as the county in the LANDSAT data could only be approximated. The approximated county boundaries were located using visible features within the LANDSAT data such as streams, lakes, cities, major highways, etc.

In a few predominantly rural counties, insufficient reference data were available to train the computer properly to identify an urban class. Maps of these counties do not reflect an Urban (red) category but contain only the following categories: Agriculture (yellow), Forestry (green), No Major Use (blue), and perhaps Clouds (white) and Cloud Shadow (black).

This land use inventory was prepared using spectral data; placement of separable spectral classes into informational classes sometimes resulted in the combination of urban and rural features into a single category. As a result many maps reflect large amounts of the Urban (red) category scattered throughout the county. These areas represent data points which have similar reflectance characteristics and are spectrally inseparable. They generally include urban areas, light colored and sandy soils without surface cover, and farmsteads. This must be considered when using the Land Use Tables as the area estimated for the urban category may be high.

Table 22

FLOW CHARACTERISTICS AT SELECTED STATIONS(8)

Station No. 4	Stream and Station	Period of Record	Drainage Area (sq mi)	Discharge (cfs)	Monthly Mean Discharge Maximum (cfs)	Monthly Mean Discharge Minimum (cfs)	Annual Mean Discharge Maximum (cfs)	Annual Mean Discharge Minimum (cfs)
	PLANNING SUBAREA 5.3							
2525	Black R. near Boonville, N.Y.	1912-73	295	680	3,000	42	1,044	448
2560	Independence R. at Donnattsburg, N.Y.	1943-73	92	184	794	23	1,691	132
2625	West Br. Oswegatchie R. near Harrisville, N.Y.	1917-73	258	500	2,260	37	833	333
2650	Crass R. at Pyrites, N.Y.	1925-73	335	594	2,550	70	1,107	353
2690	St. Regis R. at Brasher Center, N.Y.	1911-73	616	1,032	4,530	129	1,880	581

To Convert From	To	Multiply By
Square Miles (sq mi)	Square Kilometers (sq km)	2.59
Cubic Feet Per Second (cfs)	Cubic Meters Per Second (cms)	0.028

Ground Water

Availability of ground water in the subarea depends to a large extent on existing geologic conditions. Several ground water regimes result from the environments of the crystalline rocks of the Adirondacks, the sandstones and shales of Tug Hill, the sedimentary rocks of the lowlands, and the glacial mantle overlying much of these bedrock types. The metamorphic and igneous bedrock in the Adirondacks produce small to moderate ground water supplies. Adequate for farm and domestic use, the ground water resources in this region are relatively undeveloped. Sedimentary rocks found in the periphery of the highlands have produced large supplies of ground water. Recorded yields of as much as 2,650 liters per minute (700 gallons per minute) have been obtained from dolomites in the Massena area, but the average drilled well yields about 60 to 120 liters per minute (15 to 30 gpm). Deep wells in these units are plagued with sulfide and chloride contamination. In addition, water from calcareous rocks ranges from moderately to extremely hard. Sandstones and shales of the Tug Hill region also produce only moderate ground water supply. Variability in thickness and stratification in glacial drift deposits of the subarea make ground water supplies uncertain. Ranging from less than a foot to several hundred feet in thickness, the glacial drift typically produces sufficient quantities to supply farm and domestic uses. The quality of water derived from till and other types of overburden is generally the same as that found in the underlying bedrock.

COLOR COUNTY LAND USE MAPS

County maps for Planning Subarea 5.2 are not included in this volume due to technical difficulties incurred in the mapping processes.

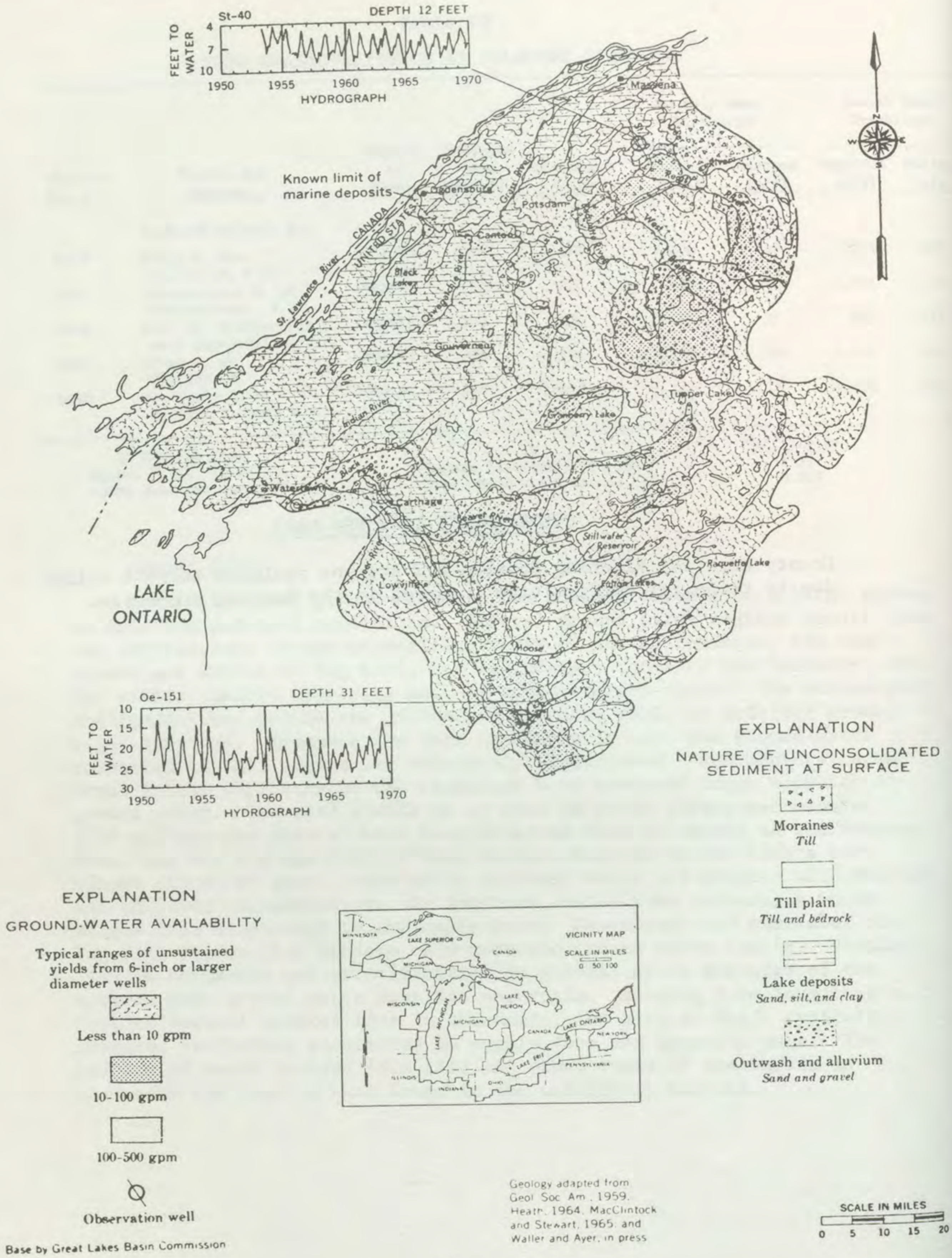


Figure 19

GROUND WATER IN THE UNCONSOLIDATED SEDIMENTS IN PLANNING SUBAREA 5.3[9]

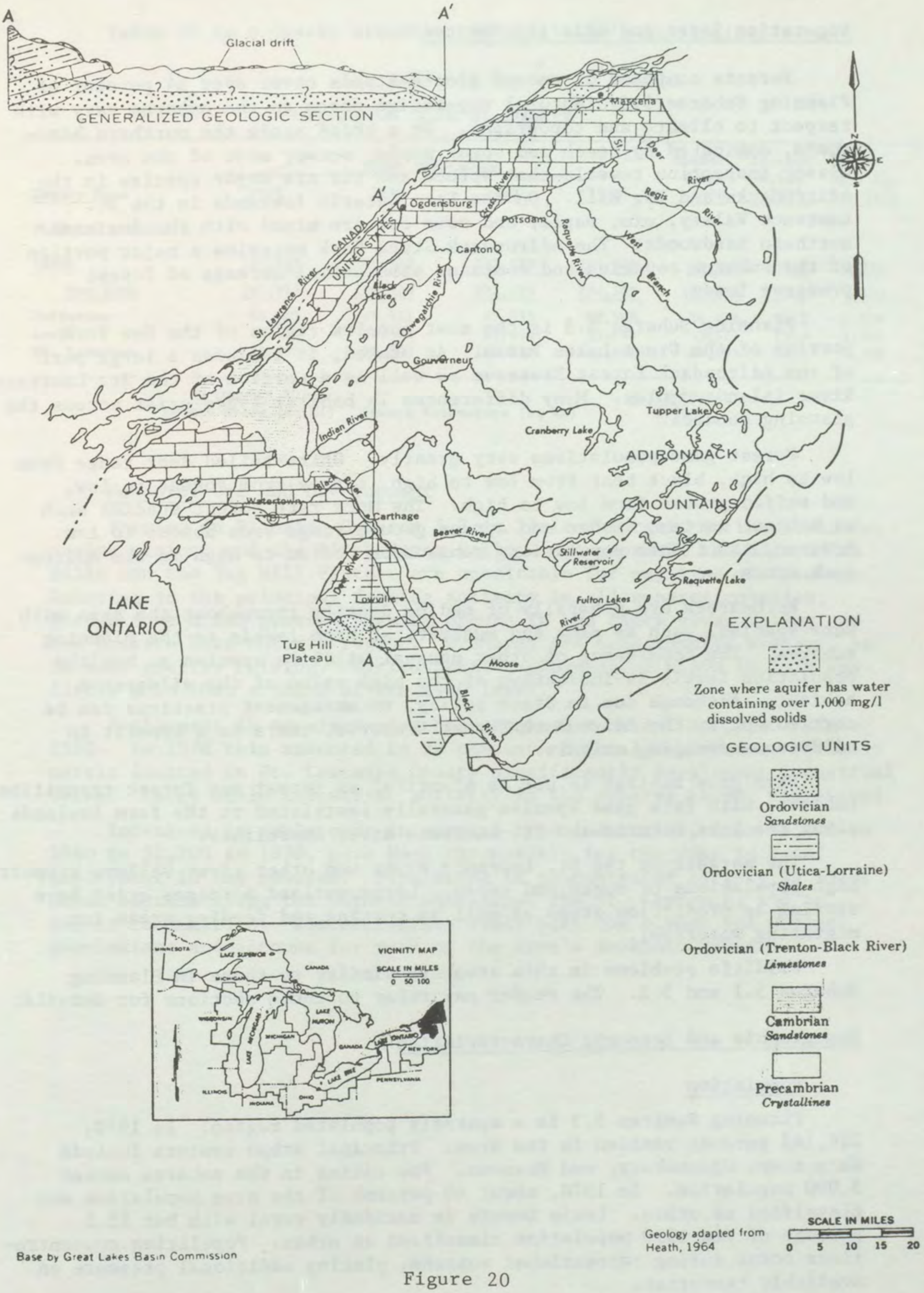


Figure 20

BEDROCK GEOLOGY AND AREAS OF MINERALIZED GROUND WATER[9]
PLANNING SUBAREA 5.3

Vegetation Zones and Wildlife Habitat

Forests composed of second growth stands cover over 64 percent of Planning Subarea 5.3. Natural vegetative zones in the subarea vary with respect to climate and topography. On a broad scale the northern hardwoods, dominated by beech and sugar maple, occupy most of the area. Closer inspection reveals that spruce and fir are major species in the Adirondacks and Tug Hill. On the Lake Ontario lowlands in the St. Lawrence Valley, elm, maple, and some oak are mixed with the dominant northern hardwoods. The Adirondack State Park occupies a major portion of the subarea counties and contains substantial acreage of forest preserve lands.

Planning Subarea 5.3 is the most complex region of the New York portion of the Great Lakes Basin. As stated, it includes a large part of the Adirondack Forest Preserve as well as a portion of the St. Lawrence River island complex. Many differences in habitat types exist across the planning subarea.

Forest game populations vary greatly. White-tailed deer range from low to high, black bear from low to high, turkey from absent to low, and ruffed grouse from low to high. The more rare forest species such as bobcat, marten, fisher and spruce grouse range from absent to low. However, the fisher populations range from medium to high in the Adirondack zones.

Furbearers are generally of medium density throughout the area with some species, such as mink and muskrat, at high levels in the planning subarea. The occurrence of other unusual wildlife species at healthy population levels is indicative of the high value of the wilderness habitat. Although due to State policy, no management practices can be carried out in the Adirondack Forest Preserve, there is a benefit to wilderness dwelling animals.

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.

The marshes of the St. Lawrence River and other river valleys support high populations of ducks and geese. Large wetland acreages exist here serving as production areas as well as resting and feeding areas for migrating waterfowl.

Wildlife problems in this area are similar to those in Planning Subarea 5.1 and 5.2. The reader may refer to these sections for details.

Demographic and Economic Characteristics

Population

Planning Subarea 5.3 is a sparsely populated region. In 1970, 224,143 persons resided in the area. Principal urban centers include Watertown, Ogdensburg, and Massena. Few cities in the subarea exceed 5,000 population. In 1970, about 40 percent of the area population was classified as urban. Lewis County is decidedly rural with but 15.5 percent of its 1970 population classified as urban. Population concentrations occur during recreational seasons, placing additional pressure on available resources.

Table 25 is a county breakdown of this area's population.

Table 25

POPULATION DATA BY COUNTY[10]

County Name	TOTAL POPULATION 1940	1950	1960	1970	Number Urban 1970	Percent Urban 1970	Land Area Sq. Mi. 1970
PLANNING SUBAREA 5.3							
TOTAL	197,916	206,939	222,323	224,143	87,900	39.0	5,353
New York	197,916	206,939	222,323	224,143	87,900	39.0	5,353
Jefferson	84,003	85,521	87,835	88,508	34,676	39.2	1,294
Lewis	22,815	22,521	23,249	23,644	3,671	15.5	1,291
St. Lawrence	91,098	98,897	111,239	111,991	49,553	44.2	2,768

To Convert From	To	Multiply By
Square Miles (sq mi)	Square Kilometers (sq km)	2.59

Resource Use and Development

Farming in Planning Subarea 5.3 is limited largely to the lowlands, marine plains, and the Black River Valley. In general, the Adirondack Hills and the Tug Hill Plateau are unsuitable for any type of farming. Dairying is the principal farming activity in all subarea counties, though some mixed general farming occurs in the Black River Valley and the eastern Lake Ontario region. Orchards are occasionally present, as is some poultry raising. Agricultural employment of 6,100 in 1970 was little more than a third of its 1940 level.

Employment in manufacturing has remained constant at 17,000 since 1950. In 1970 this amounted to 22 percent of total employment. Primary metals located in St. Lawrence County significantly supplement industrial value. Large scale industrial activity in the subarea is not widespread.

Increases in employment in service-type industries, from 43,400 in 1960 to 51,100 in 1970, have been responsible for the rise in total employment in the subarea. Population is concentrated largely in major urban centers along the Ontario shoreline, the St. Lawrence, and in resort communities. Recreationists swell both the summer and winter populations and account for much of the area's economic value.

Table 26

AGRICULTURAL LAND USE, PLANNING SUBAREA 5.3 (11)

Crop	Current Normal 3/ Acres 2/	Hectares 2/
Wheat	1.9	.8
Oats	53.1	21.5
Rye	0	-
Barley	0.3	.1
Misc. Small Grains	0	-
Corn for Grain	1.5	.6
Corn Silage	35.7	14.4
Soybean	0	-
Dry E.D. Beans	0	-
Sugar Beets	0	
Potatoes	0.1	-
Fruits	0.1	-
Comm. Vegetables	0	-
Comm. Sod	0	
Alfalfa Hay	120.1	48.6
Clover & Timothy Hay	248.2	100.4
Cropland Pasture	30.0	12.1
Idle Cropland	142.9	57.8
Total Cropland	633.9	256.3
Improved Pasture	40.0	16.2
Improvable Pasture	71.3	28.9
N. Improv. Pasture	143.1	57.9
Total Pasture	254.4	103.0
Total Ag. Land 1/	888.3	359.3

Less Than 100 Units.

1/ Totals may not add due to rounding.

2/ Measurement is in thousands of acres or hectares.

Table 27

POPULATION, EMPLOYMENT, PERSONAL INCOME, AND EARNINGS BY INDUSTRY IN 1970, PLANNING SUBAREA 5.3 (11)

Item	1970
Population, midyear	224,418
Per capita income (1967$)	2,779
Per capita income Rel. (U.S.=1.00)	.80
Total employment	75,840
Employment/population ratio	.34
Total personal income	623,561
Total earnings	457,464
Agriculture, forestry & fisheries	34,930a
Agriculture	-
Forestry and Fisheries	-
Mining	8,092a
Metal	-
Coal	-
Crude petroleum & natural gas	-
Nonmetallic, except fuels	-
Contract construction	25,547
Manufacturing	118,402
Food & kindred products	-
Textile mill products	-
Apparel & other fabric products	-
Lumber products & furniture	-
Paper and allied products	-
Printing and publishing	-
Chemicals and allied products	-
Petroleum refining	-
Primary metals	-
Fabricated metals & ordinance	-
Machinery, excluding electrical	-
Electrical machinery & supplies	-
Motor vehicles & equipment	-
Transportation equip., excl. mtr. vehs	-
Other manufacturing	-
Trans., comm. & public utilities	25,892
Wholesale and retail trade	68,688
Finance, insurance & real estate	13,355
Services	60,633
Government	100,650
Federal government	13,538
State and local government	83,610
Armed forces	3,501

a-represents 80.0 to 99.9 percent of the true value

REFERENCES

1. Great Lakes Basin Commission, The Great Lakes Basin Framework Study, Appendix 5, "Mineral Resources," 1975

2. D. W. Phillips and Jan McCulloch, The Climate of the Great Lakes Basin, "Climatological Studies," Number 20, Environment Canada, 1972

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MAJOR LAND USES

INTRODUCTION

In 1972 the governments of Canada and the United States upon signing the Great Lakes Water Quality Agreement requested that the International Joint Commission (IJC) investigate pollution of the boundary waters of the Great Lakes system from agriculture, forestry and other land use activities. In 1973 the IJC charged its Reference Group on Great Lakes Pollution from Land Use Activities with the responsibility of obtaining a land use inventory of the Great Lakes Basin. The Environmental Protection Agency contracted with Purdue University/Laboratory for Applications of Remote Sensing (LARS) to prepare for the Reference Group a current land use inventory of the 34,000,000 hectares (84,000,000 acres) included within the U.S. portion of the Great Lakes Basin. The results of this inventory will be used to determine the contribution to the pollution of the Great Lakes from land use activities.

This report contains the inventory information collected by county for the Lake Ontario basin. A detailed discussion of the procedures used to obtain these results is contained in Volume I - Great Lakes Basin Report.

Approach

LANDSAT multispectral scanner data, collected from the 1972 and 1973 growing seasons were used as the prime data source for analysis. These LANDSAT MSS data were analyzed by computer-implemented pattern recognition techniques to produce spectrally separable classes which were then related to the land use categories listed in Table 28.

Results

Results of the land use inventory are reported in two forms: geometrically correct color-coded maps and statistical tables. Individual geometrically correct county maps were produced with each of the Level I land use categories represented by a designated color. Statistical tables of each county were compiled which include both primary and secondary levels of land use with each category reported as 1) percentage of the county area, 2) the number of hectares and 3) the number of acres present in each county.

Table 28

LAND USE CATEGORIES CLASSIFIED

Level I	Level II
Urban	Residential Commercial/Industrial
Agriculture	Row Crops Close Grown Crops Pasture and Meadows
Forest	Forest
No Major Usage 1/	Water Wetlands

1/The residual inland area not devoted to urban, agricultural or forest use.

LAND USE INVENTORY PROCEDURES

Data

The LANDSAT data used for the Lake Ontario basin study are listed by planning subarea in Table 29.

In addition to LANDSAT data, aerial photography was collected for use as underflight reference data. This consisted of 70mm color and color infrared photography, taken at approximately 3,000 meters altitude during August 1973 and June 1974. Coverage by aerial photography represents approximately 4 percent of the total area of the Great Lakes Basin. Figure 21 indicates the locations of the underflight data collected for the Lake Ontario basin. These flight lines were chosen because they represent the majority of the land use classes found throughout the plan area. It should be observed that the underflight reference data were not collected concurrent with any satellite overpass.

Other reference data include:

(1) County highway maps
(2) 1:24,000 United States Geological Survey topographic maps
(3) 1:250,000 United States Geological Survey topographic maps
(4) County soil surveys
(5) City maps
(6) 1967 Conservation Needs Inventory (USDA/SCS)
(7) 1972, 1973 reports of the Statistical Reporting Service (USDA)

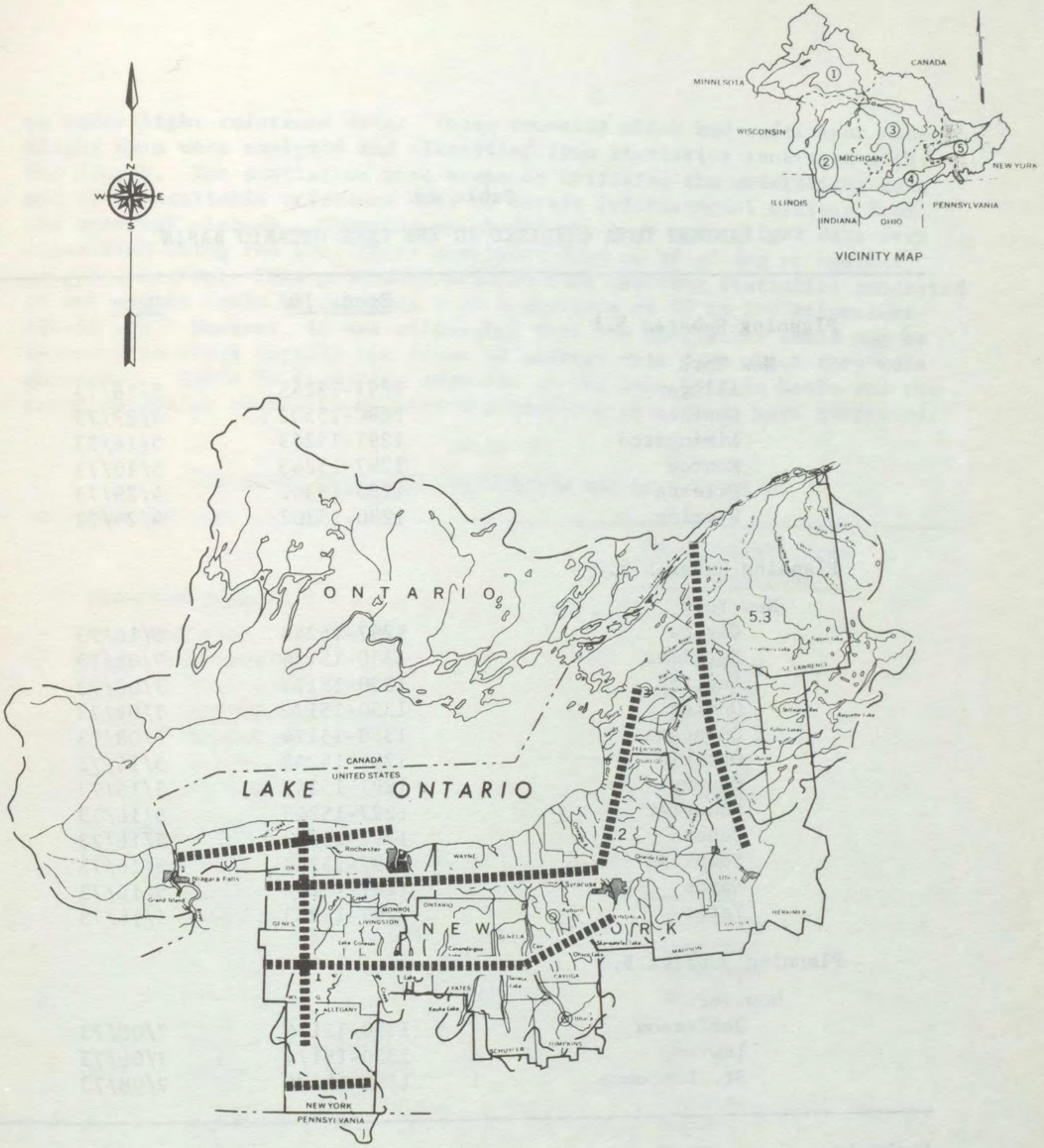

Figure 21

Reference Data Flightlines

PLAN AREA NO. 5

SCALE IN MILES

0 10 20 30 40 50

Table 29

LANDSAT DATA UTILIZED IN THE LAKE ONTARIO BASIN

	Scene ID	Date
Planning Subarea 5.1		
New York		
Allegany	1297-15245	5/16/73
Genesee	1280-15302	4/29/73
Livingston	1297-15243	5/16/73
Monroe	1297-15243	5/16/73
Orleans	1280-15302	4/29/73
Wyoming	1280-15302	4/29/73
Planning Subarea 5.2		
New York		
Cayuga	1297-15243	5/16/73
Herkimer	1350-15174	7/08/73
Madison	1350-15174	7/08/73
Oneida	1350-15174	7/08/73
Onondaga	1350-15174	7/08/73
Ontario	1297-15243	5/16/73
Oswego	1297-15243	5/16/73
Schuyler	1297-15243	5/16/73
Seneca	1297-15243	5/16/73
Tompkins	1297-15243	5/16/73
Wayne	1297-15243	5/16/73
Yates	1297-15243	5/16/73
Planning Subarea 5.3		
New York		
Jefferson	1350-15174	7/08/73
Lewis	1350-15174	7/08/73
St. Lawrence	1350-15174	7/08/73

Analysis

Since the results of this project were to be presented at the county level, this dictated that several rather small analysis tasks be performed as opposed to a few tasks covering large areas. In order to standardize the analysis procedures, a comprehensive procedures document was prepared. This document was concerned with the areas of data preprocessing, analysis and results and is summarized in Volume I - Great Lakes Basin Report.

Prior to analysis the 191 counties were divided into two categories: (a) those having underflight reference data available and (b) those having no underflight reference data. Those counties which had sufficient underflight data were analyzed and classified from statistics generated within the county. The statistics were prepared utilizing the underflight data and other available reference data to obtain informational classes from the spectral classes. Counties which did not have underflight data were classified using the statistics generated from an adjoining or nearest neighbor county. This procedure assumed that training statistics generated in one county could be extended over a distance of 90 to 100 kilometers (50-60 mi). However, it was stipulated that the statistics could not be extended to areas outside the frame of LANDSAT data from which they were generated. Table 30 lists the counties in the Lake Ontario basin and the counties and/or county from which the training statistics were generated.

Table 30

TRAINING STATISTICS EXTENSION FOR LAKE ONTARIO

	County Statistics Derived From
Planning Subarea 5.1	
New York	
Allegany	Allegany
Genesee	Niagara
Livingston	Allegany
Monroe	Monroe
Orleans	Niagara
Wyoming	Allegany
Planning Subarea 5.2	
New York	
Cayuga	Cayuga
Herkimer	Onondaga
Madison	Onondaga
Oneida	Onondaga
Onondaga	Onondaga
Ontario	Yates
Oswego	Oswego
Schuyler	Seneca
Seneca	Seneca
Tompkins	Seneca
Wayne	Wayne
Yates	Yates
Planning Subarea 5.3	
New York	
Jefferson	Jefferson
Lewis	Lewis
St. Lawrence	Jefferson

Classification Categories

Table 31 lists the categories which could be routinely identified and inventoried taking into consideration the variability in dates of data collection and the limited amount of underflight reference data available.

Table 31

FINAL LAND USE CLASSIFICATION CATEGORIES

Level I	Level II
Urban	
	Residential
	Commercial/Industrial
Agricultural	
	Row Crops
	Close Grown Crops
	Pasture
Forest	
	Forest
No Major Use 1/	
	Water
	Wetland

1/The residual inland area not devoted to urban, agricultural or forest use.

Throughout the project the urban land use category was generally classified into two Level II classes, i.e., residential and commercial/industrial. Level II transportation and extractive classes as well as the Level III residential and commercial/industrial classes were not included in the inventory because they could not be routinely identified due to insufficient underflight reference data. However, this is not to imply that transportation routes, extractive areas, and a division of residential and commercial/industrial areas cannot be identified. With sufficient and appropriate reference data these categories can be readily identified.

In some counties only the Level I urban category was classified with no distinction being made between the residential and commercial/industrial categories. The Level II results of these counties are reported only as residential. In a few predominantly rural counties insufficient underflight reference data were available to train the computer properly to identify any urban class. In these instances only the remaining classes of agriculture, forestry and no major use were classified. However, the tabulation of statistics includes an urban/residential category.

The urban statistics used in these tables were taken from the appropriate 1967 Conservation Needs Inventory. The areas included in these artificial classes were subtracted from the forest area of the respective counties. This is justifiable since most small towns are spectrally similar to forest areas. The maps of these counties do not include an urban category.

The agriculture category was generally classified into two Level II classes, i.e., bare soil and pasture/meadow/close grown crops. A procedure was developed which allowed the analysts to relate the areas classified as bare soil to row crops planted. This procedure was based on a study conducted in 1974 on data from Boone County, located in central Indiana. In this study the amount of bare soil in Boone County was inventoried using June 1973 LANDSAT data. That area classified as bare soil was used as an estimate of the area of row crop that would be planted that year. This figure was compared to the area of row crop grown in Boone County in 1973 as determined by the United States Department of Agriculture/Statistical Reporting Service (USDA/SRS). The LARS estimated figure was comparable to the USDA/SRS figure, yielding an estimate approximately 2% greater than that reported by SRS. Thus, since the majority of the LANDSAT data were collected in June of 1972 and 1973, bare soil was used as an indicator of row crops. Areas covered by LANDSAT data collected later in the growing season allowed for direct classification of row crops.

Generally with all the LANDSAT data, pasture/meadow was not spectrally separable from close grown crops. In this situation a pasture/meadow/close grown crops category was classified. These classes were artificially separated into the pasture/meadow and close grown crops classes. This artificial separation of classes was performed by subtracting the area of close grown crops(wheat, oats, and barley) as reported by the USDA/SRS from the total area of pasture/meadow/close grown crops determined for each respective county for the appropriate cropping year. The remaining area was tabulated as pasture/meadow.

It was determined that orchards and vineyards were not spectrally separable in the majority of cases because sufficient underflight reference data were not available for adequate training of the computer. Thus, this class was deleted. The orchards and vineyards were included in those classes most spectrally similar, i.e., forest and pasture/meadow/close grown crops.

Forest cover was usually classified into Level II classes such as coniferous, deciduous, and sparse forest. However, these classes were aggregated to yield only a Level I forest class.

In the no major usage category only water and wetland were categorized. Insufficient underflight reference data precluded the routine classification of barren land.

Specific Problems

Only one major problem occurred in the Lake Ontario basin. Large areas of individual counties were covered by clouds and cloud shadows. Areas classified as clouds and cloud shadows were assumed to contain the same distribution of land use as the other portions of each individual county. Land use was estimated by multiplying the acreage classified as clouds and cloud shadows by the relative percentage obtained for each respective land use class in the remainder of the county. These estimates were then added to each respective land use class to produce the county table. Also in areas of steep terrain, some valley walls were shaded and classified as cloud shadows or water. However, these contributions to the total county figures are relatively small.

RESULTS

Results of this project are represented in statistical tables which list the land use categories in Table 31 for each individual county by acreage, hectares, and percentage of county. These area statistics have been rounded off to the nearest 4-hectare (10-acre) unit. Additional tables show the aggregation of these results of state, planning subarea, and plan area totals. Some minor differences may exist in the data due to the rounding off of figures at various points of aggregation.

In addition to the tabular statistics, individual color-coded county maps have been prepared at an approximate scale of 1:215,000. These maps show the Level I categories listed in Table 31 and are color coded as shown in Table 32.

Table 32

COLOR CODE FOR COUNTY MAPS

Color	Level I Category
Red	Urban
Yellow	Agriculture
Green	Forest
Blue	No Major Use
Black	Cloud Shadow
White	Clouds

These maps were prepared by converting the LARS digital classification computer tapes into a format compatible with a laser digital printer located at Mead Technology Laboratory, Dayton, Ohio. With a digital laser printer Mead Technology Laboratory provided color separations of each map. These color separations were used to prepare the printing plates for the county maps.

The area included in this land use inventory is defined by the Great Lakes Region (political) boundary (Figure 22). However, at the request of the U.S./Environmental Protection Agency land use within Planning Subareas 1.1 and 2.2 was also determined for the Great Lakes Basin (hydrologic) boundary of the subareas as well as the Region boundary. This was accomplished by approximating the hydrologic boundary within each county by line and column coordinates at the *PRINTRESULTS stage and requesting that new tabular statistics be generated utilizing only the area contained within those boundaries. County maps on a hydrologic boundary basis were not prepared.

Figure 22 also shows the relationship of the Plan Areas to the entire Great Lakes Region. The major land uses for Lake Ontario basin and the Great Lakes Region are shown in Table 33. Figure 23 is a more detailed map of the Lake Ontario basin, Plan Area 5.0.

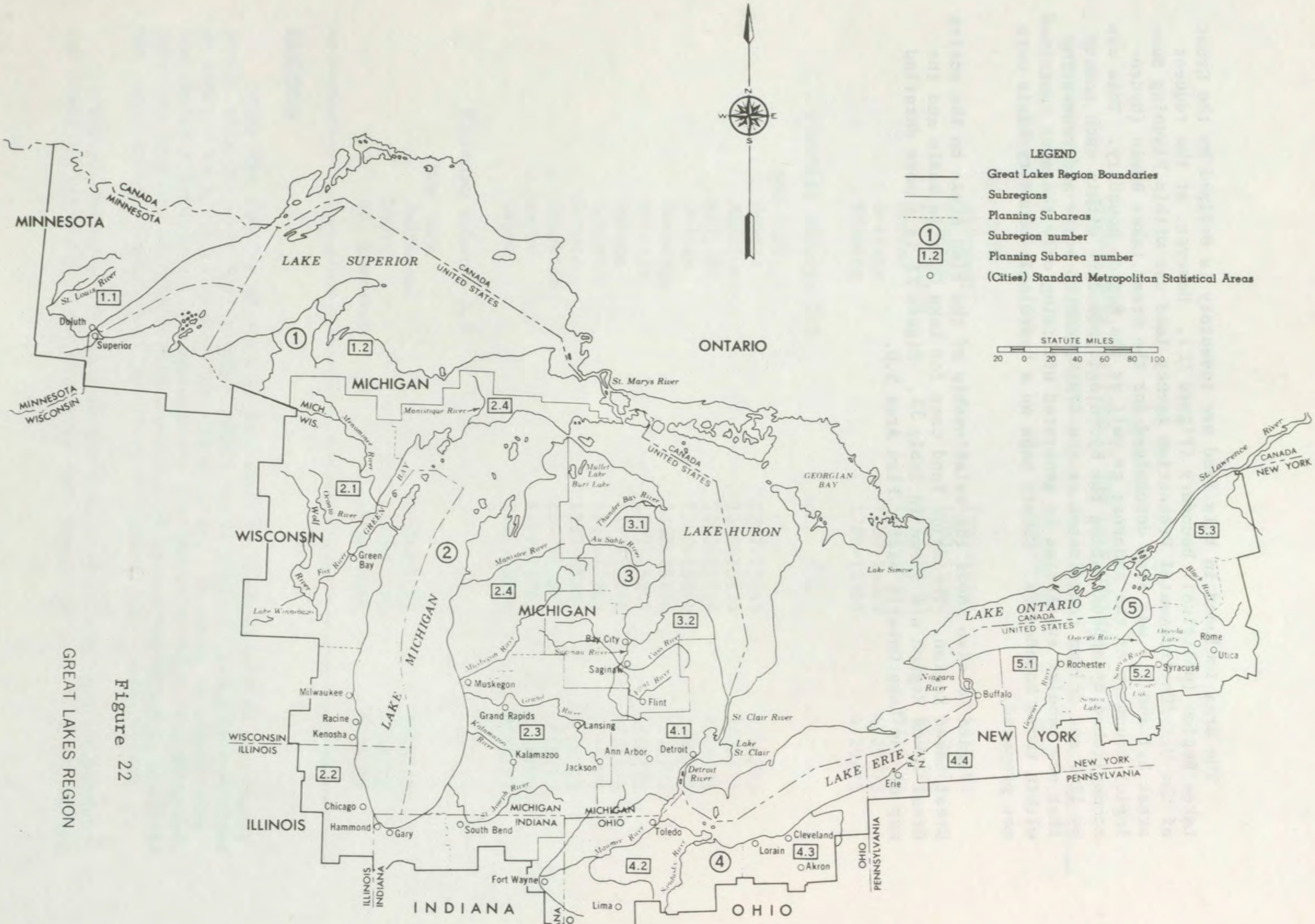

Figure 22

GREAT LAKES REGION

Table 33

MAJOR LAND USES, LAKE ONTARIO AND GREAT LAKES REGION

Subarea	Urban-Commercial-Industrial: Residential Acres	Commercial Acres	Subtotal Acres	Subtotal Hectares	Subtotal %	Agriculture: Row Crop Acres	Close Grown Acres	Pasture Acres	Subtotal Acres	Subtotal Hectares	Subtotal %	Forest: Acres	Hectares	%	No Major Use: Water Acres	Wetland Acres	Subtotal Acres	Subtotal Hectares	Subtotal %
5.1	278950	156720	435680	176380	17.6	203300	135740	778390	1117390	452380	45.1	879150	355930	35.5	44570	-0-	44570	18040	1.8
5.2	369590	89400	458990	185820	8.1	430410	161640	1462610	2054660	831840	36.2	2863620	1159360	50.4	228630	76650	305280	123590	5.4
5.3	77060	-0-	77060	31190	2.2	87820	44060	569040	700930	283770	19.7	2378230	962840	66.8	405380	-0-	405380	164120	11.4
Lake Ontario Total	725600	246120	971730	393390	8.3	721530	341440	2810040	3872980	1567990	33.0	6121000	2478130	52.2	678580	76650	755230	305750	6.4
Great Lakes Total																			
Acres	5293310	1526710	6820040			12123740	3023000	18418260	33565000			41125720			3423000	1574620	4997620		
%	6.1	1.8			7.9	14.0	3.5	21.3			38.8			47.5	4.0	1.8			5.8

TOTAL AREA

	Acres	Hectares
PSA 5.1	2,476,790	1,002,730
PSA 5.2	5,682,550	2,300,610
PSA 5.3	3,561,600	1,441,920
Lake Ontario Basin	11,720,940	4,745,260
Great Lakes Region	86,505,190	

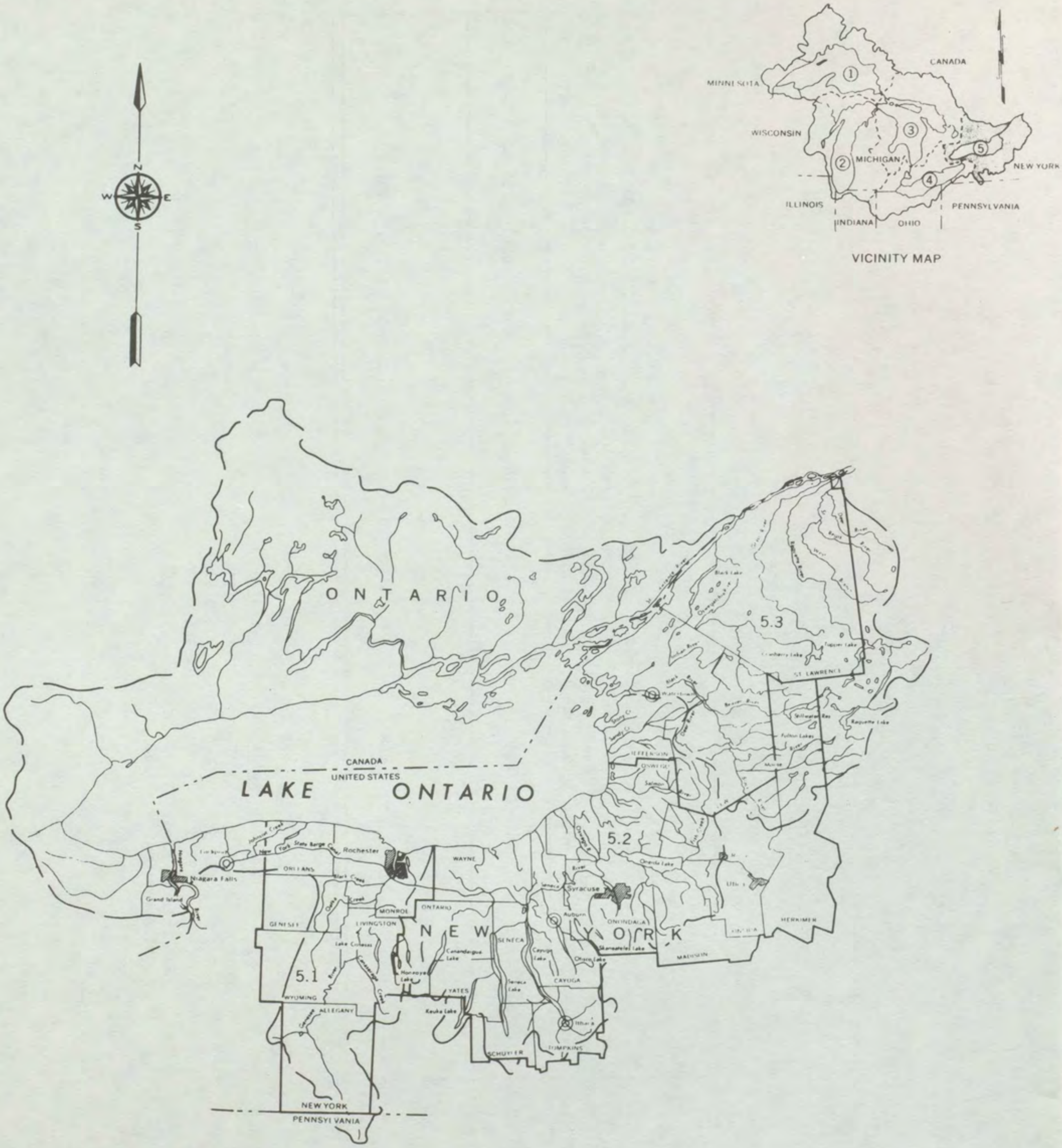

Figure 23

LAKE ONTARIO BASIN

— — — Great Lakes Basin
——— Great Lakes Region

SCALE IN MILES
0 10 20 30 40 50

Planning Subarea 5.1

Figure 24 shows the counties contained in Planning Subarea 5.1. The major land uses in Planning Subarea 5.1 presented by county for the Great Lakes Region boundary are shown in Table 34. Table 35 presents the major land uses for Planning Subarea 5.1 (by state) for the Great Lakes Region.

The land use tabulations presented in these tables were derived by LARS using 1974 state-of-the-art LANDSAT analyses technology. The areas shown may not match those in other tabulations of land use information due to differences in procedures used, land use category definitions, or the date of inventory.

The county boundaries and the area classified may not exactly agree since the area chosen as the county in the LANDSAT data could only be approximated. The approximated county boundaries were located using visible features within the LANDSAT data such as streams, lakes, cities, major highways, etc.

In a few predominantly rural counties, insufficient reference data were available to train the computer properly to identify an urban class. Maps of these counties do not reflect an Urban (red) category but contain only the following categories: Agriculture (yellow), Forestry (green) No Major Use (blue), and perhaps Clouds (white) and Cloud Shadow (black).

This land use inventory was prepared using spectral data; placement of separable spectral classes into informational classes sometimes resulted in the combination of urban and rural features into a single category. As a result some maps reflect large amounts of the Urban (red) category scattered throughout the county. These areas represent data points which have similar reflectance characteristics and are spectrally inseparable. They generally include urban areas, light colored and sandy soils without surface cover, and farmsteads. This must be considered when using the Land Use tables as the areas estimated for the urban category may be high.

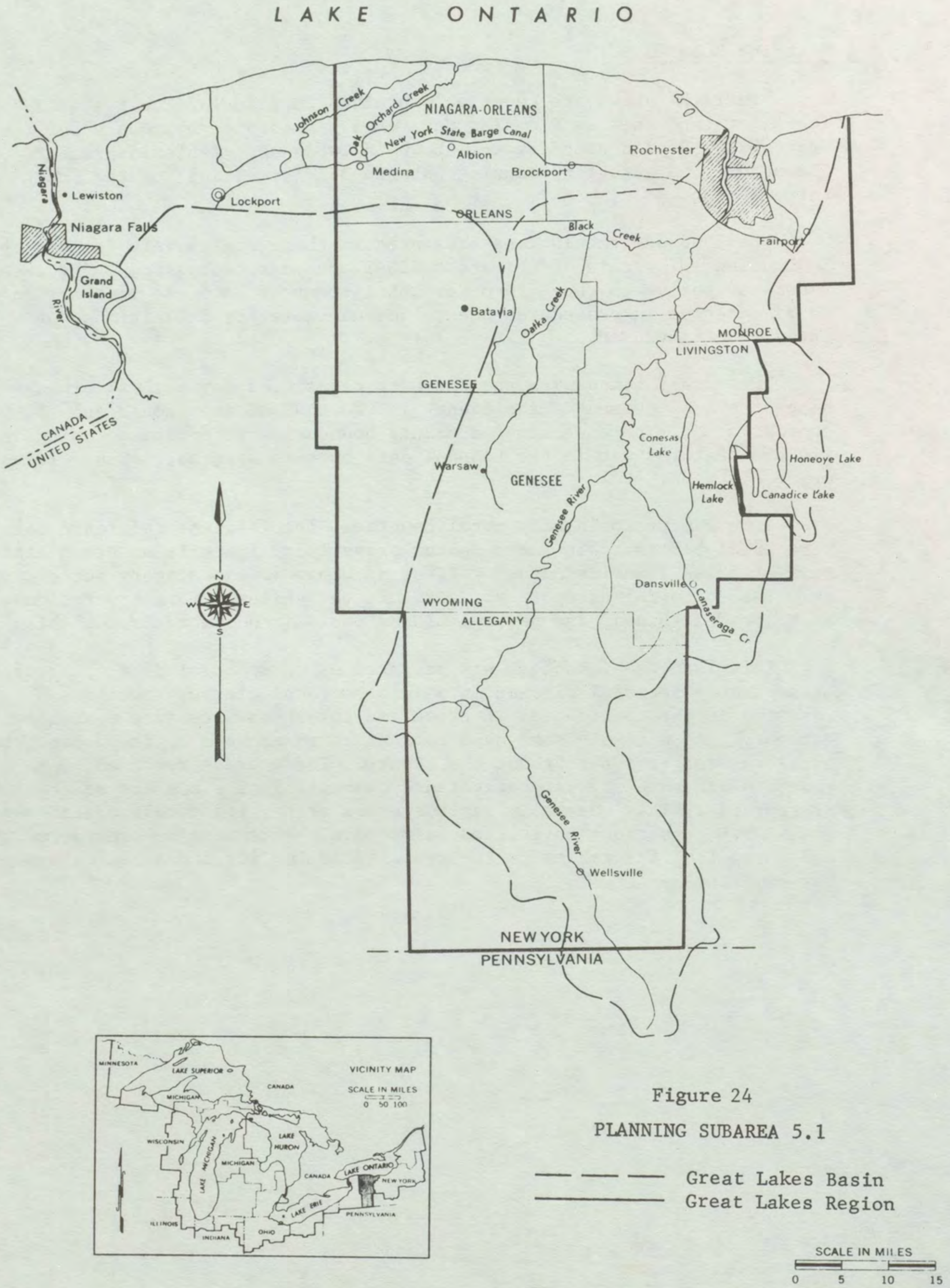

Figure 24

PLANNING SUBAREA 5.1

COLOR COUNTY LAND USE MAPS

County maps for Planning Subarea 5.1 are not included in this volume due to technical difficulties incurred in the mapping processes.

Table 34

MAJOR LAND USES IN PLANNING SUBAREA 5.1 BY COUNTY - GREAT LAKES REGION

	Acres	Hectares	Percent
Allegany County, New York	671360	271800	
Urban-Commercial-Industrial	18800	7610	2.8
Residential	18800	7610	2.8
Commercial	-	-	-
Agriculture	272070	110140	40.5
Row Crop	32310	13080	4.8
Close Grown Crop	12030	4870	1.8
Pasture	227740	92200	33.9
Forest	378760	153340	56.4
No Major Use	1730	700	0.3
Water	1730	700	0.3
Wetland	-	-	-
Genesee County, New York	320640	129810	
Urban-Commercial-Industrial	125270	50710	39.1
Residential	61070	24720	19.0
Commercial	64200	25990	20.0
Agriculture	132070	53460	41.2
Row Crop	29390	11890	9.2
Close Grown Crop	31220	12630	9.7
Pasture	71470	28930	22.3
Forest	63180	25570	19.7
No Major Use	120	40	0.0
Water	120	40	0.0
Wetland	-	-	-
Livingston County, New York	413440	167380	
Urban-Commercial-Industrial	11990	4850	2.9
Residential	11990	4850	2.9
Commercial	-	-	-
Agriculture	248750	100700	60.2
Row Crop	57560	23300	13.9
Close Grown Crop	25020	10120	6.1
Pasture	166170	67270	40.2
Forest	145470	58890	35.2
No Major Use	7230	2920	1.7
Water	7230	2920	1.7
Wetland	-	-	-

	Acres	Hectares	Percent
Monroe County, New York	434550	175930	
Urban-Commercial-Industrial	167620	67860	38.6
Residential	135510	54860	31.2
Commercial	32110	13000	7.4
Agriculture	137210	55550	31.6
Row Crop	35510	14370	8.2
Close Grown Crop	35270	14270	8.1
Pasture	66430	26890	15.3
Forest	115330	46690	26.5
No Major Use	14390	5820	3.3
Water	14390	5820	3.3
Wetland	-	-	-
Orleans County, New York	253440	102600	
Urban-Commercial-Industrial	101120	40930	39.9
Residential	40700	16470	16.1
Commercial	60410	24450	23.8
Agriculture	101020	40890	39.9
Row Crop	20980	8490	8.3
Close Grown Crop	14620	5910	5.8
Pasture	65430	26480	25.8
Forest	51270	20750	20.2
No Major Use	30	10	0.0
Water	30	10	0.0
Wetland	-	-	-
Wyoming County, New York	383360	155200	
Urban-Commercial-Industrial	10880	4400	2.8
Residential	10880	4400	2.8
Commercial	-	-	-
Agriculture	226270	91600	59.0
Row Crop	27550	11150	7.2
Close Grown Crop	17580	7110	4.6
Pasture	181150	73340	47.3
Forest	125140	50660	32.6
No Major Use	21070	8530	5.5
Water	21070	8530	5.5
Wetland	-	-	-

Table 35

MAJOR LAND USES, PLANNING SUBAREA 5.1, GREAT LAKES REGION

County	Urban-Commercial-Industrial					Agriculture						Forest			No Major Use				
	Residential Acres	Commercial Acres	Subtotal Acres	Subtotal Hectares	Subtotal %	Row Crop Acres	Close Grown Acres	Pasture Acres	Subtotal Acres	Subtotal Hectares	Subtotal %	Acres	Hectares	%	Water Acres	Wetland Acres	Subtotal Acres	Subtotal Hectares	Subtotal %
New York																			
Allegany	18800		18800	7610	2.8	32310	12030	227740	272070	110140	40.5	378760	153340	56.4	1730		1730	700	0.3
Genesee	61070	64200	125270	50710	39.1	29390	31220	71470	132070	53460	41.2	63180	25570	19.7	120		120	40	0.0
Livingston	11990		11990	4850	2.9	57560	25020	166170	248750	100700	60.2	145470	58890	35.2	7230		7230	2920	1.7
Monroe	135510	32110	167620	67860	38.6	35510	35270	66430	137210	55550	31.6	115330	46690	26.5	14390		14390	5820	3.3
Orleans	40700	60410	101120	40930	39.9	20980	14620	65430	101020	40890	39.9	51270	20750	20.2	30		30	10	0.0
Wyoming	10880		10880	4400	2.8	27550	17580	181150	226270	91600	59.0	125140	50660	32.6	21070		21070	8530	5.5
State Total			435680	176380	17.6				1117390	452380	45.1	879150	355930	35.5			44570	18040	1.8
Subarea Total			435680	176380	17.6				1117390	452380	45.1	879150	355930	35.5			44570	18040	1.8

Planning Subarea 5.2

Figure 31 shows those counties contained in Planning Subarea 5.2. The county maps of the land use inventory for Planning Subarea 5.2 are shown in Figures 32 through 43. The major land uses in Planning Subarea 5.2 presented by county are shown in Table 36. Table 37 presents the major land uses for Planning Subarea 5.2 by state.

The county boundaries and the area classified may not exactly agree since the area chosen as the county in the LANDSAT data could only be approximated. The approximated county boundaries were located using visible features within the LANDSAT data such as streams, lakes, cities, major highways, etc.

In a few predominantly rural counties, insufficient reference data were available to train the computer properly to identify an urban class. Maps of these counties do not reflect an Urban (red) category but contain only the following categories: Agriculture (yellow), Forestry (green), No Major Use (blue), and perhaps Clouds (white) and Cloud Shadow (black).

This land use inventory was prepared using spectral data; placement of separable spectral classes into informational classes sometimes resulted in the combination of urban and rural features into a single category. As a result some maps reflect large amounts of the Urban (red) category scattered throughout the county. These areas represent data points which have similar reflectance characteristics and are spectrally inseparable. They generally include urban areas, light colored and sandy soils without surface cover, and farmsteads.

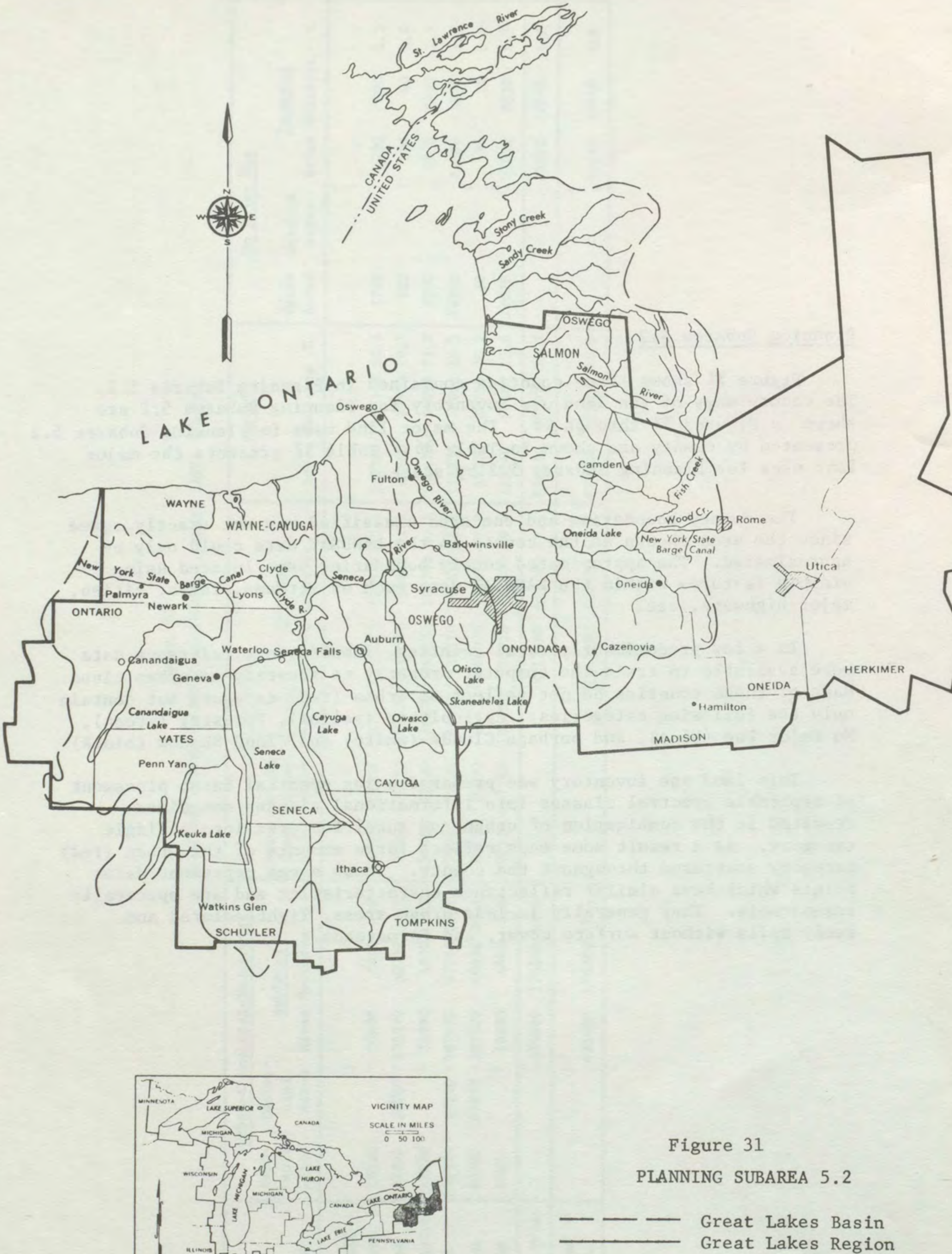

Figure 31

PLANNING SUBAREA 5.2

— — — Great Lakes Basin
——— Great Lakes Region

COLOR COUNTY MAPS

15 Figures (maps) for Subarea 5.2 will be presented in final edition. Figure numbers 32 through 43.

Table 36

MAJOR LAND USES IN PLANNING SUBAREA 5.2 BY COUNTY - GREAT LAKES REGION

	Acres		Hectares		Percent	
Cayuga County, New York	472320		191220			
Urban-Commercial-Industrial	13710		5550		2.9	
Residential		13710		5550		2.9
Commercial		-		-		-
Agriculture	289140		117060		61.2	
Row Crop		97270		39380		20.6
Close Grown Crop		25760		10420		5.5
Pasture		166110		67250		35.2
Forest	140230		56770		29.7	
No Major Use	29240		11830		6.2	
Water		20590		8330		4.4
Wetland		8650		3500		1.8
Herkimer County, New York	942710		381660			
Urban-Commercial-Industrial	95740		38760		10.2	
Residential		85080		34440		9.0
Commercial		10660		4310		1.1
Agriculture	179710		72750		19.1	
Row Crop		14300		5780		1.5
Close Grown Crop		6180		2500		0.7
Pasture		159230		64460		16.9
Forest	655490		265380		69.5	
No Major Use	11770		4760		1.2	
Water		11770		4760		1.2
Wetland		-		-		-
Madison County, New York	426240		172560			
Urban-Commercial-Industrial	39890		16140		9.4	
Residential		31990		12950		7.5
Commercial		7900		3190		1.9
Agriculture	121800		49310		28.6	
Row Crop		48420		19600		11.4
Close Grown Crop		11020		4460		2.6
Pasture		62350		25240		14.6
Forest	260380		105410		61.1	
No Major Use	4170		1680		1.0	
Water		4170		1680		1.0
Wetland		-		-		-

	Acres		Hectares		Percent	
Oneida County, New York	808960		327510			
Urban-Commercial-Industrial	105760		42810		13.1	
Residential		69400		28090		8.6
Commercial		36360		14720		4.5
Agriculture	246240		99690		30.4	
Row Crop		51210		20730		6.3
Close Grown Crop		11280		4560		1.4
Pasture		183760		74390		22.7
Forest	425000		172060		52.5	
No Major Use	31960		12930		4.0	
Water		31960		12930		4.0
Wetland		-		-		-
Onondaga County, New York	521600		211170			
Urban-Commercial-Industrial	109160		44190		20.9	
Residential		74680		30230		14.3
Commercial		34480		13950		6.6
Agriculture	143700		58170		27.5	
Row Crop		27170		11000		5.2
Close Grown Crop		5800		2340		1.1
Pasture		110730		44820		21.2
Forest	254810		103160		48.9	
No Major Use	13930		5630		2.7	
Water		13930		5630		2.7
Wetland		-		-		-
Ontario County, New York	426250		172570			
Urban-Commercial-Industrial	19480		7880		4.6	
Residential		19480		7880		4.6
Commercial		-		-		-
Agriculture	263360		106620		61.8	
Row Crop		37400		15140		8.8
Close Grown Crop		36570		14800		8.6
Pasture		189390		76670		44.4
Forest	121760		49290		28.6	
No Major Use	21650		8760		5.1	
Water		10990		4440		2.6
Wetland		10660		4310		2.5

Table 36 Cont.

	Acres		Hectares		Percent	
Oswego County, New York	658560		266620			
Urban-Commercial-Industrial	9270		3750		1.4	
Residential		9270		3750		1.4
Commercial		-		-		-
Agriculture	170460		69010		25.9	
Row Crop		10000		4040		1.5
Close Grown Crop		-		-		-
Pasture		160460		64960		24.4
Forest	403020		163160		61.2	
No Major Use	75810		30690		11.5	
Water		36380		14720		11.5
Wetland		39430		15960		
Schuyler County, New York	222070		89900			
Urban-Commercial-Industrial	2880		1160		1.3	
Residential		2880		1160		1.3
Commercial		-		-		-
Agriculture	84920		34380		38.2	
Row Crop		12010		4860		5.4
Close Grown Crop		5010		2020		2.3
Pasture		67900		27480		30.6
Forest	125630		50860		56.6	
No Major Use	8640		3490		3.9	
Water		8640		3490		3.9
Wetland		-		-		-
Seneca County, New York	264970		107270			
Urban-Commercial-Industrial	12650		5120		4.8	
Residential		12650		5120		4.8
Commercial		-		-		-
Agriculture	125180		50680		47.2	
Row Crop		16120		6520		6.1
Close Grown Crop		21380		8650		8.1
Pasture		87680		35490		33.1
Forest	73200		29630		27.6	
No Major Use	53940		21830		20.4	
Water		53940		21830		20 4
Wetland		-		-		-

	Acres		Hectares		Percent	
Tompkins County, New York	318070		128770			
Urban-Commercial-Industrial	33080		13390		10.4	
Residential		33080		13390		10.4
Commercial		-		-		-
Agriculture	135560		54880		42.6	
Row Crop		24090		9750		7.6
Close Grown Crop		7950		3210		2.5
Pasture		103520		41910		32.5
Forest	139680		56550		43.9	
No Major Use	9750		3940		3.1	
Water		9750		3940		3.1
Wetland		-		-		-
Wayne County, New York	392970		159090			
Urban-Commercial-Industrial	5980		2420		1.5	
Residential		5980		2420		1.5
Commercial		-		-		-
Agriculture	193700		78420		49.3	
Row Crop		78290		31690		19.9
Close Grown Crop		18000		7280		4.6
Pasture		97410		39430		24.8
Forest	179610		72710		45.7	
No Major Use	13680		5530		3.5	
Water		5470		2210		1.4
Wetland		8210		3320		2.1
Yates County, New York	227830		92230			
Urban-Commercial-Industrial	11390		4610		5.0	
Residential		11390		4610		5.0
Commercial		-		-		-
Agriculture	100890		40840		44.3	
Row Crop		14130		5720		6.2
Close Grown Crop		12690		5130		5.6
Pasture		74070		29980		32.5
Forest	84810		34330		37.2	
No Major Use	30740		12440		13.5	
Water		21040		8510		9.2
Wetland		9700		3920		4.3

Table 37

MAJOR LAND USES, PLANNING SUBAREA 5.2, GREAT LAKES REGION

County	Urban-Commercial-Industrial					Agriculture						Forest			No Major Use				
	Residential Acres	Commercial Acres	Subtotal Acres	Subtotal Hectares	Subtotal %	Row Crop Acres	Close Grown Acres	Pasture Acres	Subtotal Acres	Subtotal Hectares	Subtotal %	Acres	Hectares	%	Water Acres	Wetland Acres	Subtotal Acres	Subtotal Hectares	Subtotal %
New York																			
Cayuga	13710		13710	5550	2.9	97270	25760	166110	289140	117060	61.2	140230	56770	29.7	20590	8650	29240	11830	6.2
Herkimer	85080	10660	95740	38760	10.2	14300	6180	159230	179710	72750	19.1	655490	265380	69.5	11770		11770	4760	1.2
Madison	31990	7900	39890	16140	9.4	48420	11020	62350	121800	49310	28.6	260380	105410	61.1	4170		4170	1680	1.0
Oneida	69400	36360	105760	42810	13.1	51210	11280	183760	246240	99690	30.4	425000	172060	52.5	31960		31960	12930	4.0
Onondaga	74680	34480	109160	44190	20.9	27170	5800	110730	143700	58170	27.5	254810	103160	48.9	13930		13930	5630	2.7
Ontario	19480		19480	7880	4.6	37400	36570	189390	263360	106620	61.8	121760	49290	28.6	10990	10660	21650	8760	5.1
Oswego	9270		9270	3750	1.4	10000		160460	170460	69010	25.9	403020	163160	61.2	36380	39430	75810	30690	11.5
Schuyler	2880		2880	1160	1.3	12010	5010	67900	84920	34380	38.2	125630	50860	56.6	8640		8640	3490	3.9
Seneca	12650		12650	5120	4.8	16120	21380	87680	125180	50680	47.2	73200	29630	27.6	53940		53940	21830	20.4
Tompkins	33080		33080	13390	10.4	24090	7950	103520	135560	54880	42.6	139680	56550	43.9	9750		9750	3940	3.1
Wayne	5980		5980	2420	1.5	78290	18000	97410	193700	78420	49.3	179610	72710	45.7	5470	8210	13680	5530	3.5
Yates	11390		11390	4610	5.0	14130	12690	74070	100890	40840	44.3	84810	34330	37.2	21040	9700	30740	12440	13.5
State Total			458990	185820	8.1				2054660	831840	36.2	2863620	1159360	50.4			305280	123590	5.4
Subarea Total			458990	185820	8.1				2054660	831840	36.2	2863620	1159360	50.4			305280	123590	5.4

Planning Subarea 5.3

Figure 44 shows those counties contained in Planning Subarea 5.3. The major land uses in Planning Subarea 5.3 presented by county are shown in Table 38. Table 39 presents the major land uses for Planning Subarea 5.3 by state.

The land use tabulations presented in these tables were derived by LARS using 1974 state-of-the-art LANDSAT analyses technology. The areas shown may not match those in other tabulations of land use information due to differences in procedures used, land use category definitions, or the date of inventory.

The county boundaries and the area classified may not exactly agree since the area chosen as the county in the LANDSAT data could only be approximated. The approximated county boundaries were located using visible features within the LANDSAT data such as streams, lakes, cities, major highways, etc.

In a few predominantly rural counties, insufficient reference data were available to train the computer properly to identify an urban class. Maps of these counties do not reflect and Urban (red) category but contain only the following categories: Agriculture (yellow), Forestry (green), No Major Use (blue), and perhaps Clouds (white) and Cloud Shadow (black).

This land use inventory was prepared using spectral data; placement of separable spectral classes into informational classes sometimes resulted in the combination of urban and rural features into a single category. As a result many maps reflect large amounts of the Urban (red) category scattered throughout the county. These areas represent data points which have a similar reflectance characteristics and are spectrally inseparable. They generally include urban areas, light colored and sandy soils without surface cover, and farmsteads. This must be considered when using the Land Use Tables as the area estimated for the urban category may be high.

Figure 44

PLANNING SUBAREA 5.3

— — — Great Lakes Basin

———— Great Lakes Region

SCALE IN MILES
0 5 10 15 20

5.3

COLOR COUNTY LAND USE MAPS

County maps for Planning Subarea 5.3 are not included in this volume due to technical difficulties in the mapping processes.

COLOR COUNTY LAND USE MAPS

County maps for Planning Subarea 5.3 are not included in this volume due to technical difficulties in the mapping processes.

Table 38

MAJOR LAND USES IN PLANNING SUBAREA 5.3 BY COUNTY - GREAT LAKES REGION

	Acres		Hectares		Percent	
Jefferson County, New York	897910		363520			
Urban-Commercial-Industrial	27170		11000		3.0	
Residential		27170		11000		3.0
Commercial		-		-		-
Agriculture	278480		112740		31.0	
Row Crop		36490		14770		4.1
Close Grown Crop		10620		4290		1.2
Pasture		231370		93670		25.8
Forest	441650		178800		49.2	
No Major Use	150610		60970		16.8	
Water		150610		60970		16.8
Wetland		-		-		-
Lewis County, New York	832000		336840			
Urban-Commercial-Industrial	13430		5430		1.6	
Residential		13430		5430		1.6
Commercial		-		-		-
Agriculture	202610		82020		24.4	
Row Crop		29110		11780		3.5
Close Grown Crop		28360		11480		3.4
Pasture		145140		58760		17.4
Forest	596290		241410		71.7	
No Major Use	19670		7960		2.4	
Water		19670		7960		2.4
Wetland		-		-		-
St. Lawrence County, New York	1831690		741570			
Urban-Commercial-Industrial	36460		14760		2.0	
Residential		36460		14760		2.0
Commercial		-		-		-
Agriculture	219840		89000		12.0	
Row Crop		22220		8990		1.2
Close Grown Crop		5080		2050		0.3
Pasture		192530		77940		10.5
Forest	1340290		542620		73.2	
No Major Use	235100		95180		12.8	
Water		235100		95180		12.8
Wetland		-		-		-

Table 39

MAJOR LAND USES, PLANNING SUBAREA 5.3, GREAT LAKES REGION

County	Urban-Commercial-Industrial					Agriculture						Forest			No Major Use				
	Residential	Commercial	Subtotal			Row Crop	Close Grown	Pasture	Subtotal						Water	Wetland	Subtotal		
	Acres	Acres	Acres	Hectares	%	Acres	Acres	Acres	Acres	Hectares	%	Acres	Hectares	%	Acres	Acres	Acres	Hectares	%
New York																			
Jefferson	27170		27170	11000	3.0	36490	10620	231370	278480	112740	31.0	441650	178800	49.2	150610		150610	60970	16.8
Lewis	13430		13430	5430	1.6	29110	28360	145140	202610	82020	24.4	596290	241410	71.7	19670		19670	7960	2.4
St. Lawrence	36460		36460	14760	2.0	22220	5080	192530	219840	89000	12.0	1340290	542620	73.2	235100		235100	95180	12.8
State Total			77060	31190	2.2				700930	283770	19.7	2378230	962840	66.8			405380	164120	11.4
Subarea Total			77060	31190	2.2				700930	283770	19.7	2378230	962840	66.8			405380	164120	11.4

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SPECIALIZED LAND USES

LAKE ONTARIO BASIN - CATEGORIES

This section explores eight specialized land uses covering the more significant nonpoint sources of pollution affecting the water quality of the Great Lakes. They are as follows: (1) liquid waste disposal areas, (2) solid waste disposal areas, (3) dredge spoil disposal, (4) deep-well disposal, (5) lakeshore and riverbank erosion, (6) intensive livestock operations, (7) high density, nonsewered residential areas and (8) recreational lands.

Disposal Operations

Four disposal operations have been identified in this section. They are liquid waste, solid waste, dredge spoil, and deep-well disposal. Liquid waste disposal is defined here to be the application of wastewaters on land. Solid waste disposal includes sanitary landfills, modified landfills, open dumps, and disposal sites for construction debris. Dredging is defined as the process of removing bottom materials from underwater and their subsequent disposal at dredge spoil disposal sites. Because there are no deep-well disposal sites in operation at the present time in the Lake Ontario Basin, there are no current problems from this activity.

Liquid Waste Disposal

Land disposal of liquid waste has been used for some time as an alternative method of depositing municipal and industrial effluents. The process uses the soils to filter the wastewaters and sludges applied to it. However, the application of liquid waste to land is relatively limited in the Lake Ontario basin even though it has been found to be rather effective in many areas where utilized.

Depending on the composition of wastes, site characteristics, and other factors, land application methods may differ. The four primary types of liquid waste disposal utilize either lagoon storage, spray irrigation, septic tank-tile fields, or direct application to the surface of ground. All four types of discharge require soils with at least moderate permeability. Lagooning of wastes usually is employed where large volumes must be disposed of, and has the limitation that during the storage of wastes in lagoons, odors and other nuisances can result. Spray irrigation can be used in conjunction with agricultural or silvicultural operations and in this connection provides a nutrient for various crops. Where there are moderate amount of waste to be discharged, septic tanks in conjunction with tile fields are most often utilized.

Impacts on water quality will vary according to site characteristics. Potential pollutants are organic compounds, heavy metals, nitrogen (organic and ammonium), phosphorus, inorganic ions, suspended solids, and pathogens.

Ground waters can be affected in different ways according to soil types and the application technique used. The use of lagoon systems is more likely to affect ground water quality than will spray irrigation techniques. However, this depends on the amount and types of effluents supplied and the porosity of the soil.

Table 40

LIQUID WASTE DISPOSAL 1973(1b)

	Number of Operations	Type Municipal	Industrial
Lake Ontario Basin	1	-	1
PSA 5.1	-	-	-
PSA 5.2	1	-	1
PSA 5.3	-	-	-

According to available information at the present time there is one liquid waste disposal operation in the Lake Ontario basin. This may understate the true number of sites, however, as until recently there has been little state involvement in regulation of land treatment facilities. Steeply sloped and stony areas in the basin are unsuitable for liquid waste disposal. In addition, low population and low rates of industrial development in much of the basin have limited the need for liquid waste disposal sites.

Solid Waste Disposal

Many conditions are involved in establishing efficient solid waste disposal sites which have been frequently ignored in the past. Such conditions include climate, geology, hydrology, and soils.

Climate is of particular concern within the Lake Ontario basin because of the rainfall conditions present. Due to the amount of precipitation in this area, leachate production is almost inevitable from solid waste disposal sites. Leachates are produced by water infiltrating and percolating through the landfill and into groundwater supplies, or are produced from saturation by high ground water tables that come into contact with the buried refuse. The types of pollutants that may arise are directly related to the type of refuse present and the manner of disposal. However, leachates are usually characterized as being high in biochemical oxygen demand (BOD), dissolved chemicals (iron, chloride, sodium), hardness, acids, and nitrates (organic decomposition).

The State of New York has initiated disposal objectives, depending upon the natural features of the site. New York currently does not have regulations controlling the types of materials which can be applied at landfill sites. This determination is at the discretion of the landfill operator. Thus, highly organic materials such as oils are not currently regulated on a state-wide basis. Daily coverage of sanitary landfill sites is also waived in some rural areas.

Date concerning the precise type of landfill was not available from the data gatherd.

Table 41

SOLID WASTE DISPOSAL SITES 1973 (1c)

	Total	Sanitary Landfills	Modified Or Open Dumps
Lake Ontario basin	231	-	-
PSA 5.1	86	-	-
PSA 5.2	121	-	-
PSA 5.3	24	-	-

Dredging And Artificial Fill Areas

Dredging is the process of excavating bottom material from underwater and disposing of it in suitable areas to assure that harbors will have sufficient width and depth for commercial and recreational boating. This removal includes the soft sediments and the hard bottoms of limestone and compacted clays.

Due to population and industrial development in the Lake Ontario basin, some of the sediment that is removed by dredging activities has been polluted by municipal, industrial, and agricultural activities. Potential pollutants that are common to the affected sediments include nitrates, phosphates, organic matter, pH, alkalinity, chlorides, iron, oil and grease, mercury, lead, and zinc.

Federal legislation concerned with polluted dredge spoil was enacted in 1970 (PL 91-611). Section 123 of this act specifically deals with requirements for confined disposal areas and restrictions on open lake disposal of polluted dredge spoil. However, most dredge spoil material excavated in the Lake Ontario basin continues to be disposed of in open lake areas.

In considering the future of dredging activities, it is unlikely that any major work will be accomplished in the Lake Ontario basin in the near future unless larger locks are constructed. If this occurs, larger ships will be utilizing the facilities and there will be a need for deeper and wider harbors.

The amount of future maintenance dredging is expected to decrease if regulatory agencies succeed in their efforts to reduce waste discharges and prevent soil erosion which contributes to the buildup of polluted harbor sediments.

In all likelihood if economic development continues to occur in the Lake Ontario basin there will be an increase in the percentage of polluted sediments. If sediment pollution does increase, more diked disposal areas will be used which may in turn raise the potential for nearshore water pollution if diked areas are not properly managed. Conversely, if proper technology is applied to controlling pollutant loss from confined areas, the potential may be much less than if open lake disposal methods were used.

Table 42

AVERAGE ANNUAL VOLUME OF DREDGE SPOIL DISPOSAL (1961-1970)[2,3]

		Annual Average Dredging		Polluted Sediments Requiring Confinement	
	Total Number Of Sites	Cubic Meters	Cubic Yards	Cubic Meters	Cubic Yards
Lake Ontario basin	6	277,801	363,614	254,865	333,594
PSA 5.1	3	206,351	270,093	204,010	267,029
PSA 5.2	3	71,450	93,521	50,855	66,565
PSA 5.3	0	0	0	0	0

Artificial fill areas include man-made landfills created by dredging or other means for additional land development, or the process of replenishing beaches by the deposition of dredged materials. On Lake Ontario there is only a limited amount of artificial fill area - 5 kilometers (3.1 miles).

Deep-Well Disposal

Deep-well disposal is the injection of liquid wastes, such as brine and industrial materials into the subsurface. Disposal by this method has not been developed to any great extent. New York is attempting to discourage deep-well disposal by regulatory practices and by utilizing deep-well disposal as a last resort. In addition, the slower industrial development in much of this lake basin has not created a need for this type of operation. The existence of porous and fractured geological zones in a portion of the Lake Ontario basin make this area poorly suited for the underground storage of waste.

Three disposal wells have been drilled in the Great Lakes drainage basin area of Lake Ontario; however, none are presently in operation.

Erosion

Erosion is caused by, and sediment derived from, the actions of moving water, ice or wind on rock and soil. Erosion along the land-water interface occurs in two particular areas - lakeshore and riverbank zones. On one hand, lakeshore erosion contributes sizable amounts of sediment into the nearshore area. However, most of this sediment does not contain nutrients or pesticide materials, and therefore its major effect on surface waters is that of increasing nearshore turbidity and smothering benthic biota. Riverbank erosion on the other hand contributes sizable amounts of nutrient and pesticide materials from surrounding lands captured in the sediment.

Lakeshore Erosion

One of the more important items which determines the intensity of shoreline erosion damage is the erodible character of the shoreland materisl. The southwestern portion of the Lake Ontario shoreline is comprised of eroded clay and silt bluffs, and it is in this soil type that sedimentation damages are most significant. The Lake Ontario basin contains no areas of sand dunes.

Table 43

LAKE ONTARIO AND NIAGARA RIVER SHORE TYPES, 1970[4]

	Lake Ontario	Niagara River	Total
Artificial fill area	3.1	11.3	14.4
Erodible high bluff	33.6	6.2	39.8
Non-erodible high bluff	8.3	6.7	15.0
Erodible low bluff	91.2	11.3	102.5
Non-erodible low bluff	106.1	0.4	106.5
High sand dune	0	0	0
Low sand dune	0	0	0
Erodible low plain	12.0	3.1	15.1
Non-erodible low plain	0	0	0
Wetlands	35.3	0	35.3
Total Shore miles	289.6	39.0	328.6

To Convert From	To	Multiply By
Miles (mi)	Kilometers (km)	1.609

Figure 48 displays the physical nature of the shoreline by indicating the distribution of shore types along Lake Ontario.

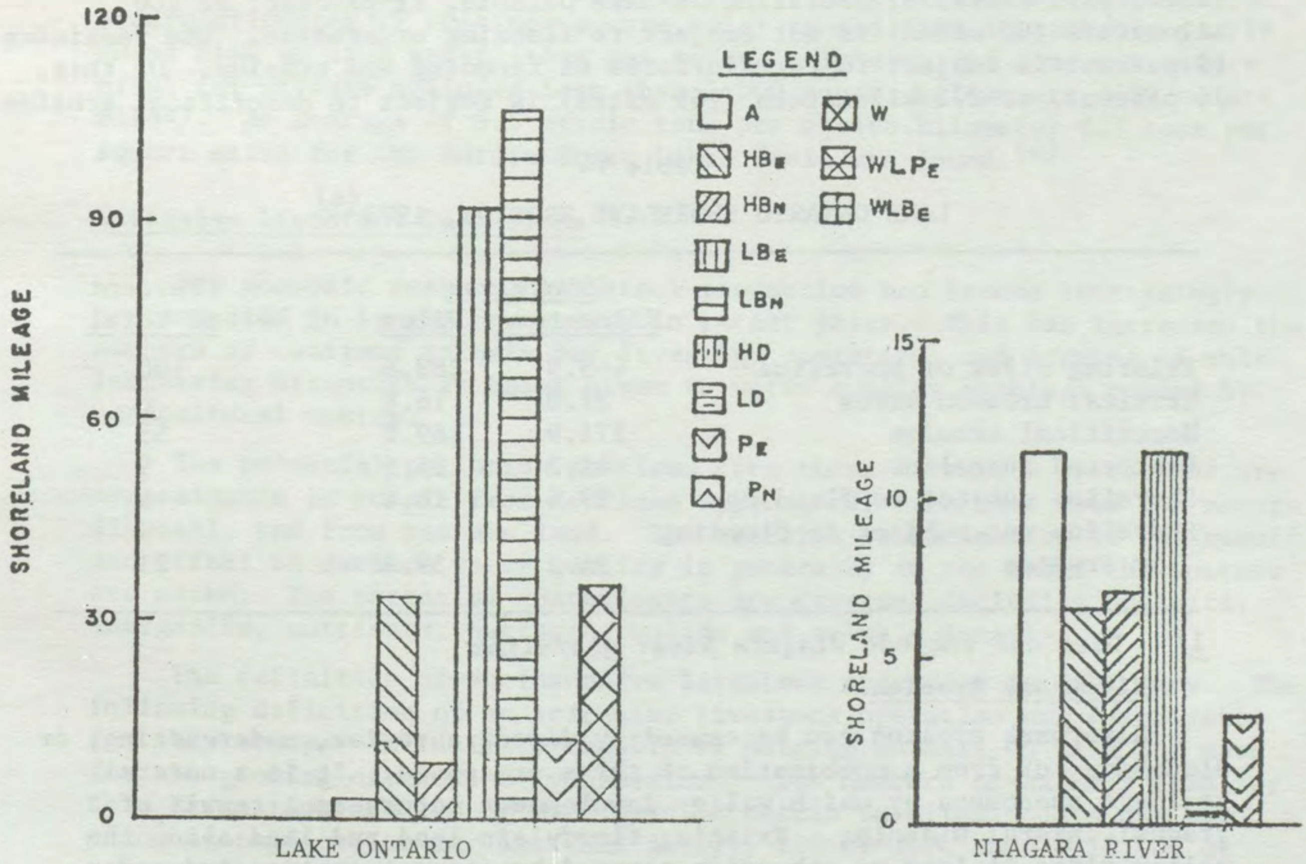


Figure 48

DISTRIBUTION OF LAKE ONTARIO AND NIAGARA RIVER SHORE TYPES, 1970[4]

As is seen in the graphs, the major part of the shoreline of Lake Ontario is nonerodible and erodible low bluffs. Erodible zones incorporate 60 percent, or 282 kilometers (175 miles) of shoreland areas. Nonerodible zones account for the remaining 184 kilometers (114 miles).

A second factor contributing to shoreline erosion is the combination of lake levels and storm intensity and frequency. Erosion and flooding damage is greatly increased during periods of high lake levels. The potential for shore property damage increases many times with each passing high water period, due to the greater erosive force, and resulting erosion and lakeshore recession. Further development of unprotected shorelands and continually increasing shore property values creates this problem.

The third controlling factor is the variety, concentration, and location of shoreline land use. Improper construction methods and location and incompatible shoreline development serve only to exacerbate the natural littoral and shoreline processes. However, much of the Lake Ontario shoreline is in agricultural use or is undeveloped.

A great deal of research and analysis has been directed towards shoreland erosion. Much of this data is based on economic parameters. Very little research has been conducted on measuring volumetric erosion rates. Volumetric measurements are necessary to properly assess the impact of shoreline erosion on water quality.

According to the economic loss criteria, of the existing 470 kilometers (290 miles) of shoreline on Lake Ontario, 21 percent, or 100 kilometers (60 miles) is not subject to flooding or erosion. The remaining 89 percent is subject to certain forms of flooding and erosion. Of this, 74 percent, or 272 kilometers (169 miles) is subject to noncritical erosion.

Table 44

LAKE ONTARIO SHORELINE EROSION, 1970[4]

	Shoreline		Percent
	Kilometers	Miles	of Total
Existing miles of shoreline 1/	465.9	289.6	100
Critical erosion areas	27.0	16.8	6
Noncritical erosion	271.9	169.0	58
Protected shoreline	41.2	25.6	9
Shoreline subject to flooding	29.6	18.4	6
Shoreline not subject to flooding or erosion	96.2	59.8	21

1/ Does not include Niagara River shoreline

Riverbank Erosion

Riverbank erosion can be caused by direct abrasion, undercutting, or sloughing, or from a combination of these processes. It is a natural geologic phenomena by which valley development occurs as a result of gradual lateral widening. Existing floodplain land and land along the valley sides is lost or otherwise altered by lateral cutting and undermining. Serious damages can also result when man's activities accelerate this natural process.

Riverbank erosion results in some siltation of reservoirs in the Lake Ontario basin and increases the amount of harbor dredging. Increased sediment resulting from urbanizing areas could become a major source of sediment in the streams in this area. Urban development usually leads to increasing runoff due to the decline in permeable surfaces which can absorb storm waters.

Table 45

TOTAL LENGTH OF RIVERBANK EROSION, 1969[5]

	PSA 5.1		PSA 5.2		PSA 5.3		Lake Ontario Total	
	Kilometers	Miles	Kilometers	Miles	Kilometers	Miles	Kilometers	Miles
Moderate	428	266	1,084	674	547	340	2,059	1,280
Severe	72	45	175	109	123	77	371	231
Total	500	311	1,259	783	670	417	2,430	1,511

In Table 45, erosion is summarized in bank lengths. "Severe streambank erosion" designates those areas having sizable damages detrimental to one or more interest and warranting further study to determine if some form of erosion protection is justified. Moderate streambank erosion includes those areas that have some damage, but under present conditions do not appear to warrent further study because installation of a protective measure will not produce sufficient benefits.

Estimates range from an average of 2.47 metric tons of sediment per square kilometer (7 tons per square mile) eroded from streambanks yearly to as high as 15.8 metric tons per square kilometer (45 tons per square mile) for streams draining less than 1,000 square kilometers (400 square miles). An average of 9.5 metric tons per square kilometer (27 tons per square mile) for the entire Great Lakes Basin was found.[4]

Intensive Livestock Operations

For economic reasons, livestock production has become increasingly concentrated in larger operations in recent years. This has increased the numbers of confined animals per livestock operation, and because of this increasing attention is being given to water quality problems caused by agricultural wastes.

The potential pollution problems from these livestock operations are contaminants in runoff from confined operations, from land used for manure disposal, and from pasture land. The relative contamination of the runoff and effect on surface water quality is generally in the order the sources are noted. The potential contaminants are diverse, including organics, inorganics, nutrients, bacteria, solids and soluble material.

The definition of an intensive livestock operation is arbitrary. The following definition of an intensive livestock operation was established for this study: "A facility capable of holding animals on land not used for the growing of crops or vegetation." The numbers of animals used for this definition are 100 or more head of cattle (available data did not allow identification for beef and dairy), 200 or more swine, 10,000 or more poultry. These standards are presented by Dr. R.C. Loehr for intensive animal feedlots, based upon what was felt to be appropriate size for a large single enterprise operation, operating at a respectable profit.[1a]

According to Dr. Loehr's standards, there are 1,838 intensive animal feedlots in the Lake Ontario basin, 98 of which are poultry operations, 44 of which are swine feedlots, and the majority of which are cattle operations (1,696). These estimates are based on information contained in the 1969 Census of Agriculture.

Table 46

NUMBER OF INTENSIVE LIVESTOCK OPERATIONS, 1969[6]

	Poultry with 10,000 or more	Cattle with 100 or more head	Swine with 200 or more	Total
Lake Ontario basin	98	1,696	44	1,838
PSA 5.1	24	465	18	507
PSA 5.2	65	816	24	905
PSA 5.3	9	415	2	426

High Density, Nonsewered Residential Areas

A problem connected with high density, nonsewered residential areas is in the effect of sewage effluent on water quality. While the effect on public health may not be significant, there may be water quality impacts. These impacts result from nutrient enrichment of streams and lakes, concentrations of chemical compounds detrimental to surface water uses, and affect the general aesthetic characteristics of nearby aquatic environments. There are no figures on the magnitude of pollution associated with these systems; however, it could be locally severe.

Table 47

HIGH DENSITY, NONSEWERED RESIDENTIAL AREAS, 1970[7]

		NONSEWERED HOUSEHOLDS					
		Urban		Rural Non-Farm		Combined	
	Total Housing Units	Number	Percent Of Total Housing Units	Number	Percent Of Total Housing Units	Number	Percent Of Total Housing Units
Lake Ontario basin	802,309	34,952	4	205,817	25	240,769	30
PSA 5.1	300,979	14,421	5	53,729	18	68,150	23
PSA 5.2	431,595	20,261	5	123,336	29	143,597	33
PSA 5.3	69,735	270	1	28,752	41	29,022	42

In the Lake Ontario basin there are 802,309 sewered and nonsewered housing units. Of these, 30 percent, or 240,769 are nonsewered high density units. Fifteen percent (34,952 units) of the nonsewered high density housing are located in urban areas, while 85 percent (205,817 units) are in rural areas.

Recreational Land Use

The land and water resources of this basin offer a variety of features important for recreation. Forested land, inland lakes and rural landscapes offer much appeal to tourists. The Lake Ontario shoreline, with its beaches, bluffs, sand dunes, inlets and bays is a dominant recreational feature. However, beach areas are less prominent than on any other Great Lake. The Thousand Islands area at the outlet of Lake Ontario and the head of the St. Lawrence River has been a prime tourist attraction for many years. The headwater areas of streams draining into Lake Ontario, including the Finger Lakes area and the Genesee Gorge have much rolling terrain and scenic appeal for vacation users.

A large percentage of recreational activity sites in this basin are in public control. State and county parks provide areas for more intensive use, while forest lands and game areas provide for more dispersed activities. The scenic beauty of the region draws many vacationists yearly, with Letchworth State Park in Planning Subarea 5.1 and Watkins Glen State Park in Planning Subarea 5.2 the most popular state parks in the basin. Private cottages are found throughout the region, particularly on the Lake Ontario and Finger Lakes shores. They serve as a base for recreational activities such as boating, fishing and swimming. Boating is particularly popular on the inland lakes, the New York Barge Canal and in the Thousand Islands region. The lack of natural shelter on much of the Lake Ontario shoreline has limited widespread use of the lake for boating. Canoeing is also popular, particularly in Planning Subarea 5.3. Urban activities such as golf, playfields and playgrounds are found in and near the urban centers of Planning Subarea 5.1 and 5.2, but are infrequent in Planning Subarea 5.3.

Table 48

SUMMARY OF RECREATIONAL AREAS AND ACTIVITIES, 1970[8]
(in acres)

	ACTIVITIES						
	Water Oriented Activities					Other Summer Activities	
				Parking			
	Swimming	Picnicking	Camping	General	Boating	Playfields	Golf
Lake Ontario basin	130	2,750	3,490	470	40	1,100	5,770
PSA 5.1	40	460	890	210	0	300	1,000
PSA 5.2	80	1,400	1,300	220	30	720	4,200
PSA 5.3	10	890	1,300	40	10	80	570

	ACTIVITIES				
	Winter Activities			Water Surface	Total Area
	Skiing	Sledding	Ice Skating	Boating	
Lake Ontario basin	20	0	30	378,000	391,800
PSA 5.1	20	0	30	48,000	50,950
PSA 5.2	0	0	0	221,000	228,950
PSA 5.3	0	0	0	109,000	111,900

To Convert From	To	Multiply By
Acres (acre)	Hectares (ha)	0.405

PLANNING SUBAREA 5.1

Disposal Operations

Liquid Waste Disposal

There are no reported liquid waste disposal operations in Planning Subarea 5.1. Sites may be developed in the future, however, if there is population or industrial growth. Soils within the basin are generally permeable except in the southern portion.

Solid Waste Disposal

In Planning Subarea 5.1, there are approximately 86 solid waste disposal operations. Detailed information concerning the type of solid waste disposal was not available. The largest number of disposal sites are located in Monroe County.

Table 49

SOLID WASTE DISPOSAL SITES BY COUNTY, 1973[1c]

	Total	Sanitary Landfill	Modified Landfill	Open Dump	Construction Debris	Acreage	Population Served
PSA 5.1							
New York							
Allegany	13						
Genesee	8						
Livingston	17						
Monroe	33						
Orleans	6						
Wyoming	9						
TOTAL	86						

To Convert From	To	Multiply By
Acres (acre)	Hectares (ha)	0.405

Dredge Spoil Disposal

On an average annual basis, there is one site that is dredged in Planning Subarea 5.1. Rochester Harbor is the location disposing an average of 204,010 cubic meters, (267,029 cubic yards) of spoil annually, and it was estimated that all of this is polluted.

As of July, 1974, there were no confined disposal sites to dispose of polluted dredge spoil on Lake Ontario projects. Rochester has selected a site, but construction is not planned until 1976.

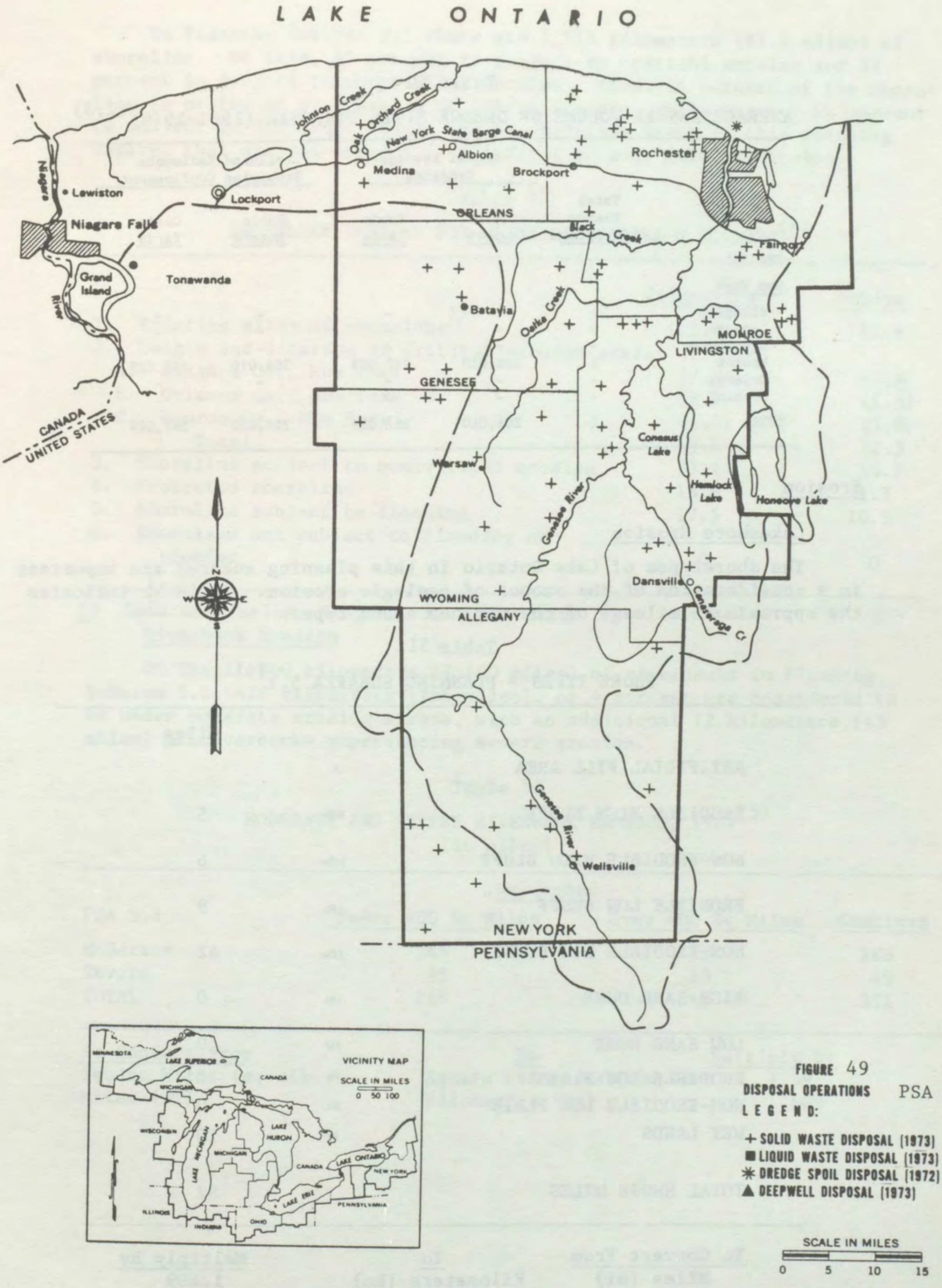


FIGURE 49
DISPOSAL OPERATIONS

PSA 5.1

Table 50

AVERAGE ANNUAL VOLUME OF DREDGE SPOIL DISPOSAL (1961-1970)[2,3]

	Total Number Of Sites	Annual Average Dredging: Cubic Meters	Annual Average Dredging: Cubic Yards	Polluted Sediments Requiring Confinement: Cubic Meters	Polluted Sediments Requiring Confinement: Cubic Yards
PSA 5.1					
New York					
Allegany	-	-	-	-	-
Genesee	-	-	-	-	-
Livingston	-	-	-	-	-
Monroe	1	204,010	267,029	204,010	267,029
Orleans	-	-	-	-	-
Wyoming	-	-	-	-	-
TOTAL	1	204,010	267,029	204,010	267,029

Erosion

Lakeshore Erosion

The shoretypes of Lake Ontario in this planning subarea are important in a consideration of the amount of geologic erosion. Table 51 indicates the approximate mileage of the various shore types.

Table 51

SHORE TYPES - PLANNING SUBAREA 5.1[4]

		Miles
ARTIFICIAL FILL AREA	A	
ERODIBLE HIGH BLUFF	HBE	5
NON-ERODIBLE HIGH BLUFF	HBN	6
ERODIBLE LOW BLUFF	LBE	9
NON-ERODIBLE LOW BLUFF	LBN	42
HIGH SAND DUNE	HD	0
LOW SAND DUNE	LD	0
ERODIBLE LOW PLAIN	PE	0
NON-ERODIBLE LOW PLAIN	PN	0
WET LANDS	W	10
TOTAL SHORE MILES		82

To Convert From	To	Multiply By
Miles (mi)	Kilometers (km)	1.609

In Planning Subarea 5.1 there are 1,313 kilometers (81.6 miles) of shoreline. Of this, 15 percent is subject to critical erosion and 57 percent is subject to noncritical erosion. About 14 percent of the shoreline is protected by seawalls or diking systems, while another 14 percent is subject to flooding. There are no shoreline areas in this planning subarea that are not subject to flooding, or some form of erosion.

Table 52

SHORELINE EROSION FOR PLANNING SUBAREA 5.1, 1970(4)

	Kilometers	Miles
1. Existing miles of shoreline 1/	131.3	81.6
2. Length and location of critical erosion areas		
A. Niagara Co., New York	(7.9)	(4.9)
B. Orleans Co., New York	(2.4)	(1.5)
C. Monroe Co., New York	(4.5)	(5.9)
Total	19.8	12.3
3. Shoreline subject to noncritical erosion	75.1	46.7
4. Protected shoreline	18.8	11.7
5. Shoreline subject to flooding	17.5	10.9
6. Shoreline not subject to flooding or erosion	0	0

1/ Does not include Niagara River shoreline

Riverbank Erosion

Of the 11,900 kilometers (7,400 miles) of riverbanks in Planning Subarea 5.1, 428 kilometers (266 miles), or 4 percent are considered to be under moderate erosion stress, with an additional 72 kilometers (45 miles) of riverbanks experiencing severe erosion.

Table 53

MODERATE AND SEVERE RIVERBANK EROSION, 1969(5)
(in miles)

	Watershed		
PSA 5.1	Under 400 Sq Miles	Over 400 Sq Miles	Combined
Moderate	244	22	266
Severe	25	20	45
TOTAL	269	42	311

To Convert From	To	Multiply By
Square Miles (sq mi)	Square Kilometers (sq km)	2.59
Miles (mi)	Kilometers (km)	1.609

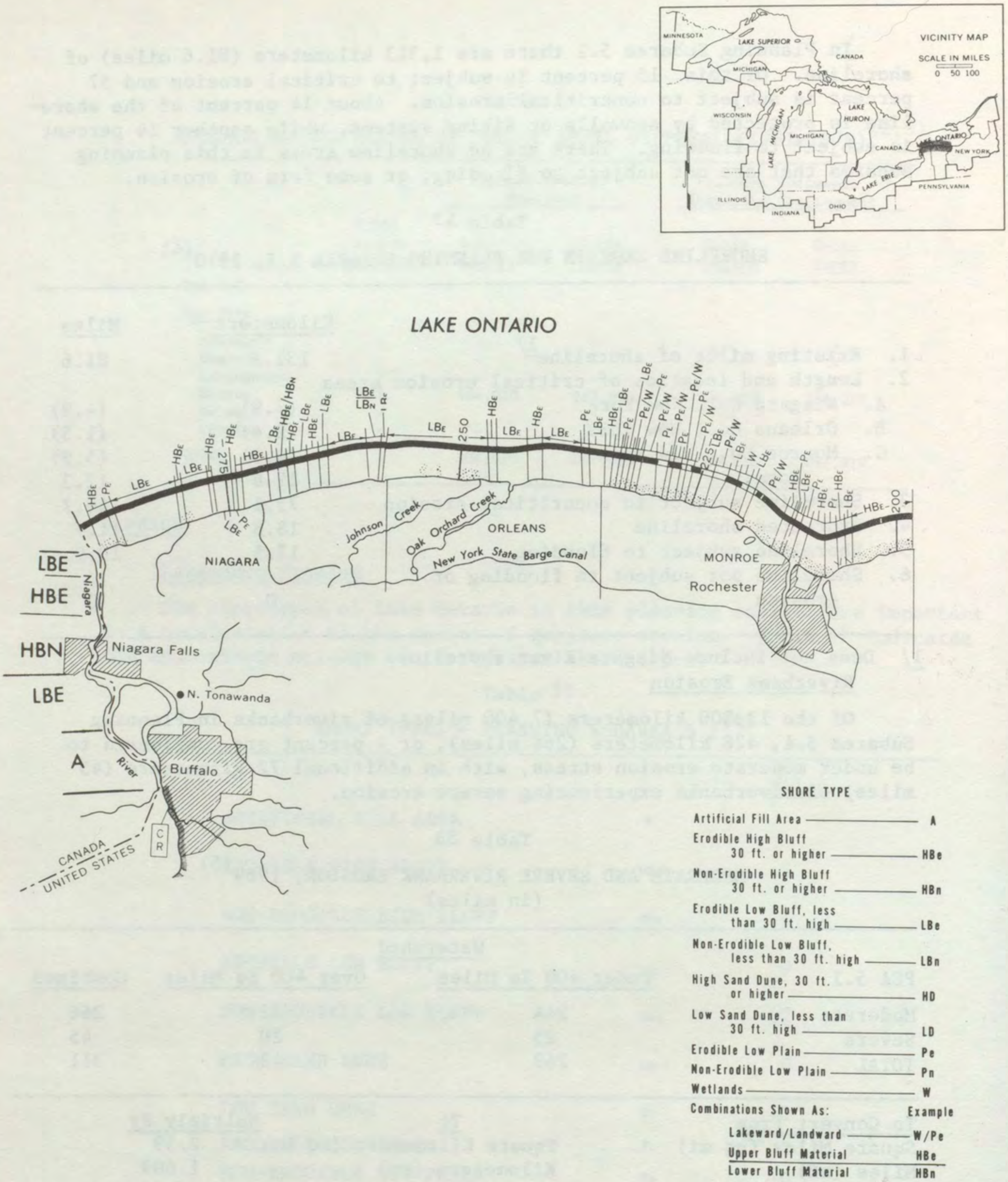


Figure 50

PSA 5.1 SHORE TYPE (4)

Intensive Livestock Operations

There are approximately 507 intensive livestock operations in Planning Subarea 5.1. The majority of these are cattle feedlots, which number 465 and total about 74,470 head of cattle. An estimate has been made as to the amount of animal waste produced in terms of wet pounds per day from these operations. The conversion coefficients were based on Dr. Loehr's findings.[1a] In converting the number of animals in to pounds of waste per day, poultry produces 63,023 kilograms (138,818 wet pounds) per day, swine produces 29,030 kilograms (63,950 wet pounds) per day, and cattle 1,690,500 kilograms (3,723,500 wet pounds) per day.

Table 54

INTENSIVE LIVESTOCK OPERATIONS BY COUNTY, 1969

	Estimated Livestock Total[6]						Estimated Animal Waste Wet Lbs/Day		
	Poultry		Cattle		Swine				
PSA 5.1	Farms	Number	Farms	Number	Farms	Number	Poultry	Cattle	Swine
New York									
Allegany	5	101,300	63	8,585	2	400	31,403	429,250	4,000
Genesee	6	115,000	89	15,050	1	200	35,650	752,500	2,000
Livingston	3	85,000	98	16,001	7	3,098	26,350	800,050	30,980
Monroe	2	20,000	41	7,769	3	600	6,200	388,450	6,000
Orleans	4	74,000	57	8,900	5	2,097	22,940	445,000	20,970
Wyoming	4	52,500	117	18,165	-	---	16,275	908,250	---
TOTAL	24	447,800	465	74,470	18	6,395	138,818	3,723,500	63,950

To Convert From	To	Multiply By
Pounds (lb)	Kilograms (kg)	0.454

High Density, Nonsewered Residential Areas

Nonsewered residential housing excluding farms formed 23 percent of the total housing units in Planning Subarea 5.1. Out of a total housing stock of 300,979 units, 68,150 nonfarm residential units were not connected to the public sewer system. The majority of nonsewered residential units (79 percent) were in rural nonfarm areas.

Table 55

HIGH DENSITY, NONSEWERED RESIDENTIAL AREAS BY COUNTY, 1970[7]

		Nonsewered Households					
		Urban		Rural		Combined	
PSA 5.1	Total Housing Units	Number	Percent Of Total Housing Units	Number	Percent Of Total Housing Units	Number	Percent Of Total Housing Units
New York							
Allegany	14,951	0	0	9,766	65	9,766	65
Genesee	18,301	14	1	8,544	47	8,558	47
Livingston	16,113	238	5	7,781	48	8,019	50
Monroe	227,934	13,742	6	16,591	7	30,333	13
Orleans	12,151	174	1	5,549	46	5,723	47
Wyoming	11,529	253	2	5,498	48	5,751	50
TOTAL	300,979	14,421	5	53,729	18	68,150	23

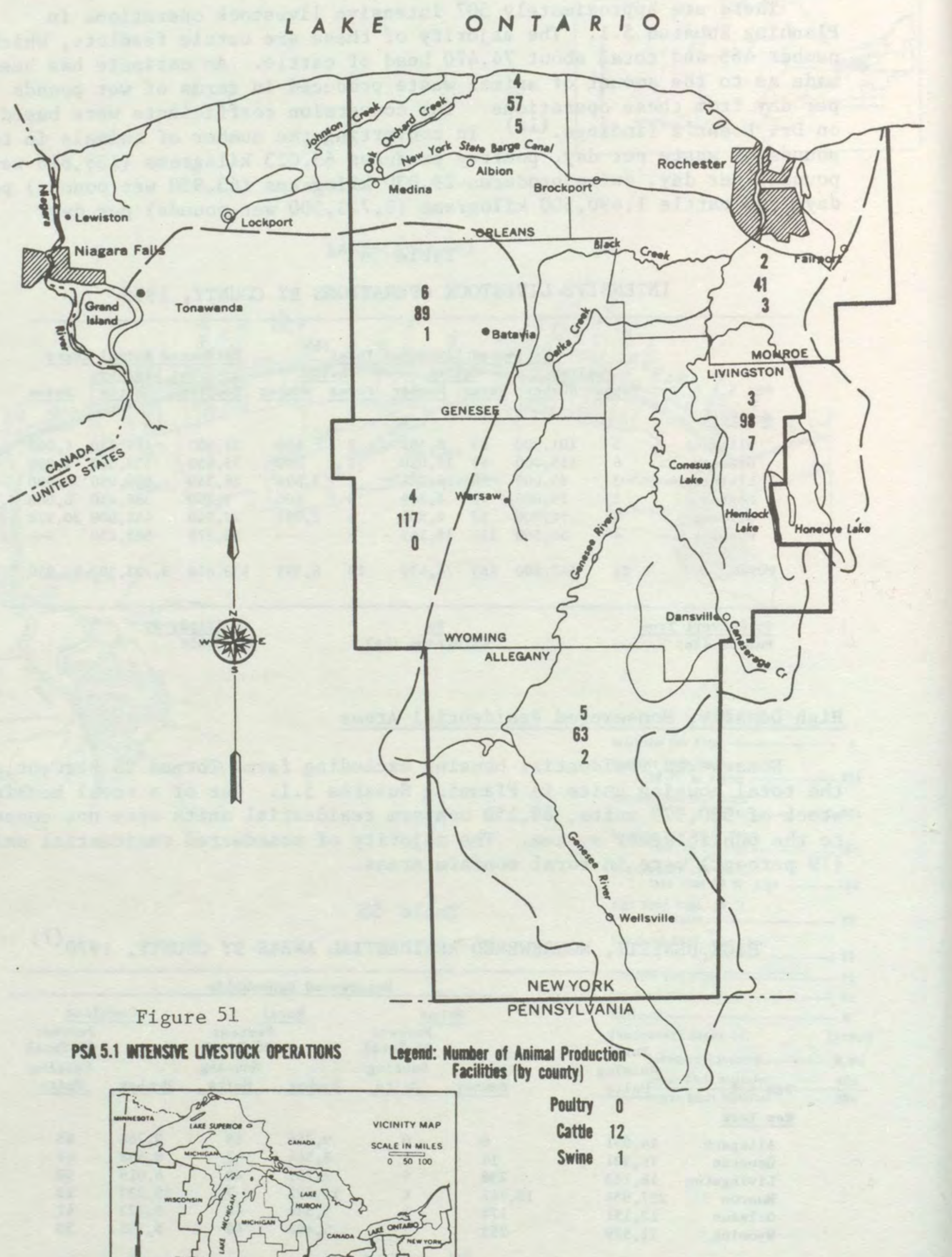


Figure 51

PSA 5.1 INTENSIVE LIVESTOCK OPERATIONS

5.1

Recreational Land

The land and water resources of Planning Subarea 5.1 offer a variety of features for recreation. The Genesee River is a major recreational attraction with the Genesee Gorge and in the inland lakes, while the Niagara-Orleans Complex contains the internationally famous Niagara Falls, included in Planning Subarea 4.4. Inland lakes and reservoirs provide recreational opportunities, as do the limited number of rivers and streams found in this planning subarea. A vast amount of land in the subarea is in agricultural use, contributing to the rural flavor, however, the growing Rochester metropolitan area, and the Buffalo-Niagara area to the west, exert pressure for urban recreational and day-use facilities.

Recreational areas are focused around the Lake Ontario shoreline and in the lower and central portions of the subarea near the Genesee Gorge and the inland lakes. Letchworth State Park, surrounding the Gorge, is one of the most popular parks in the New York State system with over 700,000 visitors each year. Activities popular throughout the region are swimming, boating, fishing, picnicking and camping. Forty-four camping areas provide a total of over 5,500 camping sites. Monroe County Parks focus primarily on the day-use needs of the Rochester area. Although the major source of pollutants to Lake Ontario is the Niagara River, there are no problems from recreational activities in Planning Subarea 5.1. Pleasure boats and domestic sewage, garbage and refuse, and inefficient motors in pleasure craft which cause the spewing of much of their gasoline on the water are all problems. Runoff from playfields and golf courses also has an effect on water quality in the lake. In the private sector, a wide range of facilities exist along the Lake Ontario shoreline and around the inland "Little Finger Lakes." Summer cottages, campgrounds and boating facilities are common. A major problem from these activities is inadequately treated sewage wastes. Private marinas may contribute to erosion and gasoline pollutant problems, in addition to sewage waste difficulties.

PLANNING SUBAREA 5.2

Disposal Operations

Liquid Waste Disposal

There is one liquid waste disposal operation in Planning Subarea 5.2. This is an industrial disposal site operated by the Borden Company in Seneca County, New York, with an average .64 million liters per day (0.07 million gallons per day) applied.[1b] Soils are generally permeable through the center of the area; however, climate could be a limiting factor in future liquid waste disposal sites development.

Solid Waste Disposal

One hundred and twenty-one solid waste disposal sites are located in Planning Subarea 5.2. All counties, except Madison, Schuyler, Tompkins and Yates have over 10 disposal sites each. Data concerning the precise physical location of the disposal sites, and the type of operation was not able to be obtained.

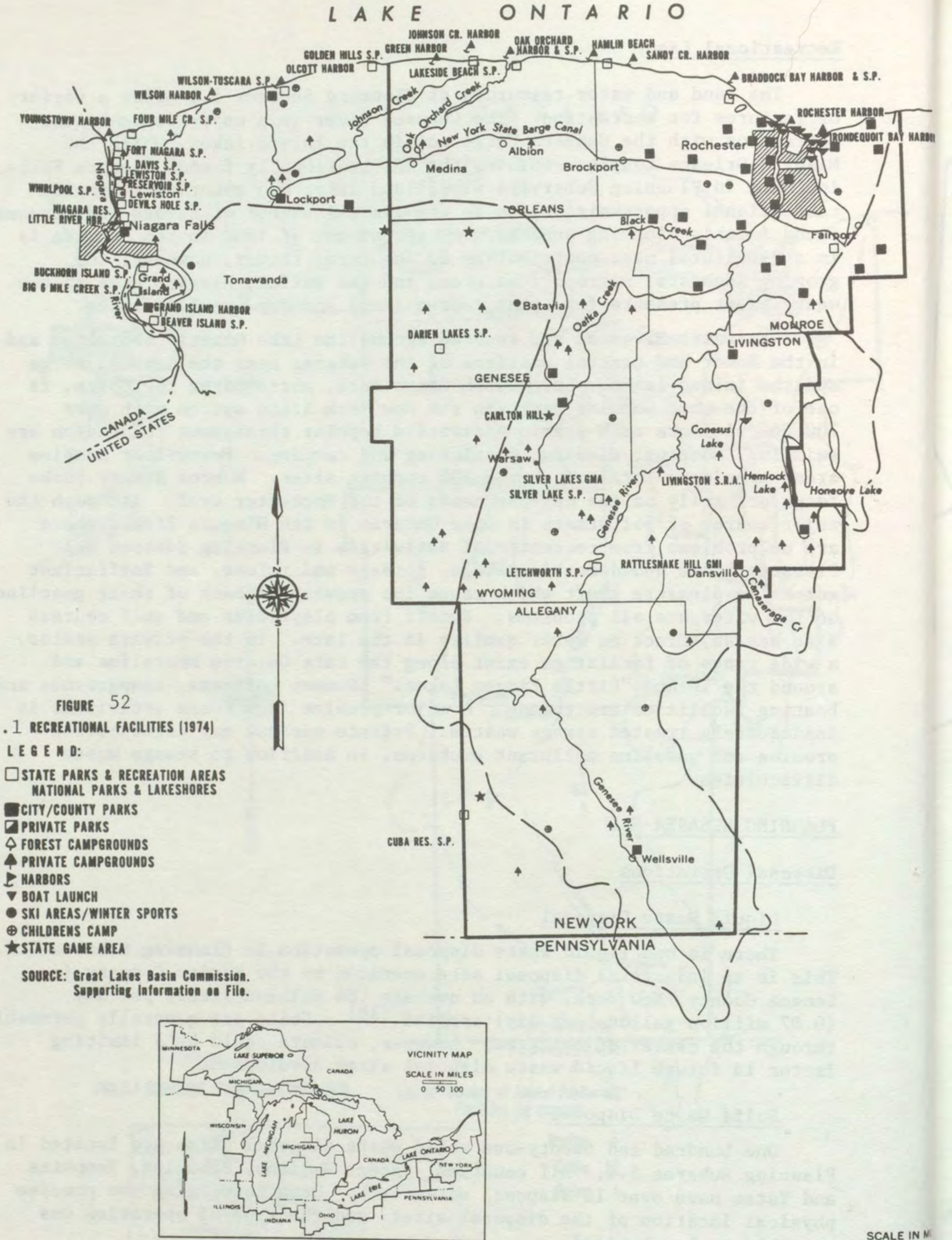


FIGURE 52

PSA 5.1 RECREATIONAL FACILITIES (1974)

Table 56

SOLID WASTE DISPOSAL SITES BY COUNTY, 1973[1c]

	Total	Sanitary Landfill	Modified Landfill	Open Dump	Construction Debris	Acreage	Population Served
PSA 5.2							
New York							
Cayuga	11						
Herkimer	12						
Madison	-						
Oneida	17						
Onondaga	20						
Ontario	17						
Oswego	12						
Schuyler	4						
Seneca	12						
Tompkins	1						
Wayne	15						
Yates	-						
TOTAL	121						

Dredge Spoil Disposal

Three sites are dredged in Planning Subarea 5.2. As of July 1974 there were no confined disposal sites being used in this Planning Subarea; however, Oswego had construction scheduled for such a site to begin in 1975. Oswego has been designated as a polluted harbor with all of its 41,777 cubic meters (54,683 cubic yards) of dredge spoil being polluted.

Table 57

AVERAGE ANNUAL VOLUME OF DREDGE SPOIL DISPOSAL (1961-1970)[2,3]

		Annual Average Dredging		Polluted Sediments Requiring Confinement	
	Total Number Of Sites	Cubic Meters	Cubic Yards	Cubic Meters	Cubic Yards
PSA 5.2					
New York					
Cayuga	-	-	-	-	-
Herkimer	-	-	-	-	-
Madison	-	-	-	-	-
Oneida	-	-	-	-	-
Onondaga	-	-	-	-	-
Ontario	-	-	-	-	-
Oswego	1	41,777	54,683	41,777	54,683
Schuyler	-	-	-	-	-
Seneca	-	-	-	-	-
Tompkins	-	-	-	-	-
Wayne	2	29,672	38,838	9,077	11,882
Yates	-	-	-	-	-
TOTAL	3	71,449	93,521	50,854	66,565

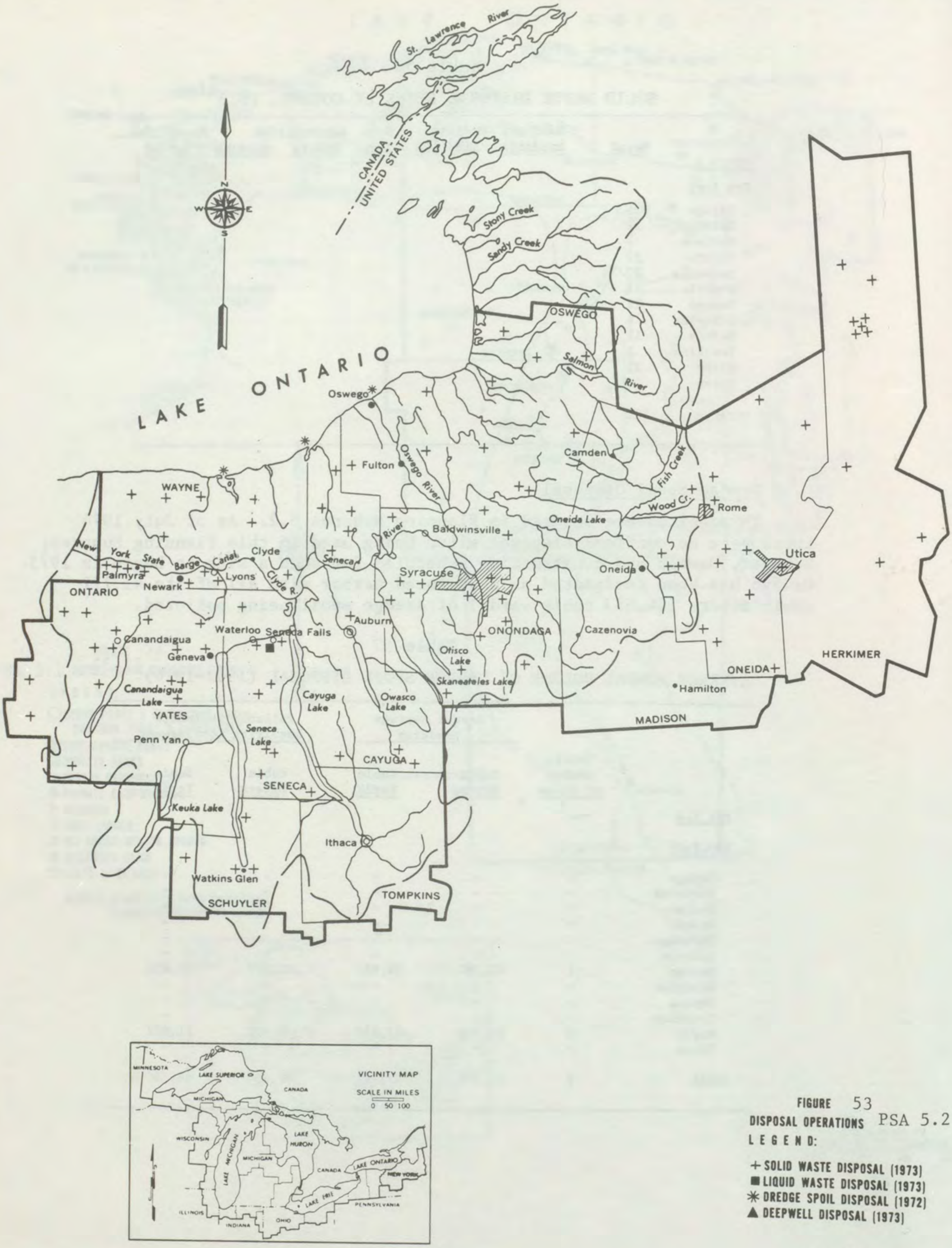
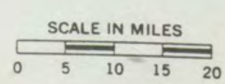


FIGURE 53
DISPOSAL OPERATIONS PSA 5.2

LEGEND:

+ SOLID WASTE DISPOSAL (1973)
■ LIQUID WASTE DISPOSAL (1973)
✳ DREDGE SPOIL DISPOSAL (1972)
▲ DEEPWELL DISPOSAL (1973)



Erosion

Lakeshore Erosion

The shoretypes of Lake Ontario in this planning subarea are important in a consideration of the amount of geologic erosion. Table 58 indicates the approximate mileage of the various shore types.

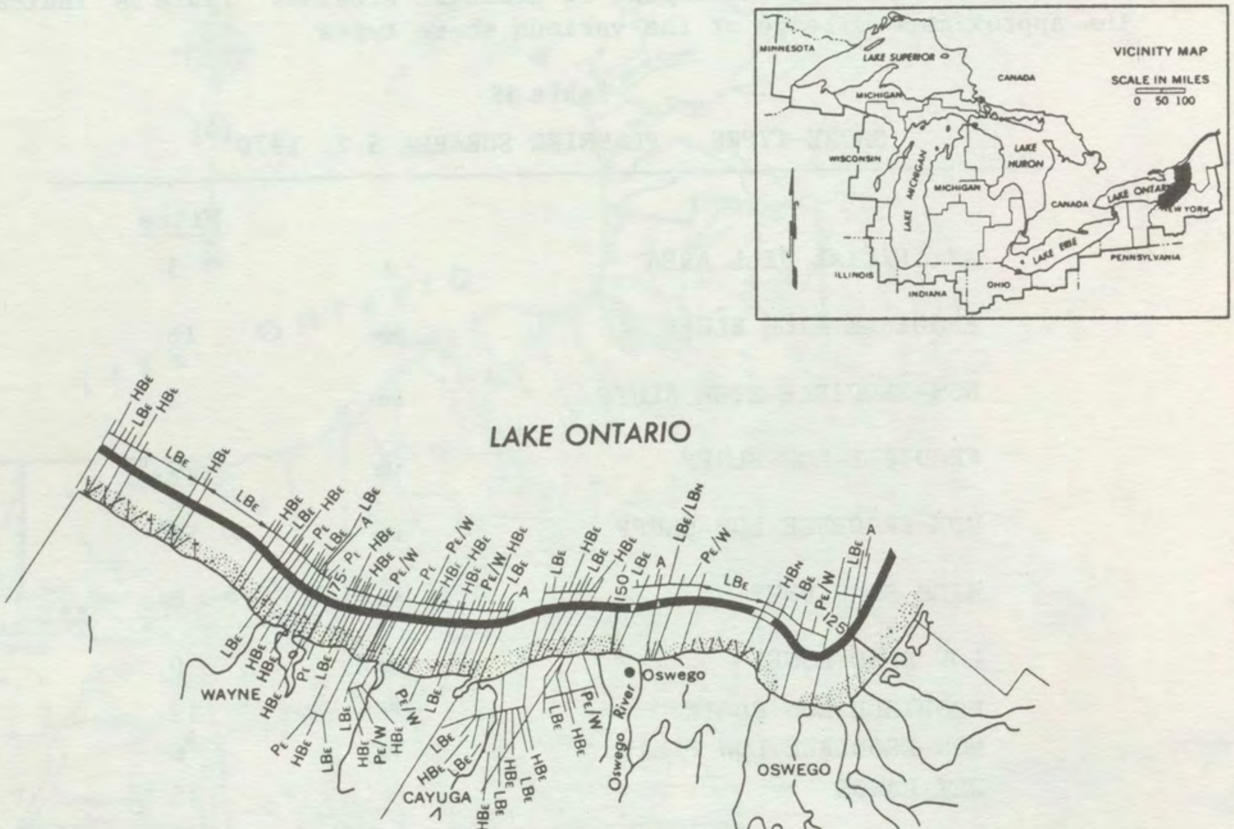
Table 58

SHORE TYPES - PLANNING SUBAREA 5.2, 1970 (4)

		Miles
ARTIFICIAL FILL AREA	A	3
ERODIBLE HIGH BLUFF	HB_E	16
NON-ERODIBLE HIGH BLUFF	HB_N	2
ERODIBLE LOW BLUFF	LB_E	29.5
NON-ERODIBLE LOW BLUFF	LB_N	54
HIGH SAND DUNE	HD	0
LOW SAND DUNE	LD	0
ERODIBLE LOW PLAIN	P_E	12
NON-ERODIBLE LOW PLAIN	P_N	0
WET LANDS	W	15
TOTAL SHORE MILES		132.5

To Convert From	To	Multiply By
Miles (mi)	Kilometers (km)	1.609

In Planning Subarea 5.2 there are 213.1 kilometers (132.5 miles) of shoreline. Economic erosion loss encompassed 67 percent of this area, or a total of 142.5 kilometers (88.6 miles) which is subject to either critical or noncritical erosion. Twenty-six percent of the shoreline in this area is not subject to flooding or erosion.



SHORE TYPE

Artificial Fill Area	A
Erodible High Bluff 30 ft. or higher	HBe
Non-Erodible High Bluff 30 ft. or higher	HBn
Erodible Low Bluff, less than 30 ft. high	LBe
Non-Erodible Low Bluff, less than 30 ft. high	LBn
High Sand Dune, 30 ft. or higher	HD
Low Sand Dune, less than 30 ft. high	LD
Erodible Low Plain	Pe
Non-Erodible Low Plain	Pn
Wetlands	W
Combinations Shown As:	Example
Lakeward/Landward	W/Pe
Upper Bluff Material / Lower Bluff Material	HBe / HBn

Figure 54

PSA 5.2 SHORE TYPE (4)

Table 59

SHORELINE EROSION FOR PLANNING SUBAREA 5.2, 1970[4]

	Kilometers	Miles
1. Existing miles of shoreline	213.1	132.5
2. Length and location of critical erosion areas		
A. Wayne Co., New York	(3.2)	(2.0)
B. Cayuga Co., New York	(2.2)	(1.4)
C. Oswego Co., New York	(1.7)	(1.1)
Total	7.2	4.5
3. Shoreline subject to noncritical erosion	135.3	84.1
4. Protected shoreline	15.1	9.4
5. Shoreline subject to flooding	0	0
6. Shoreline not subject to flooding or erosion	55.5	34.5

Riverbank Erosion

Of the 25,070 kilometers (15,580 miles) of riverbanks in Planning Subarea 5.2, about 5 percent, or 1,255 kilometers (780 miles) is subject to either moderate or severe erosion. Eighty-six percent of the erosion is moderate, while the remaining 14 percent is severe.

Table 60

MODERATE AND SEVERE RIVERBANK EROSION, 1969[5]
(in miles)

	Watershed		
PSA 5.2	Under 400 sq miles	Over 400 sq miles	Combined
Moderate	674	0	674
Severe	67	42	109
TOTAL	741	42	783

To Convert From	To	Multiply By
Square Miles (sq mi)	Square Kilometers (sq km)	2.59
Miles (mi)	Kilometers (km)	1.609

Intensive Livestock Operations

In Planning Subarea 5.2 there are approximately 905 intensive livestock operations. The majority of these are cattle feedlots, which number 816 and contain 117,259 head of cattle. The amount of animal waste produced in terms of wet pounds per day using Dr. Loehr's conversion coefficients totals 2,661,800 kilograms (5,862,950 wet pounds) per day for the cattle operations in Planning Subarea 5.2.[1a] Poultry produces 260,500 kilograms (573,789 wet pounds) per day while swine operations in Planning Subarea 5.2 produce 33,170 kilograms (73,060 wet pounds) per day.

Figure 55

PSA 5.2 INTENSIVE LIVESTOCK OPERATIONS

Legend: Number of Animal Production Facilities (by county)

Poultry 0
Cattle 12
Swine 1

SCALE IN MILES
5 10 15 20

Table 61

INTENSIVE LIVESTOCK OPERATIONS BY COUNTY, 1969

	Estimated Livestock Total (6)						Estimated Animal Waste Wet Lbs/Day		
	Poultry		Cattle		Swine				
PSA 5.2	**Farms**	**Number**	**Farms**	**Number**	**Farms**	**Number**	**Poultry**	**Cattle**	**Swine**
New York									
Cayuga	8	337,471	93	13,827	4	1,650	104,616	691,350	16,500
Herkimer	-	-	74	10,095	-	-	-	504,750	-
Madison	5	50,000	145	19,994	-	-	15,500	999,700	-
Oneida	3	125,256	149	20,836	1	200	38,829	1,041,800	2,000
Onondaga	8	133,550	89	13,761	1	224	41,400	688,050	2,240
Ontario	10	287,520	79	11,545	4	800	89,131	577,250	8,000
Oswego	2	20,000	38	5,168	1	200	6,200	258,400	2,000
Schuyler	4	91,500	17	4,109	-	-	28,365	205,450	-
Seneca	5	88,668	24	2,714	4	1,331	27,487	135,700	13,310
Tompkins	5	206,826	52	7,792	-	-	64,116	389,600	-
Wayne	9	360,329	36	5,418	1	200	111,701	270,900	2,000
Yates	6	149,822	20	2,000	8	2,701	46,444	100,000	27,010
TOTAL	65	1,850,942	816	117,259	24	7,306	573,789	5,862,950	73,060

To Convert From	To	Multiply By
Pounds (lb)	Kilograms (kg)	0.454

High Density, Nonsewered Residential Areas

Out of the total housing stock in Planning Subarea 5.2, 33 percent, or 143,597 residential units were classified as nonsewered. For the urban sector a total of 20,261 homes, or 5 percent of the total housing units in Planning Subarea 5.2, were nonsewered. Rural nonfarming housing units that were nonsewered totaled 123,336, or 29 percent of the total housing units. Fourteen percent of the nonsewered housing is located in urban areas while 86 percent is in rural areas.

Table 62

HIGH DENSITY, NONSEWERED RESIDENTIAL AREAS BY COUNTY, 1970 (7)

		NONSEWERED HOUSEHOLDS					
		Urban		Rural Nonfarm		Combined	
PSA 5.2	Total Housing Units	Number	Percent of Total Housing Units	Number	Percent of Total Housing Units	Number	Percent of Total Housing Units
New York							
Cayuga	24,553	185	<.01	8,855	.36	9,040	.37
Herkimer	23,190	162	<.01	7,744	.33	7,906	.34
Madison	18,908	901	.05	8,620	.46	9.521	.50
Oneida	86,293	7,669	.09	18,802	.22	26,471	.31
Ontario	24,781	77	<.01	10,774	.43	10,821	.44
Onondaga	151,952	9,575	.06	19,188	.13	28,763	.19
Oswego	30,947	592	.02	15,023	.49	10,821	.44
Schuyler	5,500	22	<.01	3,378	.61	3,400	.62
Tompkins	23,744	141	<.01	9,237	.39	9,378	.40
Wayne	24,463	693	.03	13,780	.56	14,473	.59
Yates	6,716	20	<.01	3,329	.50	3,349	.50
TOTAL	431,595	20,261	.05	123,336	.29	143,597	.33

Recreational Lands

Planning Subarea 5.2 ranks high among the vacation destination areas of New York State because of its numerous recreational resources. The Lake Ontario shoreline, marshlands, lakes, glens and cascades provide opportunity for a variety of recreational activities. Inland lakes, particularly in the western part of the Planning Subarea are large and well suited for recreational boating, while smaller lakes in the north-eastern corner are more inaccessible and are suitable for canoeing. Although much of the subarea is rural in nature, the cities of Syracuse, Utica, Rome and Auburn, as well as Rochester to the west, provide pressure for day-use and urban facilities.

The Finger Lakes area has been the destination of vacationists for many years, and provides a major focus for recreational activities. Total usage of the state parks in Planning Subarea 5.2 is more evenly divided among the parks than in 5.1. This means that population pressure and accompanying increase in water quality influences will be more evenly spread among the state parks in Planning Subarea 5.2. There are also vast tracts of state forests and game areas, and the federal Hector Land Use Area available for hunting and other less intensive land use. Within wilderness areas, developed plots for camping, boating, and picnicking, etc., are generally small. It is at these plots that most of the water quality influences would occur, primarily from sewage and erosion. Onondaga County, encompassing the city of Syracuse, has a well developed county park system with a variety of day use facilities for the urban population. There is a variety of private recreational enterprises in the subarea, due to its position as one of the foremost vacation destinations in New York State. Private summer homes and camps dot the shorelines, and make use of swimming beaches. Boat access sites are also found throughout the area, particularly in the western sector, with problems of accelerated erosion, gasoline spill and waste, sewage, and litter. The eastern sector of the subarea is more suited for canoeing and may have problems from bank erosion at portage points. The Lake Ontario shoreline, although lacking natural shelter, has received its share of development, with marinas, swimming beaches, summer cottages, camps and campgrounds.

FIGURE 56

PSA 5.2 RECREATIONAL FACILITIES (1974)

LEGEND:

- STATE PARKS & RECREATION AREAS NATIONAL PARKS & LAKESHORES
- CITY/COUNTY PARKS
- PRIVATE PARKS
- FOREST CAMPGROUNDS
- PRIVATE CAMPGROUNDS
- HARBORS
- BOAT LAUNCH
- SKI AREAS/WINTER SPORTS
- CHILDRENS CAMP
- STATE GAME AREA

SOURCE: Great Lakes Basin Commission. Supporting Information on File.

SCALE IN MILES
0 5 10 15 20

PLANNING SUBAREA 5.3

Disposal Operations

Liquid Waste Disposal

Currently, there are no liquid waste disposal sites in Planning Subarea 5.3. Boulders and stony materials close to the surface in much of the area make it unsuitable for future development of liquid waste disposal sites.

Solid Waste Disposal

Planning Subarea 5.3 has far fewer solid waste disposal sites than other planning subareas in the Lake Ontario basin. Twenty-four disposal sites are located in these predominantly rural counties. Precise information about the type of operation was unavailable.

Table 63

SOLID WASTE DISPOSAL SITES BY COUNTY(1c)

PSA 5.3	Total	Sanitary Landfill	Modified Landfill	Open Dump	Construction Debris	Acreage	Population Served
New York							
Jefferson	13						
Lewis	11						
St. Lawrence	-						
TOTAL	24						

Dredge Spoil Disposal

Planning Subarea 5.3 has no dredge spoil disposal sites at the present time.

Erosion

Lakeshore Erosion

The shoretypes of Lake Ontario in this planning subarea are important in a consideration of the amount of geologic erosion. Table 64 indicates the approximate mileage of the various shore types.

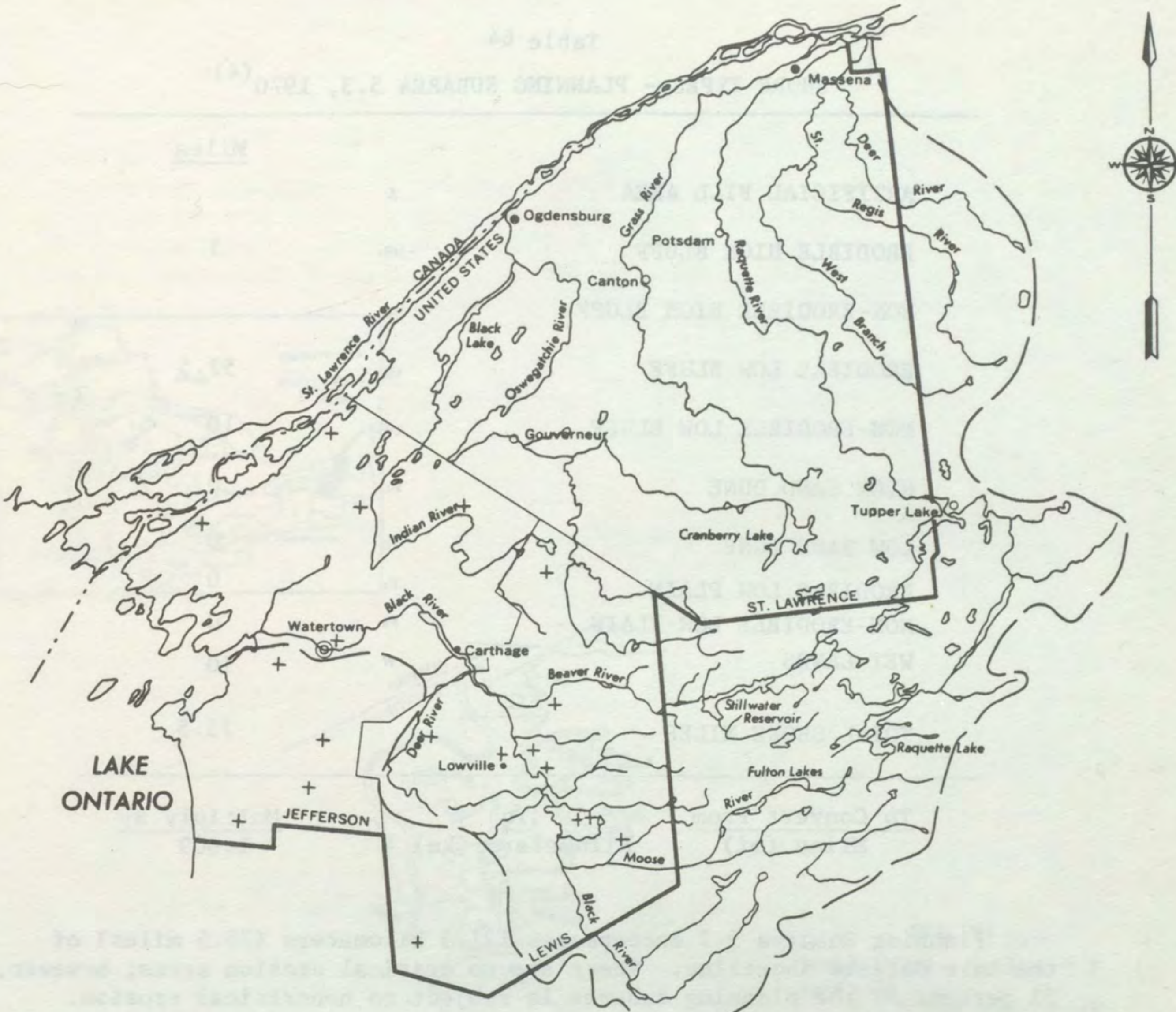


FIGURE 57
DISPOSAL OPERATIONS PSA 5.3
LEGEND:

- + SOLID WASTE DISPOSAL (1973)
- ■ LIQUID WASTE DISPOSAL (1973)
- ✳ DREDGE SPOIL DISPOSAL (1972)
- ▲ DEEPWELL DISPOSAL (1973)

5.3

Table 64

SHORE TYPES - PLANNING SUBAREA 5.3, 1970[4]

		Miles
ARTIFICIAL FILL AREA	A	
ERODIBLE HIGH BLUFF	HBE	3
NON-ERODIBLE HIGH BLUFF	HBN	
ERODIBLE LOW BLUFF	LBE	52.5
NON-ERODIBLE LOW BLUFF	LBN	10
HIGH SAND DUNE	HD	0
LOW SAND DUNE	LD	0
ERODIBLE LOW PLAIN	PE	0
NON-ERODIBLE LOW PLAIN	PN	0
WET LANDS	W	10
TOTAL SHORE MILES		75.5

To Convert From	To	Multiply By
Miles (mi)	Kilometers (km)	1.609

Planning Subarea 5.3 encompasses 121.5 kilometers (75.5 miles) of the Lake Ontario shoreline. There are no critical erosion areas; however, 51 percent of the planning subarea is subject to noncritical erosion. Thirty-four percent of the area is not subject to any form of flooding or erosion.

Table 65

SHORELINE EROSION FOR PLANNING SUBAREA 5.3, 1970[4]

	Kilometers	Miles
1. Existing miles of shoreline	121.5	75.5
2. Length and location of critical erosion areas	0	0
3. Shoreline subject to noncritical erosion	61.5	38.2
4. Protected shoreline	7.2	4.5
5. Shoreline subject to flooding	12.1	7.5
6. Shoreline not subject to flooding or erosion	40.7	25.3

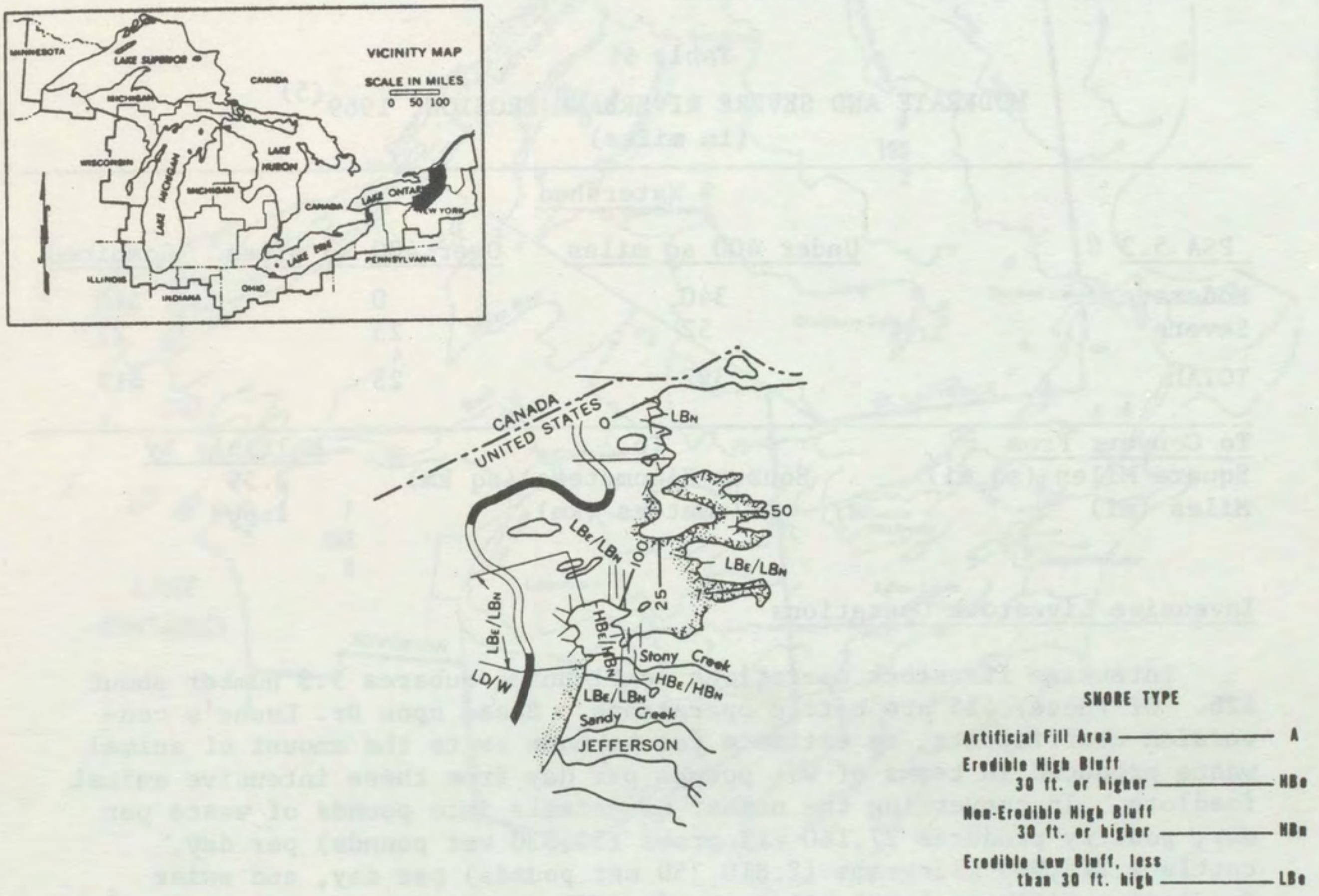


Figure 58

PSA 5.3 SHORE TYPE (4)

Riverbank Erosion

Approximately 670 kilometers (417 miles) of riverbanks in Planning Subarea 5.3 are subject to some form of erosion. This amounts to 3 percent of the total bank miles in this area. Moderate erosion affects 82 percent of the eroded riverbanks, while 18 percent of the eroded riverbanks are undergoing severe erosion.

Table 66

MODERATE AND SEVERE RIVERBANK EROSION, 1969[5]
(in miles)

	Watershed		
PSA 5.3	Under 400 sq miles	Over 400 sq miles	Combined
Moderate	340	0	340
Severe	52	25	77
TOTAL	392	25	417

To Convert From	To	Multiply By
Square Miles (sq mi)	Square Kilometers (sq km)	2.59
Miles (mi)	Kilometers (km)	1.609

Invensive Livestock Operations

Intensive livestock operations in Planning Subarea 5.3 number about 426. Of these, 415 are cattle operations. Based upon Dr. Loehr's conversion coefficients, an estimate can be made as to the amount of animal waste produced in terms of wet pounds per day from these intensive animal feedlots. In converting the number of animals into pounds of waste per day, poultry produces 27,160 kilograms (59,830 wet pounds) per day, cattle 1,275,900 kilograms (2,810,350 wet pounds) per day, and swine feedlots contribute 1,800 kilograms (4,000 wet pounds) per day.

Table 67

INTENSIVE LIVESTOCK OPERATIONS BY COUNTY, 1969

	Estimated Livestock Total[6]						Estimated Animal Waste		
	Poultry		Cattle		Swine		Wet Lbs/Day		
PSA 5.3	No. Farms	Number	No. Farms	Number	No. Farms	Number	Poultry	Cattle	Swine
New York									
Jefferson	7	173,000	163	22,835	-	-	53,630	1,141,750	-
Lewis	2	20,000	87	10,521	-	-	6,200	526,050	-
St. Lawrence	-	-	165	22,851	2	400	-	1,142,550	4,000
TOTAL	9	193,000	415	56,207	2	400	59,830	2,810,350	4,000

To Convert From	To	Multiply By
Pounds (lb)	Kilograms (kg)	0.454

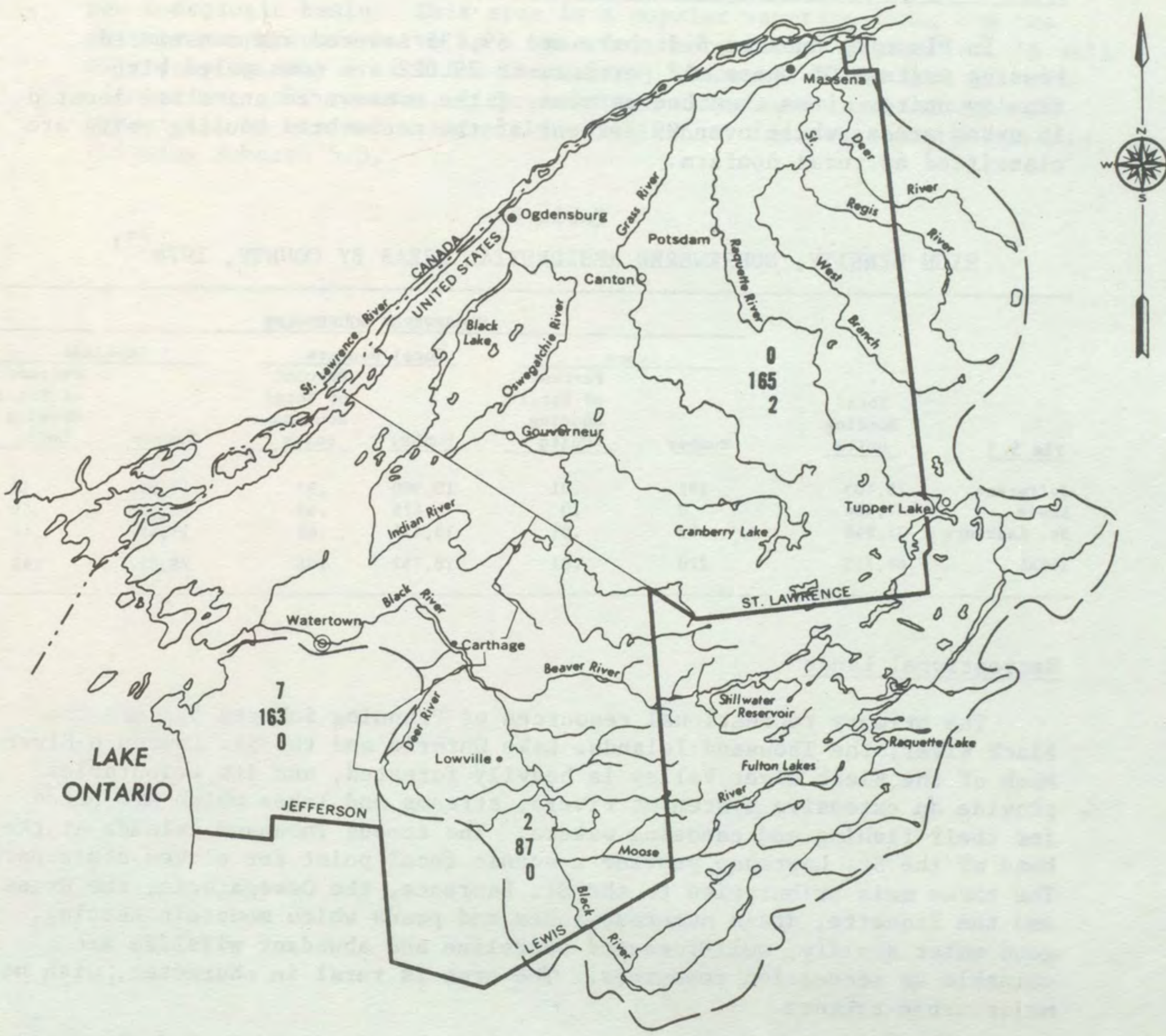
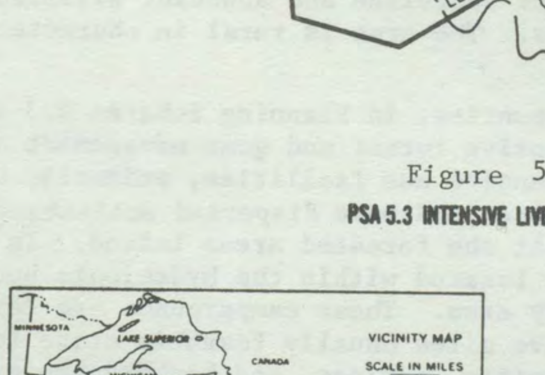


Figure 59

PSA 5.3 INTENSIVE LIVESTOCK OPERATIONS

Legend: Number of Animal Production Facilities (by county)

Poultry	0
Cattle	12
Swine	1



High Density, Nonsewered Residential Areas

In Planning Subarea 5.3 there are 69,735 sewered and nonsewered housing units. Of these, 42 percent, or 29,022 are nonsewered high density units. Less than one percent of the nonsewered units are located in urban areas, while over 99 percent of the nonsewered housing units are classified as rural nonfarm.

Table 68

HIGH DENSITY, NONSEWERED RESIDENTIAL AREAS BY COUNTY, 1970(7)

		NONSEWERED HOUSEHOLDS					
		Urban		Rural Nonfarm		Combined	
PSA 5.3	Total Housing Units	Number	Percent of Total Housing Units	Number	Percent of Total Housing Units	Number	Percent of Total Housing Units
Jefferson	29,405	197	.01	10,900	.37	11,097	.38
Lewis	7,484	0	.0	4,428	.59	4,428	.59
St. Lawrence	32,846	73	.01	13,424	.41	13,497	.41
TOTAL	69,735	270	.01	28,752	.41	29,022	.42

Recreational Lands

The primary recreational resources of Planning Subarea 5.3 are the Black River, the Thousand Islands, Lake Ontario and the St. Lawrence River. Much of the Black River Valley is heavily forested, and its tributaries provide an extensive system of rivers, streams and lakes which are noted for their fishing and canoeing waters. The famous Thousand Islands at the head of the St. Lawrence provide a scenic focal point for eleven state parks. The three main tributaries to the St. Lawrence, the Oswegathcie, the Grass and the Raquette, drain numerous lakes and ponds which mountain setting, good water quality, well-forested shoreline and abundant wildlife are valuable as recreation resources. The area is rural in character, with no major urban centers.

Although covering only 3 counties, in Planning Subarea 5.3 there are twenty-one state parks and extensive forest and game management areas. These provide a mix between intensive use facilities, primarily on the Lake Ontario or St. Lawrence shore, and more dispersed activities, such as hunting, canoeing and fishing, at the forested areas inland. In addition, numerous forest campgrounds are located within the hydrologic boundaries, although not within the 3-county area. These campgrounds are larger and more developed than the primitive sites usually found in state forests. Boating is popular and access points, marinas, and harbors are provided. The sheltered bays of Lake Ontario, the Thousand Islands region, and the St. Lawrence Seaway are heavily used for power boating, while inland streams are popular for canoeing. Water quality influences will differ--the bay, harbors, marinas, and the seaway may have problems from gasoline spillage and human waste, while canoeing may mean accelerated erosion at portage points inland. Private campgrounds are found throughout the area, particularly in Jefferson County and around Tupper Lake, which is part of the hydrologic basin. This area is a popular vacation land, and the private campgrounds serve as a base for recreational activities, as well as supplying many activities themselves. Because of the lack of urban population, golf courses, city parks and playgrounds are infrequent. There will be minimal water quality influences from these activities in Planning Subarea 5.3.

FIGURE 60

PSA 5.3 RECREATIONAL FACILITIES (1974)

LEGEND:

- ☐ STATE PARKS & RECREATION AREAS NATIONAL PARKS & LAKESHORES
- ■ CITY/COUNTY PARKS
- PRIVATE PARKS
- FOREST CAMPGROUNDS
- PRIVATE CAMPGROUNDS
- HARBORS
- ▼ BOAT LAUNCH
- ● SKI AREAS/WINTER SPORTS
- ⊕ CHILDRENS CAMP
- ★ STATE GAME AREA

SOURCE: Great Lakes Basin Commission. Supporting Information on File.

5.3

REFERENCES

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    a) A8-9 Loehr, Raymond C., Cornell University, Problems Associated with Animal Feedlots in the U.S. portion of the Great Lakes Basin

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    d) A16 Pettyjohn, W.A., et. al., Ohio State University, Water Resources Center. Deep-Well Industrial Waste Disposal

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3. U. S. Environmental Protection Agency, Office of Research and Monitoring. Future Dredging Quantities in the Great Lakes, Prepared by Dr. C. Nicholas Raphael, et. al., Eastern Michigan University, July 1974

4. Great Lakes Basin Commission. The Great Lakes Basin Framework Study, Appendix 12, "Shore Use and Erosion "

5. Great Lakes Basin Commission. The Great Lakes Basin Framework Study, Appendix 18, "Erosion and Sedimentation "

6. U. S. Bureau of the Census. Census of Agriculture, 1969. Volume 1 Area Reports.

7. U. S. Bureau of the Census. Census of Housing. 1970 Detailed Housing Characteristics. Final Report.

8. Great Lakes Basin Commission. The Great Lakes Basin Framework Study, Appendix 21, "Outdoor Recreation." Additional supporting information is on file.

MATERIALS USAGE

BASIN CHARACTERISTICS

This area encompasses 21 New York counties, 6 in the western part of the state (Planning Subarea 5.1), 12 in the central part (Planning Subarea 5.2), and 3 counties in the northern part (Planning Subarea 5.3).

Agricultural Characteristics

This Lake basin has several areas producing fruit and vegetable products. Other crops grown are corn, grains, and hay which primarily support the livestock. Dairying is the major livestock enterprise in all three subareas.

Table 69 indicates the relative proportions of materials usage in the Lake Ontario basin as compared to the total U.S. Great Lakes Basin.

Table 69

MATERIALS USAGE BASIN RELATIONSHIP -- LAKE ONATRIO 5.0 to GREAT LAKES

Per harvested acre of cropland	Lake Ontario basin	Great Lakes Basin
Lbs of chemicals applied	3.05	2.66
Index of chemicals applied	115	100
Tons livestock manure defecated	4.77	3.37
Index of manure defecated	142	100
Lbs primary nutrients in livestock manure	116	82
Index primary nutrients in manure	141	100
Lbs commercial fertilizer applied	309	321
Percent liquid fertilizer applied	7	22
Index commercial fertilizer applied	96	100
Lbs primary nutrients in commercial fertilizer	120	153
Index primary nutrients in commercial fertilizer	78	100
Lbs of lime applied	198	170
Index of lime applied	116	100
Per acre of total land area		
Lbs road salts used	59.77	41.74
Index road salts used	143	100

To Convert From	To	Multiply By
Pounds (lb)	Kilograms (kg)	0.454
Tons (ton)	Kilograms (kg)	907.2
	Metric Tons	0.907

Materials Usage

An inventory and analysis of materials usage was made based on personal interviews, correspondence and statistics as available from agricultural statistics, census information, state highway departments, universities, private companies, and state and federal agencies. Background for the analysis is presented in the Methodology Section. Table 70 summarizes the findings of this inventory and analysis. Detailed statistics are shown in Table 71.

Table 70

MATERIALS USAGE
(in 1972)

Area	Chemicals Applied to Crops (100 lbs)	Livestock Manure (tons)	Commercial Fertilizer on Cropland (tons)	Limestone Purchased or Applied (tons)	Salts Applied to All Highways (tons)
Lake Ontario basin	60,021	9,397,934	304,073	195,173	339,016
PSA 5.1	17,690	2,241,728	108,277	66,825	185,592
PSA 5.2	37,428	4,566,593	168,436	93,608	123,561
PSA 5.3	4,903	2,589,613	27,360	34,740	29,863

To Convert From	To	Multiply By
Pounds (lb)	Kilograms (kg)	0.454
Tons (ton)	Kilograms (kg)	907.2
	Metric Tons	0.907

Agricultural Chemicals

Chemical usage is modest in Planning Subarea 5.1, heavy in Planning Subarea 5.2 and light in Planning Subarea 5.3. The chemical usage combines to give a higher than average figure for the area. With the large acreages of fruit and vegetable crops produced, it is projected that there will be increased use of chemicals rather than a decrease or continuance at present levels. There are so many indefinite factors in the chemical field and so many new developments occurring that there are likely to be great changes. An increase in the use of chemicals perhaps as much as 15-20 percent is estimated. Many scientists feel that the likelihood for increased use of herbicides is the greatest, with fungicide use perhaps increasing modestly.

One of the problems concerning the use of chemicals, even if effective in performing their functional roles is that some residues will still remain in the soils. In the case of herbicides, this is known as "carryover" and in the case of insecticides as "persistence". It is believed that the persistence associated with insecticides will be almost entirely eliminated in the future and that carryover in herbicides will be greatly reduced, if not entirely eliminated.

GREAT LAKES BASIN MATERIAL USAGE INVENTORY

Agricultural Chemicals, Manures, Fertilizers, Lime and Highway De-Icing Compounds

PLANNING AREA: Lake Ontario 5.0 STATE: New York

PLANNING SUBAREA: West 5.1, Central 5.2, East 5.3 COUNTY: 21 County Totals (New York-21)

TABLE 1--ESTIMATED AMOUNTS OF CHEMICALS USED ON CROPS, 1972

Crop Group or Crops	Herbicides		Insecticides		Fungicides	
	Acres Treated	Amount Used 100 lbs	Acres Treated	Amount Used 100 lbs	Acres Treated	Amount Used 100 lbs
Corn	458640	12612.0	101920	1528.8		
Grains	190725	952.9	63576	634.9		
Hay or Grass Silage	298334	2982.2	248613	2485.3		
Pastured Cropland	166499	1663.9	166499	1663.9		
Other Field Crops	16446	449.9	13735	1550.9	13464	2019.8
Vegetables	73321	2470.1	73321	2814.0	73321	3265.0
Orchards						
Berries	42078	2007.1	48921	8820.4	50037	12100.2
Nursery, Greenhouse						
Other Crops						
Totals	1246043	23138.1	716585	19498.2	136822	17385.0
Total Herbicides, Insecticides, Fungicides: 100 lbs					2099450	60021.3

TABLE 2--MANURE FROM SWINE

Year	Hog & Pig Inventory Dec. 1	Number Sows Farrowing: Dec. 1-May 31 Spring	June 1-Nov. 30 Fall	Total
1964	46736	4347	4214	8561
1969	46856	4159	4168	8327
1972	45036	4238	3766	8004

Wet Manure Factor: Tons per litter farrowed 7.23

Wet Manure Defecated: Tons, 1972 57869

Nutrients in Wet Manure: Nitrogen, tons 289

Phosphorus, tons 81

Potash, tons 220

TABLE 3--MANURE FROM CATTLE

Year	Total	Number Cattle and Calves: Cows & Heifers Calved	Heifers, Steers, Bulls, Calves
1964	897645	537901	359744
1969	785825	449034	336791
1972	795981	462507	333474
Wet Manure Factor: Tons Per Animal		13.14	6.45
Wet Manure Defecated: Tons, 1972		6077342	2150907

Wet Manure Defecated: Tons, 1972 Combined: 8228249

Nutrients in Wet Manure: Nitrogen, tons 46078

Phosphorus, tons 8228

Potash, tons 41141

TABLE 4--MANURE FROM SHEEP AND HORSES

Year	Item	Sheep & Lambs	Horses & Ponies
1964		79096	
1969		63592	19962
1972		60434	68523
Wet Manure Factor: Tons per animal		1.61	12.78
Wet Manure Defecated: Tons, 1972		97299	875724
Nutrients in Wet Manure: Nitrogen, Tons		1362	6042
Phosphorus, Tons		204	876
Potash, Tons		973	5254

TABLE 5--MANURE FROM CHICKENS & TURKEYS

Year	Item	Chickens	Turkey Hens	Turkeys Raised
1964		3314405		
1969		3463154		
1972		3152725	12910	129100
Wet Manure Factor: Lbs. per bird		82.9	365	89.63
Wet Manure Defecated: Tons, 1972		130680	Combined	8113
Nutrients in Wet Manure: Nitrogen, tons		2039		127
Phosphorus, tons		523		32
Potash, tons		457		28

TABLE 6--CROP ACREAGES & FERTILIZER USED--CLASS I-V CENSUS FARMS, 1969

COUNTY, land area, acres (1) 11344000 Number I-V farms 15615

Number of farms 23765 Acres in I-V farms 3952356

Acres in farms 4772215 Cropland I-V farms 2653559

Cropland in farms 3066249 Harvested cropland I-V farms 1813365

Harvested cropland in farms 1969823

Crops	Crop Acres	Tons of Fertilizer Used: Dry	Liquid	Total
CORN	363163	63005	6605	69610
GRAINS	317878	37219	864	38083
Wheat	101767	13425	438	13863
Oats	192332	21722	366	22088
Barley	10564	1179	45	1224
Rye	5028	438	10	448
OTHER FIELD CROPS	97786	26010	565	26575
Soybeans	2362	230	8	238
Potatoes	18386	12825	42	12867
Sugar beets				
Field beans	12070	106		106
HAY OR GRASS SILAGE	888311	13620	409	14029
PASTURED CROPLAND	653616	5495	207	5702
Cropland used for pasture	546489	4262	153	4415
Improved pasture	107127	1233	54	1287
VEGETABLES, SWEET CORN, MELONS	84706	23852	1156	25008
ORCHARDS	62333	9133	502	9635
BERRIES	613	111	1	112
NURSERY & GREENHOUSE PRODUCTS	2668	454	11	465
OTHER CROPS	1114	150	22	172
Total Fertilizer Used, Tons		179155	10342	189497
Percent of Fertilizer Used		95	10	100

TABLE 7--FERTILIZER USED IN 1972

Item	Tons
Fertilizer Used on Crops: Solid	282787
Liquid	21286
Total	304073
Primary Nutrients in Fertilizer	118588
Nitrogen	36766
Phosphorus	43876
Potash	37946

TABLE 8--GROUND LIMESTONE EQUIVALENT APPLIED

Year	Tonnage Government Cost/Shared	Tonnage not Government Cost/Shared	Total Tonnage
1972			195173
Tonnages for Other Recent Years			

TABLE 9--SALTS APPLIED TO FEDERAL, STATE, COUNTY, & MUNICIPAL HIGHWAYS

Year	Tons Purchased Through State	Tons Applied Per "E" Mile
1970-71		
1971-72		
1972-73	233740	

Total Estimated Tons Applied on All Highways in 1972-73, As Computed 339016

TABLE 10--SUMMARY OF AGRICULTURAL MATERIALS AND HIGHWAY DE-ICING

Chemicals: Hundredweight Applied on Cropland

	Herbicides	Insecticides	Fungicides	Total
Table 1	23138.1	19498.2	17385.0	60021.3

Manure: Kind of Livestock	Manure	Nitrogen	Phosphorus	Potash
Swine: Table 2	57869	289	81	220
Cattle: Table 3	8228249	46078	8228	41141
Sheep: Table 4	97299	1362	204	973
Horses: Table 4	875724	6042	876	5254
Chickens: Table 5	130680	2039	523	457
Turkeys: Table 5	8113	127	32	28
Total from Livestock, Tons	9397934	55937	9944	48073

(Tons of Materials in Wet Manure Defecated)

Fertilizers: Tons of Commercial Fertilizers Applied

Item	Total	Primary Nutrients: Nitrogen	Phosphorus	Potash
Applied on Cropland: Table 7	304073	36766	43876	37946

Lime: Limestone equivalent purchased or applied, tons: Table 8 195173

Salts: Applied on all highways, tons: Table 9 339016

To Convert From	To	Multiply By
Pounds (lb)	Kilograms (kg)	0.453
Acres (acre)	Hectare (ha)	.4047
Tons (ton)	Kilograms (kg)	907.2

(1) County, land area, acres includes water areas under 40 acres in size.

Animal Wastes

Dairying is the major livestock enterprise in all three planning subareas. The cows and supporting young cattle produced 88 percent of the livestock manure; horses produced 9 percent while chickens, swine and sheep each produced 1 percent. The manure index was above the Great Lakes Basin average in each of the three subareas. Overall livestock numbers may decrease slightly. Horse numbers may increase but not at recent rates. Manure production may stay about the same or decline slightly, but will continue well above the Basin average for the next 10 years. The 1972 levels were 8,525,800 metric tons (9,397,934 tons) of wet manure produced in the Lake Ontario basin. Nitrogen, phosphorus and potash comprise 1.2 percent of the total manure defecated.

Commercial Fertilizers

It is not uncommon for chemical use and fertilizer use to accompany each other. Good farmers use both if needed. In this area nitrogen represented 32 percent of the fertilizer nutrients applied, phosphorus 32 percent and potash 36 percent. This ratio is likely to continue, although it is possible that nitrogen may show a little greater increase, potash second and phosphorus the least. Fertilization rates are likely to increase by at least 15 percent in the next 10 years. A total of 275,855 metric tons (304,073 tons) of commercial fertilizers were applied to crops in the Lake Ontario basin in 1972.

Lime

A total of 177,060 metric tons (195,173 tons) of limestone was used in the Lake Ontario basin in 1972. Lime is important in terms of its water quality impacts due to its effects on the pH level of water and subsequent effects on water's acid-base relationships. The possibility of precipatating phosphorus in the water and altering calcium content is also likely.

Salts

Road de-icing salts are intensively used in this lake basin, heaviest in PSA 5.1, modest in PSA 5.2, but surprisingly light in PSA 5.3. The severe climatic conditions during winter and resultant heavy snowfalls require using the salts to keep major roadways open. The 1972-73 figures show that 307,555 metric tons (339,016 tons) of road de-icing salts were used in highways in this lake basin. It is projected that this rate will continue to be high for the Lake Ontario area. The primary impact upon ground and surface waters resulting from road de-icing salts comes from chloride discharges which can over time affect the salinity of nearby wells and open water areas. Assuming that chlorides are conservation and that ion exchange between chlorides and various soil types are minimal, most of the chlorides will eventually reach ground and surface water areas.

PLANNING SUBAREA 5.1

Planning Subarea 5.1 comprises six western New York counties extending from the shores of Lake Ontario southward to the Pennsylvania border to Allegany County. The largest urban concentration is in Monroe County where Rochester and other cities are located.

Agricultural Characteristics

Fruits and vegetables are the major agricultural activites. Apples are the most important fruit crop and are found primarily in Orleans and Monroe Counties. These two counties plus Genesee County produce the majority of the vegetables. Major vegetable crops raised are snap beans, sweet corn, cabbage, onions and tomatoes. Potatoes are grown primarily in Wyoming and Orleans Counties. Dairying is the major livestock enterprise with over 100,000 head of dairy cows and heifers.

Table 72 indicates the relative proportions of materials usage in Planning Subarea 5.1 in comparison with the total Great Lakes Basin.

Table 72

MATERIALS USAGE BASIN RELATIONSHIP -- PSA 5.1 to GREAT LAKES

Per harvested acre of cropland	Planning Subarea 5.1	Great Lakes Basin
Lbs of chemicals applied	3.11	2.66
Index of chemicals applied	117	100
Tons of livestock manure defecated	3.95	3.37
Index of manure defecated	117	100
Lbs primary nutrients in livestock manure	97	82
Index primary nutrients in manure	118	100
Lbs commercial fertilizer applied	381	321
Percent liquid fertilizer applied	7	22
Index commercial fertilizer applied	119	100
Lbs primary nutrients in commercial fertilizer	149	153
Index primary nutrients in commercial fertilizer	97	100
Lbs of lime applied	235	170
Index of lime used	138	100
Per acre of total land		
Lbs road salts used	150.44	41.74
Index road salts used	360	100

To Convert From	To	Multiply By
Pounds (lb)	Kilograms (kg)	0.454
Tons (ton)	Kilograms (kg)	907.2
	Metric Tons	0.907

Materials Usage

Table 73 lists by county the material usage inventory for Planning Subarea 5.1. Detailed statistics are shown on Table 74.

Table 73

MATERIALS USAGE

(in 1972)

PSA 5.1	Chemicals Applied to Crops (100 lbs)	Livestock Manure (tons)	Commercial Fertilizer on Cropland (tons)	Limestone Purchased or Applied (tons)	Salt Applied to all Highways (tons)
New York					
Allegany	1022	382688	6874	13159	4931
Genesee	2621	378703	20618	7370	38146
Livingston	2612	427774	20866	8451	22510
Monroe	3346	206175	16026	6056	88242
Orleans	5658	207958	22736	11447	12328
Wyoming	2431	638430	21157	20342	19435
TOTAL	17690	2241728	108277	66825	185592

To Convert From	To	Multiply By
Pounds (lbs)	Kilograms (kg)	0.454
Tons (ton)	Kilograms (kg)	907.2
	Metric Tons	0.907

Agricultural Chemicals

Agricultural chemicals used in PSA 5.1 totaled 802,410 kilograms (1,769,020 lbs) during 1972. The fruit, vegetable and potato crops account for the fact that 31 percent of the chemicals used are fungicides. Forty percent of the chemicals used are herbicides and 29 percent insecticides. Usage during the next 10 years will increase 15-25 percent overall.

Animal Wastes

The cattle produce 84 percent of the manure, horses 12, sheep 2 and chickens and swine 1 percent each. There are about 30,000 head of sheep and 660,000 chickens. Livestock manure production in the subarea is 17 percent above the Basin average. All livestock types have either been decreasing or holding their own, except for horses. Horses may increase further in number, but not at the rapid rates of recent years. Manure production should continue to run above average. The 1972 figures for manure production show that 2,033,696 metric tons (2,241,728 tons) were produced.

Table 74

GREAT LAKES BASIN MATERIAL USAGE INVENTORY

Agricultural Chemicals, Manures, Fertilizers, Lime and Highway De-Icing Compounds

PLANNING AREA: Lake Ontario 5.0 STATE: New York

PLANNING SUBAREA: West 5.1 COUNTY: 6 County Totals (New York-6)

TABLE 1--ESTIMATED AMOUNTS OF CHEMICALS USED ON CROPS, 1972

Crop Group or Crops	Herbicides		Insecticides		Fungicides	
	Acres Treated	Amount Used 100 lbs	Acres Treated	Amount Used 100 lbs	Acres Treated	Amount Used 100 lbs
Corn	138870	3818.7	30860	462.9		
Grains	67339	336.5	22447	224.3		
Hay or Grass Silage	68203	681.7	56837	568.1		
Pastured Cropland	35071	350.4	35071	350.4		
Other Field Crops	7927	221.3	7079	803.2	6977	1046.6
Vegetables	33657	1133.9	33657	1291.7	33657	1498.7
Orchards						
Berries	10125	493.4	11855	1370.2	11904	3038.2
Nursery, Greenhouse						
Other Crops						
Totals	361192	7035.9	197806	5070.8	52538	5583.5
Total Herbicides, Insecticides, Fungicides: 100 lbs					611536	17690.2

TABLE 2--MANURE FROM SWINE

Year	Hog & Pig Inventory Dec. 1	Number Sows Farrowing: Dec. 1-May 31 Spring	June 1-Nov. 30 Fall	Total
1964	19814	1871	1789	3660
1969	19732	1585	1537	3122
1972	18947	1587	1415	3002

Wet Manure Factor: Tons per litter farrowed 7.23
Wet Manure Defecated: Tons, 1972 21704
Nutrients in Wet Manure: Nitrogen, tons 109
Phosphorus, tons 30
Potash, tons 82

TABLE 3--MANURE FROM CATTLE

Year	Total	Number Cattle and Calves: Cows & Heifers Calved	Heifers, Steers, Bulls, Calves
1964	221087	123180	97907
1969	193274	102443	90831
1972	181597	105517	76080
Wet Manure Factor: Tons Per Animal		13.14	6.45
Wet Manure Defecated: Tons, 1972		1386493	490716

Wet Manure Defecated: Tons, 1972 Combined: 1877209
Nutrients in Wet Manure: Nitrogen, tons 10512
Phosphorus, tons 1877
Potash, tons 9386

TABLE 4--MANURE FROM SHEEP AND HORSES

Year	Item	Sheep & Lambs	Horses & Ponies
1964		37750	
1969		31781	6715
1972		30198	20829
Wet Manure Factor: Tons per animal		1.61	12.78
Wet Manure Defecated: Tons, 1972		48619	266195
Nutrients in Wet Manure: Nitrogen, Tons		681	1837
Phosphorus, Tons		102	266
Potash, Tons		486	1597

TABLE 5--MANURE FROM CHICKENS & TURKEYS

Year	Item	Chickens	Turkey Hens	Turkeys Raised
1964		661387		
1969		728962		
1972		663391	800	8000
Wet Manure Factor: Lbs. per bird		82.9	365.0	89.63
Wet Manure Defecated: Tons, 1972		27498	Combined	503
Nutrients in Wet Manure: Nitrogen, tons		429		8
Phosphorus, tons		110		2
Potash, tons		96		2

TABLE 6--CROP ACREAGES & FERTILIZER USED--CLASS I-V CENSUS FARMS, 1969

COUNTY, land area, acres (1) 2467264 Number I-V farms 3854
Number of farms 6332 Acres in I-V farms 1032922
Acres in farms 1262448 Cropland I-V farms 740902
Cropland in farms 867776 Harvested cropland
Harvested cropland in farms 567936 I-V farms 521610

Crops	Crop Acres	Tons of Fertilizer Used: Dry	Liquid	Total
CORN	106018	19490	1661	21151
GRAINS	112232	13961	359	14320
Wheat	48538	6533	197	6730
Oats	56337	6701	145	6846
Barley	3795	415	13	428
Rye	2106	214	3	217
OTHER FIELD CROPS	50284	13409	383	13792
Soybeans	756	76		76
Potatoes	9602	6819	38	6857
Sugar beets				
Field beans	1987	54		54
HAY OR GRASS SILAGE	199035	3093	37	3130
PASTURED CROPLAND	133817	1495	50	1545
Cropland used for pasture	111569	1221	31	1252
Improved pasture	22248	274	19	293
VEGETABLES, SWEET CORN, MELONS	39131	10187	743	10930
ORCHARDS	17305	2216	7	2223
BERRIES	110	10		10
NURSERY & GREENHOUSE PRODUCTS	1656	340	6	346
OTHER CROPS	240	30	17	47
Total Fertilizer Used, Tons		64285	3263	67548
Percent of Fertilizer Used		95	5	100

TABLE 7--FERTILIZER USED IN 1972

Item	Tons
Fertilizer Used on Crops: Solid	100697
Liquid	7580
Total	108277
Primary Nutrients in Fertilizer	42228
Nitrogen	13092
Phosphorus	15624
Potash	13512

TABLE 8--GROUND LIMESTONE EQUIVALENT APPLIED

Year	Tonnage Government Cost/Shared	Tonnage not Government Cost/Shared	Total Tonnage
1972			66825
Tonnages for Other Recent Years			

TABLE 9--SALTS APPLIED TO FEDERAL, STATE, COUNTY, & MUNICIPAL HIGHWAYS

Year	Tons Purchased Through State	Tons Applied Per "E" Mile
1970-71		
1971-72		
1972-73	127960	

Total Estimated Tons Applied on All Highways in 1972-73, As Computed 185592

TABLE 10--SUMMARY OF AGRICULTURAL MATERIALS AND HIGHWAY DE-ICING

Chemicals: Hundredweight Applied on Cropland

	Herbicides	Insecticides	Fungicides	Total
Table 1	7035.9	5070.8	5583.5	17690.2

Manure: Kind of Livestock	Tons of Materials in Wet Manure Defecated: Manure	Nitrogen	Phosphorus	Potash
Swine: Table 2	21704	109	30	82
Cattle: Table 3	1877209	10512	1877	9386
Sheep: Table 4	48619	681	102	486
Horses: Table 4	266195	1837	266	1597
Chickens: Table 5	27498	429	110	96
Turkeys: Table 5	503	8	2	2
Total from Livestock, Tons	2241728	13576	2387	11649

Fertilizers: Tons of Commercial Fertilizers Applied

Item	Total	Primary Nutrients: Nitrogen	Phosphorus	Potash
Applied on Cropland: Table 7	108277	13092	15624	13512

Lime: Limestone equivalent purchased or applied, tons: Table 8 66825

Salts: Applied on all highways, tons: Table 9 185592

To Convert From	To	Multiply By
Pounds (lb)	Kilograms (kg)	0.453
Acres (acre)	Hectare (ha)	.4047
Tons (ton)	Kilograms (kg)	907.2

(1) County, land area, acres includes water areas under 40 acres in size.

Commercial Fertilizers

Fertilization rates are running well above the Basin average in this planning subarea and are projected to continue with perhaps some increases, especially in nitrogen. The 1972 total of commercial fertilizer applied to cropland was 98,229 metric tons (108,277 tons). Nitrogen accounted for 31 percent, phosphorus 37 percent, and potash 32 percent of the primary nutrients in the commercial fertilizer.

Lime

Lime rates are also applied at rates above Basin average. These levels are expected to continue into the near future. The amount of lime purchased or applied in PSA 5.1 was 60,624 metric tons (66,825 tons) for 1972.

Salts

Road de-icers are used in greater quantities in PSA 5.1 than for the Basin as a whole. Highway people expect future quantities used to depend more on increased road mileage rather than higher usage rates. The total amount of salts applied to highways in this area (1972-73) was 168,369 metric tons (185,592 tons).

PLANNING SUBAREA 5.2

Planning Subarea 5.2 extends from Rochester on the west, east through the Finger Lake regions encompassing the city of Syracuse and then to Oneida and Herkimer Counties. It is a large land area and diversified in its agriculture. These counties follow along the southern shores of Lake Ontario. Most of the counties do not border directly on the lake.

Agricultural Characteristics

Planning Subarea 5.2 is generally a strong agricultural area. The general crops grown are corn, grains and hay primarily to support the livestock, which is mainly dairy. Fruit and vegetable crops are also very important. Apples, and to a lesser extent, cherries, are important in Wayne County. There are nearly 4,000 hectares (10,000 acres) of grapes in the subarea with Yates County being the heaviest producer. The major vegetable crops are snap beans, sweet corn, cabbage, onions and tomatoes.

Table 75 indicates the relative proportions of materials usage in Planning Subarea 5.2 in comparison with the total Great Lakes Basin.

Table 75

MATERIALS USAGE BASIN RELATIONSHIP -- PSA 5.2 to GREAT LAKES

Per harvested acre of cropland	Planning Subarea 5.2	Great Lakes Basin
Lbs of chemicals applied	3.78	2.66
Index of chemicals applied	142	100
Tons of livestock manure defecated	4.61	3.37
Index of manure defecated	137	100
Lbs primary nutrients in livestock manure	113	82
Index primary nutrients in manure	138	100
Lbs commercial fertilizer applied	340	321
Percent liquid fertilizer applied	7	22
Index commercial fertilizer applied	106	100
Lbs primary nutrients in commercial fertilizer	133	153
Index primary nutrients in commercial fertilizer	87	100
Lbs of lime applied	189	170
Index of lime used	111	100
Per acre of total land area		
Lbs road salts used	45.33	41.74
Index road salts used	109	100

To Convert From	To	Multiply By
Pounds (lb)	Kilograms (kg)	0.454
Tons (ton)	Kilograms (kg)	907.2
	Metric Tons	0.907

Materials Usage

Table 76 lists by county the material usage inventory for PSA 5.2. Detailed statistics are shown in Table 77.

Table 76
MATERIALS USAGE
(in 1972)

PSA 5.2	Chemicals Applied to Crops (100 lbs)	Livestock Manure (tons)	Commercial Fertilizer on Cropland (tons)	Limestone Purchased or Applied (tons)	Salts Applied to all Highways (tons)
New York					
Cayuga	2946	500081	25077	6899	7470
Herkimer	1048	521176	5357	8123	4206
Madison	1860	654286	13122	12061	6092
Oneida	2463	821125	15184	19324	14649
Onondaga	2316	458764	15158	6480	29008
Ontario	3902	379330	25728	3278	8572
Oswego	1485	298448	8235	7639	16100
Schuyler	1502	96427	2685	3291	5802
Seneca	1320	123045	12106	3727	3916
Tompkins	926	277805	7973	8453	5700
Wayne	12632	287394	26942	10592	19435
Yates	5028	148713	10869	3741	2611
TOTAL	37428	4566593	168436	93608	123561

To Convert From	To	Multiply By
Pounds (lb)	Kilograms (kg)	0.454
Tons (ton)	Kilograms (kg)	907.2
	Metric Tons	0.907

Agricultural Chemicals

A total of 1,699,200 kilograms (3,742,790 lbs) of agricultural chemicals were used in this area during 1972. Fruit and vegetable crops along with potatoes account for 31 percent of the chemical usage being fungicides. Thirty five percent are herbicides and 34 percent insecticides. The use of chemicals will increase 15-20 percent in the next 10 years.

Animal Wastes

There are 4,142,813 metric tons (4,566,593 tons) of wet manure produced from livestock in PSA 5.2. Cattle contribute 86 percent of the manure, horses 10, chickens 2 and swine and sheep each 1 percent. The manure production index is above average. Manure rates may stay about the same or even decrease some but are expected to still continue above the Basin average. Nitrogen, phosphorus, and potash combined comprise 1.2 percent of the total manure tonnage.

Commercial Fertilizers

Fertilizer use in Planning Subarea 5.2 is slightly above the Basin average. Thirty one percent of the primary nutrients are nitrogen, thirty two percent potash. Fertilizer usage will increase 10-20 percent in the next 10 years. The 1972 usage totaled 152,805 metric tons (168,436 tons) of commercial fertilizer that was applied to croplands.

Table 77

GREAT LAKES BASIN MATERIAL USAGE INVENTORY

Agricultural Chemicals, Manures, Fertilizers, Lime and Highway De-Icing Compounds

PLANNING AREA: Lake Ontario 5.0 STATE: New York

PLANNING SUBAREA: Central 5.2 COUNTY: 12 County Totals (New York-12)

TABLE 1--ESTIMATED AMOUNTS OF CHEMICALS USED ON CROPS, 1972

Crop Group or Crops	Herbicides		Insecticides		Fungicides	
	Acres Treated	Amount Used 100 lbs	Acres Treated	Amount Used 100 lbs	Acres Treated	Amount Used 100 lbs
Corn	265770	7308.4	59060	885.9		
Grains	103344	516.3	34448	343.9		
Hay or Grass Silage	132110	1320.5	110092	1100.5		
Pastured Cropland	75404	753.4	75404	753.4		
Other Field Crops	8227	219.8	6331	710.3	6162	924.4
Vegetables	39456	1329.2	39456	1514.3	39456	1757.1
Orchards						
Berries	31875	1508.6	36983	7435.9	38046	9046.0
Nursery, Greenhouse						
Other Crops						
Totals	656186	12956.2	361774	12744.2	83664	11727.5
Total Herbicides, Insecticides, Fungicides: 100 lbs					1101624	37427.9

TABLE 2--MANURE FROM SWINE

Year	Hog & Pig Inventory Dec. 1	Number Sows Farrowing: Dec. 1-May 31 Spring	Number Sows Farrowing: June 1-Nov. 30 Fall	Total
1964	22672	2144	2113	4257
1969	23815	2229	2315	4544
1972	22869	2313	2055	4368

Wet Manure Factor: Tons per litter farrowed 7.23
Wet Manure Defecated: Tons, 1972 31581
Nutrients in Wet Manure: Nitrogen, tons 158
Phosphorus, tons 44
Potash, tons 120

TABLE 3--MANURE FROM CATTLE

Year	Total	Number Cattle and Calves: Cows & Heifers Calved	Number Cattle and Calves: Heifers, Steers, Bulls, Calves
1964	434748	260132	174616
1969	377387	214482	162905
1972	380202	220917	159285
Wet Manure Factor: Tons Per Animal		13.14	6.45
Wet Manure Defecated: Tons, 1972		2902849	1027388

Wet Manure Defecated: Tons, 1972 Combined: 3930237
Nutrients in Wet Manure: Nitrogen, tons 22009
Phosphorus, tons 3930
Potash, tons 19651

TABLE 4--MANURE FROM SHEEP AND HORSES

Year	Item	Sheep & Lambs	Horses & Ponies
1964		37644	
1969		30133	9934
1972		28639	36059
Wet Manure Factor: Tons per animal		1.61	12.78
Wet Manure Defecated: Tons, 1972		46109	460834
Nutrients in Wet Manure: Nitrogen, Tons		646	3180
Phosphorus, Tons		97	461
Potash, Tons		461	2765

TABLE 5--MANURE FROM CHICKENS & TURKEYS

Year	Item	Chickens	Turkey Hens	Turkeys Raised
1964		2203190		
1969		2474048		
1972		2252438	7110	71100
Wet Manure Factor: Lbs. per bird		82.9	365	89.63
Wet Manure Defecated: Tons, 1972		93364		
Nutrients in Wet Manure:			Combined	4468
Nitrogen, tons		1456		70
Phosphorus, tons		373		18
Potash, tons		327		16

TABLE 6--CROP ACREAGES & FERTILIZER USED--CLASS I-V CENSUS FARMS, 1969

COUNTY, land area, acres (1) 5450816 Number I-V farms 8179
Number of farms 12705 Acres in I-V farms 1914501
Acres in farms 2339630 Cropland I-V farms 1303462
Cropland in farms 1513656 Harvested cropland
Harvested cropland in farms 990426 I-V farms 909860

Crops	Crop Acres	Tons of Fertilizer Used: Dry	Liquid	Total
CORN	208306	35778	4587	40365
GRAINS	172241	20132	505	20637
Wheat	52336	6795	241	7036
Oats	104338	12068	221	12289
Barley	6344	731	32	763
Rye	2901	219	7	226
OTHER FIELD CROPS	47013	12353	182	12535
Soybeans	1606	154	8	162
Potatoes	8345	5767	4	5771
Sugar beets				
Field beans	9383	47		47
HAY OR GRASS SILAGE	388835	6479	355	6834
PASTURED CROPLAND	298775	2691	136	2827
Cropland used for pasture	242536	1985	102	2087
Improved pasture	56239	706	34	740
VEGETABLES, SWEET CORN, MELONS	45358	13621	413	14034
ORCHARDS	44979	6912	495	7407
BERRIES	487	101	1	102
NURSERY & GREENHOUSE PRODUCTS	947	113	4	117
OTHER CROPS	798	120	5	125
Total Fertilizer Used, Tons		98347	6683	105030
Percent of Fertilizer Used		94	6	100

TABLE 7--FERTILIZER USED IN 1972

Item	Tons
Fertilizer Used on Crops: Solid	156646
Liquid	11790
Total	168436
Primary Nutrients in Fertilizer	65690
Nitrogen	20366
Phosphorus	24304
Potash	21020

TABLE 8--GROUND LIMESTONE EQUIVALENT APPLIED

Year	Tonnage Government Cost/Shared	Tonnage not Government Cost/Shared	Total Tonnage
1972			93608
Tonnages for Other Recent Years			

TABLE 9--SALTS APPLIED TO FEDERAL, STATE, COUNTY, & MUNICIPAL HIGHWAYS

Year	Tons Purchased Through State	Tons Applied Per "E" Mile
1970-71		
1971-72		
1972-73	85190	

Total Estimated Tons Applied on All Highways in 1972-73, As Computed 123561

TABLE 10--SUMMARY OF AGRICULTURAL MATERIALS AND HIGHWAY DE-ICING

Chemicals: Hundredweight Applied on Cropland

	Herbicides	Insecticides	Fungicides	Total
Table 1	12956.2	12744.2	11727.5	37437.9

Manure: Kind of Livestock	Tons of Materials in Wet Manure Defecated: Manure	Nitrogen	Phosphorus	Potash
Swine: Table 2	31581	158	44	120
Cattle: Table 3	3930237	22009	3930	19651
Sheep: Table 4	46109	646	97	461
Horses: Table 4	460834	3180	461	2765
Chickens: Table 5	93364	1456	373	327
Turkeys: Table 5	4468	70	18	16
Total from Livestock, Tons	4566593	27519	4923	23340

Fertilizers: Tons of Commercial Fertilizers Applied

Item	Total	Primary Nutrients: Nitrogen	Phosphorus	Potash
Applied on Cropland: Table 7	168436	20366	24304	21020

Lime: Limestone equivalent purchased or applied, tons: Table 8 93608

Salts: Applied on all highways, tons: Table 9 123561

To Convert From	To	Multiply By
Pounds (lb)	Kilograms (kg)	0.453
Acres (acre)	Hectare (ha)	.4047
Tons (ton)	Kilograms (kg)	907.2

(1) County, land area, acres includes water areas under 40 acres in size.

Lime

Limestone application rates have been and are likely to continue to be above Basin average. However these rates are not expected to increase. There were 84,921 metric tons (93,608 tons) of lime purchased or applied to this area in 1972.

Salts

Road de-icing salts applied to all highways in this planning subarea amounted to 112,095 metric tons (123,561 tons) in 1972-73. The rate of application is not likely to increase; however, if highway miles increase, total salt quantities used will increase proportionately.

PLANNING SUBAREA 5.3

The three counties of Planning Subarea 5.3 are at the eastern end of Lake Ontario. They are large counties covering a land area of 1.4 million hectares (3.4 million acres). Only about 162,000 hectares (400,000 acres) represent harvested cropland.

Agricultural Characteristics

These three counties are primarily dairy counties. The crops raised are primarily to support the dairy livestock program.

This represents a less intensive type of crop agriculture than is found generally throughout the entire Basin, except possibly for that found in the northern parts of the Great Lake states.

Table 78 indicates the relative proportions of materials usage in Planning Subarea 5.3 in comparison with the total Great Lakes Basin.

Table 78

MATERIALS USAGE BASIN RELATIONSHIP -- PSA 5.3 to GREAT LAKES

Per harvested acre of cropland	Planning Subarea 5.3	Great Lakes Basin
Lbs of chemicals applied	1.19	2.66
Index of chemicals applied	45	100
Tons of livestock manure defecated	6.29	3.37
Index of manure defecated	187	100
Lbs primary nutrients in livestock manure	149	82
Index primary nutrients in manure	182	100
Lbs commercial fertilizer applied	133	321
Percent liquid fertilizer applied	7	22
Index commercial fertilizer applied	41	100
Lbs primary nutrients in commercial fertilizer	52	153
Index primary nutrients in commercial fertilizer	34	100
Lbs of lime applied	169	170
Index of lime applied	99	100
Per acre of total land area		
Lbs road salts used	17.43	41.74
Index road salts used	42	100

To Convert From	To	Multiply By
Pounds (lb)	Kilograms (kg)	0.454
Tons (ton)	Kilograms (kg)	907.2
	Metric Tons	0.907

Materials Usage

Table 79 lists by county the material usage inventory for PSA 5.3. Detailed statistics are shown on Table 80.

Table 79

MATERIALS USAGE
(in 1972)

PSA 5.3	Chemicals Applied to Crops (100 lbs)	Livestock Manure (tons)	Commercial Fertilizer on Cropland (tons)	Limestone Purchased or Applied (tons)	Salts Applied to all Highways (tons)
New York					
Jefferson	1983	927132	10582	16556	13851
Lewis	874	600468	6696	10454	5134
St. Lawrence	2046	1062013	10082	7730	10878
TOTAL	4903	2589613	27360	34740	29863

To Convert From	To	Multiply By
Pounds (lb)	Kilograms (kg)	0.454
Tons (ton)	Kilograms (kg)	907.2
	Metric Tons	0.907

Agricultural Chemicals

Chemicals used are 64 percent herbicides, 34 insecticides and only 2 percent fungicides. The herbicides are used primarily on corn and the other general farm crops. Chemicals applied in this subarea may increase some but will likely remain comparatively modest. Most of the increase will be in the herbicide class. The amounts used in 1972 were 22,400 kilograms (490,320 lbs) of agricultural chemicals.

Animal Wastes

Livestock production in this planning subarea is important and this is indicated by the manure index. Cattle provide 93 percent of the livestock manure, horses 6 percent and chickens 1 percent. Horse numbers which have been increasing will probably level out. Dairy numbers will probably continue to decrease some. However, manure production rates in this subarea will continue well above the average for the Basin. The 1972 manure production totalled 2,349,297 metric tons (2,589,613 tons) for this area. This represents 28 percent of the total manure produced in the Lake Ontario basin. Nitrogen, phosphorus, and potash combined comprise 1.2 percent of the total manure tonnage.

Commercial Fertilizers

A total of 24,820 metric tons (27,360 tons) of commercial fertilizers were applied to croplands in PSA 5.3. Of the primary nutrients in the fertilizers, nitrogen accounted for 31 percent, phosphorus 37 percent and potash 32 percent. It is projected that commercial fertilizer use will increase 5-15 percent in the next 10 years.

Table 80

GREAT LAKES BASIN MATERIAL USAGE INVENTORY

Agricultural Chemicals, Manures, Fertilizers, Lime and Highway De-Icing Compounds

PLANNING AREA: Lake Ontario 5.0 STATE: New York

PLANNING SUBAREA: East 5.3 COUNTY: 3 County Totals (New York-3)

TABLE 1--ESTIMATED AMOUNTS OF CHEMICALS USED ON CROPS, 1972

Crop Group or Crops	Herbicides		Insecticides		Fungicides	
	Acres Treated	Amount Used 100 lbs	Acres Treated	Amount Used 100 lbs	Acres Treated	Amount Used 100 lbs
Corn	54000	1484.9	12000	180.0		
Grains	20042	100.1	6681	66.7		
Hay or Grass Silage	98021	980.0	81684	816.7		
Pastured Cropland	56024	560.1	56024	560.1		
Other Field Crops	292	8.8	325	37.4	325	48.8
Vegetables	208	7.0	208	8.0	208	9.2
Orchards						
Berries	78	5.1	83	14.3	87	16.0
Nursery, Greenhouse						
Other Crops						
Totals	228665	3146.0	157005	1683.2	620	74.0
Total Herbicides, Insecticides, Fungicides: 100 lbs					386290	4903.2

TABLE 2--MANURE FROM SWINE

Year	Hog & Pig Inventory Dec. 1	Number Sows Farrowing Dec. 1-May 31 Spring	June 1-Nov. 30 Fall	Total
1964	4250	332	312	644
1969	3309	345	316	661
1972	3220	338	296	634

Wet Manure Factor: Tons per litter farrowed 7.23
Wet Manure Defecated: Tons, 1972 4584
Nutrients in Wet Manure: Nitrogen, tons 23
Phosphorus, tons 6
Potash, tons 17

TABLE 3--MANURE FROM CATTLE

Year	Total	Number Cattle and Calves: Cows & Heifers Calved	Heifers, Steers, Bulls, Calves
1964	241810	154589	87221
1969	215164	132109	83055
1972	234182	136073	98109
Wet Manure Factor: Tons Per Animal		13.14	6.45
Wet Manure Defecated: Tons, 1972		1787999	632803

Wet Manure Defecated: Tons, 1972 Combined: 2420802
Nutrients in Wet Manure: Nitrogen, tons 13556
Phosphorus, tons 2421
Potash, tons 12104

TABLE 4--MANURE FROM SHEEP AND HORSES

Year	Item	Sheep & Lambs	Horses & Ponies
1964		3702	
1969		1678	3313
1972		1597	11635
	Wet Manure Factor: Tons per animal	1.61	12.78
	Wet Manure Defecated: Tons, 1972	2571	148695
	Nutrients in Wet Manure: Nitrogen, Tons	36	1026
	Phosphorus, Tons	5	149
	Potash, Tons	26	892

TABLE 5--MANURE FROM CHICKENS & TURKEYS

Year	Item	Chickens	Turkey Hens	Turkeys Raised
1964		449828		
1969		260144		
1972		236896	5000	50000
	Wet Manure Factor: Lbs. per bird	82.9	365.0	89.63
	Wet Manure Defecated: Tons, 1972	9819	Combined	3142
	Nutrients in Wet Manure: Nitrogen, tons	153		49
	Phosphorus, tons	39		13
	Potash, tons	34		11

TABLE 6--CROP ACREAGES & FERTILIZER USED--CLASS I-V CENSUS FARMS, 1969

COUNTY, land area, acres (1) 3425920 Number I-V farms 3582
Number of farms 4728 Acres in I-V farms 1004933
Acres in farms 1170137 Cropland I-V farms 609195
Cropland in farms 684817 Harvested cropland
Harvested cropland in farms 411461 I-V farms 381895

Crops	Crop Acres	Tons of Fertilizer Used: Dry	Liquid	Total
CORN	48839	7737	357	8094
GRAINS	33405	3126		3126
Wheat	893	97		97
Oats	31657	2953		2953
Barley	425	33		33
Rye	21	5		5
OTHER FIELD CROPS	489	248		248
Soybeans				
Potatoes	439	239		239
Sugar beets				
Field beans	700	5		5
HAY OR GRASS SILAGE	300441	4048	17	4065
PASTURED CROPLAND	221024	1309	21	1330
Cropland used for pasture	192384	1056	20	1076
Improved pasture	28640	253	1	254
VEGETABLES, SWEET CORN, MELONS	217	44		44
ORCHARDS	49	5		5
BERRIES	16			
NURSERY & GREENHOUSE PRODUCTS	65	1	1	2
OTHER CROPS	76			
Total Fertilizer Used, Tons		16523	396	16919
Percent of Fertilizer Used		98	2	100

TABLE 7--FERTILIZER USED IN 1972

Item	Tons
Fertilizer Used on Crops: Solid	25444
Liquid	1916
Total	27360
Primary Nutrients in Fertilizer	10670
Nitrogen	3308
Phosphorus	3948
Potash	3414

TABLE 8--GROUND LIMESTONE EQUIVALENT APPLIED

Year	Tonnage Government Cost/Shared	Tonnage not Government Cost/Shared	Total Tonnage
1972			34740
Tonnages for Other Recent Years			

TABLE 9--SALTS APPLIED TO FEDERAL, STATE, COUNTY, & MUNICIPAL HIGHWAYS

Year	Tons Purchased Through State	Tons Applied Per "E" Mile
1970-71		
1971-72		
1972-73	20590	

Total Estimated Tons Applied on All Highways in 1972-73, As Computed 29863

TABLE 10--SUMMARY OF AGRICULTURAL MATERIALS AND HIGHWAY DE-ICING

Chemicals: Hundredweight Applied on Cropland

	Herbicides	Insecticides	Fungicides	Total
Table 1	3146.0	1683.2	74.0	4903.2

Manure: Kind of Livestock	Tons of Materials in Wet Manure Defecated: Manure	Nitrogen	Phosphorus	Potash
Swine: Table 2	4584	23	6	17
Cattle: Table 3	2420802	13556	2421	12104
Sheep: Table 4	2571	36	5	26
Horses: Table 4	148695	1026	149	892
Chickens: Table 5	9819	153	39	34
Turkeys: Table 5	3142	49	13	11
Total from Livestock, Tons	2589613	14843	2633	13084

Fertilizers: Tons of Commercial Fertilizers Applied

Item	Total	Primary Nutrients: Nitrogen	Phosphorus	Potash
Applied on Cropland: Table 7	27360	3308	3948	3414

Lime: Limestone equivalent purchased or applied, tons: Table 8 34740

Salts: Applied on all highways, tons: Table 9 29863

To Convert From	To	Multiply By
Pounds (lb)	Kilograms (kg)	0.453
Acres (acre)	Hectare (ha)	.4047
Tons (ton)	Kilograms (kg)	907.2

(1) County, land area, acres includes water areas under 40 acres in size.

MATERIALS USAGE METHODOLOGY

A county summary report was prepared for all counties in the Lake Ontario basin where census and other information are available. The county summary reports were then combined into their respective planning subareas and then aggregated to the Lake Ontario basin.

In order to make comparisons or show differences in materials usage between areas and subareas, two indicators are used -- one to show intensity and the other to facilitate comparisons. The intensity of use of each material is indicated by the amount applied "per acres of harvested cropland" except for road de-icers where the amount applied "per acre of total land area" is used. Chemical fertilizer, lime usage and livestock production are closely related to acres of crops harvested. The intensity of salt usage on highways can more properly be related to total land area. Comparative relationships are indicated by developing an indice for each material using the Great Lakes Basin amount in each case as an index of 100.

Chemical Information

It is estimated that the combined amount of herbicides, insecticides and fungicides represents approximately two-thirds or at the most three quarters of all the chemicals used directly on crops by farmers in the 191 counties in the Great Lakes Basin. The amounts reported in this study do not include chemicals used for livestock pesticide control, or that used by rural homeowners. Nor does it include any chemicals used by the government or industry in agriculturally related experimental or testing work. Table 81 shows the percent of crop acres treated, the rates applied per acre and the major chemicals used. The information has sufficient breath of relevancy to permit use in all the counties. The acreages of general farm crops were available by county from the reports of the State Statistical Reporting Services, except for pastured cropland for which only the 1969 census figures were available. In most instances vegetable acreages were obtainable on a state-wide basis and not on a county-wide basis. Fruit crop production figures showing harvested amounts were also available on a state-wide basis but not for counties. Fruit acreage figures were generally not available.

The total acres of each of the important vegetable crops in each state were multiplied by the respective chemical application rates per acre and this total, divided by the total acres of vegetables in each state to obtain a weighted chemical figure per acre for the vegetables in each state. A state's 1972 to 1969 ratio times the vegetable acreage, shown for each county in the 1969 census, times the composite vegetable chemical application rates for the state provides the pounds of herbicides, insecticides and fungicides applied respectively for vegetables in each county.

Fruit acres, unlike vegetable acreages, do not experience significant fluctuations annually. It was assumed that fruit acres per county in 1972 was the same as in 1969. A similar procedure as used with vegetables was followed for fruits. The composite chemical use rates calculated were applied to each county fruit acreage to determine the total quantities of herbicides, insecticides and fungicides used in the county.

Animal Manure Information

Information from researchers provided the estimates of the tons of manure defecated from dairy cows, hogs, steers, and sheep of certain weights over a fixed time span. Both U.S. and state census and crop reporting publications provided information on the number of livestock. Manure defecation factors were then developed for various classes of livestock so that the livestock numbers could be directly converted into tons of manure defecated. After the manure quantities for the types of livestock were determined, the quantities of primary nutrients -- nitrogen, phosphorus and potash -- in the manure were then derived.

The respective tons of animal manure multiplied by the pounds of each primary nutrient per ton of manure produced from livestock, divided by 2000 gives the tons of primary nutrients. This procedure was simplified by using the following table (Table 82).

Table 81

CROPS, PERCENT OF ACRES TREATED WITH CHEMICALS, RATES AND KINDS OF CHEMICALS USED(1)

Crop(s)	Type[a]	Percent Acres Treated	Pounds Per Acre	Some of the Major Chemicals Used[b]
Corn	H	90	2.75	Atrazine, Alachlor, 2,4-D Butylate, MCPA
	I	20	1.50	Aldrin, Bux, Chlordane, Carbofuron, Dyfonate
Grain	H	60	.50	2,4-D, MCPA, Dinoseb
(wheat, oats, barley, rye)	I	20	1.00	Carbaryl, Malathion
Soybeans	H	80	2.00	Trifluralin, Dinoseb, Fluorodifen, Chloramben, Linuron, Alachlor, Chlorbromuron
	I	5	1.00	Carbaryl, Malathion
Field beans	H	95	2.50	EPTC, Trifluralin, Chloramben, Fluorodifen
	I	5	1.00	Carbaryl, Malathion, Azinphosmethyl
Sugar beets	H	95	3.00	Pyrazon, TCA Phenmedipham, Dalapon, Endothal
	I	5	1.00	Carbaryl, Parathion, Endosulfan
Hay or grass silage	H	30	1.00	EPTC, MCPA, 2, 4-DB, Simazine
	I	25	1.00	Malathion, Methyoxychlor, Diazinon, Carbaryl, Azinphosmethyl, Methyl Parathion, Imidan
Pastured cropland	H	25	1.00	2, 4-D
	I	25	1.00	Carbaryl
Potatoes	H	90	3.00	Linuron, EPTC, Dinoseb
	I	100	11.50	Phorate, Disyston, Carbaryl, Malathion, Parathion, Azinphosmethyl
	F	100	15.00	Difolatan, Bravo, Dinoseb, Mancozek, Maneb, Zinc, (activated polyethylene thiram disulfide)
Apples	H	70	5.00	Simazine, Paraquat, Terbacil, Dichlobenil, 2,4-D
	I	80	11.75	Guthion, Imidan, Zolone, Sevin, Phosphamidon, Plictran, Omite, Kelthane, Gardona
	F	80	32.00	Benlate, Cyprex, Captan, Difolatan, Polyram, Dikar, Maneb
Sweet cherries	H	75	4.00	Simazine, Paraquat, Dichlobenil
	I	81	5.00	Guthion, Sevin, Imidan, Parathion
	F	81	5.00	Difolatan, Captan, Dodine, Benomyl, Sulfur, Dichlone
Peaches	H	60	4.00	Simazine, Paraquat, Terbacil, Dichlobenil
	I	74	6.00	Guthion, Sevin, Parathion, Thiodan, Imidan
	F	74	6.00	Benomyl, Sulfur, Dichlone
Pears	H	40	5.00	Simazine, Paraquat, Dichlobenil, Diuron
	I	94	8.00	Guthion, Thiodan, Parathion, Imidan, Sevin, Perthane
	F	94	1.00	Ferbam, Streptomycin, Bordeaux (copper)
Prunes and plums	H	40	3.00	Simazine, Paraquat, Dichlobenil
	I	84	5.00	Guthion, Imidan, Parathion
	F	84	5.00	Benomyl, Dichlone, Sulfur
Strawberries	H	100	10.00	Diphenamid, DCPA, Chloroxuron
	I	90	12.50	Captan, Thiodan
	F	100	10.00	Captan, Benlate
Blueberries	H	85	5.00	Simazine, Diuron, Dichlobenil, Paraquat
	I	85	3.25	Guthion, Malathion
	F	100	41.00	Calcium Cyanamid, DNOSBP
Grapes	H	80	4.00	Simazine, Paraquat, Diuron, Dichlobenil
	I	90	51.00	Folpet, Ferbam, Guthion, Captan, Parathion
	F	100	17.50	Ferbam, Phaltan
Sweet corn	H	100	2.00	Atrazine, Alachlor, Butylate, Cyanazine, 2, 4-D
	I	80	13.50	Parathion, Sevin, Lannate, Gardona, EPM, Dieldrin, Dylox
	F	100	.10	Thiram or Captan

Table 81 Con't.

Cantaloupe	H	80	6.00	Naptalam, Bensulide
	I	50	2.00	Methoxychlor, Sevin, Thiodan, Phosphamidon
	F	90	10.00	Dithiocarbamates, Bravo, Coppers, Thiram/Captan
Asparagus	H	100	4.00	Simazine, Diuron, Dalapon, 2, 4-D
	I	90	3.00	Sevin, Dieldrin, Methoxychlor, Malathion
	F	50	5.00	Dithiocarbamates, Thiram/Captan
Snap beans	H	90	2.00	EPTC, Trifluralin, Dinoseb, Chloramben
	I	50	6.00	Sevin, Parathion, Diazinon, Dimethoate
	F	75	5.00	Dithiocarbamates, Bravo, Coppers, Thiram/Captan
Cabbage	H	100	3.00	Trifluralin, Nitrofen, DCPA
	I	100	4.50	Guthion, Diazinon, Lannate, Monitor, Thiodan, BT
	F	75	7.00	Dithiocarbamates, Bravo, Coppers, Thiram/Captan
Carrots	H	100	2.00	Linuron, Nitrofen
	I	100	8.75	Sevin, Parathion, Diazinon
	F	75	10.00	Dithiocarbamates, Bravo, Coppers, Thiram/Captan
Cauliflower	H	100	3.00	Trifluralin, Nitrofen
	I	100	4.50	Guthion, Diazinon, Lannate, Monitor, Thiodan, BT
	F	75	7.00	Dithiocarbamates, Bravo, Coppers, Thiram/Captan
Cucumbers	H	100	6.00	Naptalam, Bensulide, Chloramban, Dinoseb
	I	50	3.00	Methoxychlor, Sevin, Dieldrin, Parathion
	F	50	10.00	Dithiocarbamates, Bravo, Coppers, Thiram/Captan
Lettuce	H	100	6.00	CDEC, Chlorpropham
	I	100	18.00	Sevin, Parathion, Lannate, Thiodan, BT
	F	75	8.00	Dithiocarbamates, Thiram/Captan
Onions	H	100	12.00	CDAA, Chlorpropham, Nitrofen, Chloroxuron
	I	100	6.00	Dasanit, Dyfonate, Diazinon, Parathion, Malathion
	F	75	10.00	Dithiocarbamates, Bravo, Coppers, Thiram/Captan
Green peppers	H	100	3.00	Trifluralin, Diphenamid
	I	100	35.00	Sevin, Dibrom, Systox, Dimethoate, Diazinon
	F	50	10.00	Dithiocarbamates, Coppers, Thiram/Captan
Tomatoes	H	100	3.00	**Trifluralin, Diphenamid, Chloramben**
	I	25	1.50	**Diazinon, Lannate, BT, Guthion, Thiodan**
	F	90	10.00	Dithiocarbamates, Copper, Bravo
Celery	H	100	3.00	CDEC, Nitrofen, Prometryne, Linuron
	I	100	18.00	Sevin, Parathion, Systox, Dibrom, Phosdrin
	F	100	16.00	Dithiocarbamates, Copper, Bravo, Dyrene
Green peas	H	100	2.00	Propachlor, Dinoseb, Trifluralin
	I	100	2.00	Parathion, Systox, Dimethoate, Malathion, Diazinon
	F	50	6.00	Dithiocarbamates, Copper, Bravo
Watermelon	H	80	6.00	Naptalam, Bensulide
	I	50	2.00	Methoxychlor, Sevin, Thiodan, Phosphamidon
	F	50	10.00	Dithiocarbamates, Bravo, Coppers, Thiram/Captan

[a] H = Herbicides I = Insecticides F = Fungicides

[b] Many chemical scientists believe that "carry over" in the use of herbicides and "persistence" in the use of insecticides may be largely eliminated in the next five years. This means that some chemicals now in common use will practically disappear and the new ones having low, if any, residues will be emerging.

kilograms (kg) = pounds (lb) x 0.454
hectare (ha) = acres (acre) x 0.405
kilograms (kg) = tons (ton) x 907.2
metric tons = tons (ton) x 0.907

Table 82

ANIMAL MANURE MULTIPLIERS

Tons of manure for each kind of livestock	X	Tons of nutrient per ton of manure	= Tons of nutrients
Swine	X	.0050	= Tons of nitrogen
"	X	.0014	= Tons of phosphorus
"	X	.0038	= Tons of potash
Cattle	X	.0056	= Tons of nitrogen
"	X	.0010	= Tons of phosphorus
"	X	.0050	= Tons of potash
Sheep	X	.0140	= Tons of nitrogen
"	X	.0021	= Tons of phosphorus
"	X	.0100	= Tons of potash
Horses	X	.0069	= Tons of nitrogen
"	X	.0010	= Tons of phosphorus
"	X	.0060	= Tons of potash
Poultry	X	.0156	= Tons of nitrogen
"	X	.0040	= Tons of phosphorus
"	X	.0035	= Tons of potash

To Convert From	To	Multiply By
Tons (ton)	Kilograms (kg)	907.2
	Metric Tons	0.907

Commercial Fertilizer Information

Commercial fertilizer consumption in this study represents all commercial fertilizer materials or products sold or shipped for farm and non-farm use as fertilizer. Materials used in the manufacturing of registered mixes or for uses other than fertilizer are excluded.

The U.S. Department of Agriculture and the Statistical Reporting Service for each of the eight states publish Annual Summaries. Thus, fertilizer statistics are available nationally and by state. Three states (Ohio, Indiana, and Illinois) provide county fertilizer summaries.

The fertilizer used on Class I-V farms by counties is available from the 1969 U.S. Census of Agriculture. Fertilizer usage by state for 1972 was available from both the U.S. Department of Agriculture and the Tennessee Valley Authority. The manner of distribution--whether bagged, bulk or liquid--as well as the primary nutrient tonnages were also available for each state. This made it possible to calculate the approximate tons of fertilizer used, the amounts liquid or dry, and the amounts of primary nutrients used by county.

Lime Information

Lime usage information was not readily available from either the U.S. Department of Agriculture Statistics Reports or from most of the State Statistical Reporting Services. The U.S. Department of Agriculture, Agricultural Stabilization and Conservation Offices provided information showing the tons that the government cost-shared in each state, but not the total tons applied.

Road De-Icing Information

The Michigan Highway Department provided information from their files showing the tons of road de-icing salts purchased through the Michigan State Highway Department and used in each of the 83 Michigan counties for year 1972-73. It was the opinion of Michigan Highway officials that these sales represent 100 percent of the salts used on federal and state highways in a county, 50 percent of that used on county roads and 30 percent of that used by municipalities within a county.

To obtain the total amount used, the county purchases were doubled, the municipal purchases were multiplied by 3.33, and these sums were then added to the state purchases.

Michigan highway officials believe this represents the most reasonable approach to estimating the total tonnage applied. With these relationships established and the information provided by the states for each county, the total tons applied on all highways in the counties for 1972-73 were established. This figure is shown in each county report along with the state purchased figure for each county.

It was possible to obtain Michigan county information for Michigan for 3 years, 1970-71, 1971-72, 1972-73. This included the "Tons of Salts Applied Per 'E' Miles of Highway" for each of these 3 years. An 'E' mile of highway is equivalent to a mile of two-lane highway.

Ths procedure used in Michigan to determine the total salt tons applied per county was applied to all counties in the other Basin states. It is believed that the results represent to a reasonable degree the salts applied in the Great Lakes Basin.

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FUTURE TRENDS

INTRODUCTION

The detailed study plan of February 1974 for the International Reference Group on Great Lakes Pollution from Land Use Activities called for an inventory of land use and land use practices with emphasis on certain trends and projections to 1980, and if possible, to 2020. This section presents what is felt to be the major trends in demographic and economic activities, land uses, specialized land uses, and material usages in the near future.

The general purpose of this section is to provide to the PLUARG effort an indication as to the direction specialized land uses and materials usages may take in the forthcoming decades. These findings will form the background for determining the magnitude of water quality problems likely to result from these activities in the near future.

General

In order to provide a general frame of reference to the study, demographic and economic activities projections based upon Revised OBERS Series C and unpublished Series E projections were utilized. These provided what were felt to be reasonable upper and lower limits within which population and economic growth in the Lake Ontario basin are likely to fall within the next several decades. In so doing, the demographic and economic projections provide the setting in which subsequent projections of land uses, specialized land uses, and materials usages were made. The last portion of the section summarizes the methodologies used and the rationale underlying the development of these projections.

Summary and Conclusions

Depending on the OBERS series utilized, the Lake Ontario basin will experience between a 53 percent to a 120 percent growth by 2020. Growth will vary by location as well. Planning Subarea 5.3 at the eastern end of the lake will experience a lower level of growth than the other subareas.

In either projection series, changes in specialized land uses and materials usages are not directly dependent upon economic and demographic trends. Specialized land use trends depend, in addition, upon available technologies, land characteristics, and specific economic factors which many times are not directly related to the larger regional economy. The economic aspects of current agricultural practices will determine to a great extent trends in the types and levels of materials used in the Lake Ontario basin throughout the next decades.

The Lake Ontario basin is projected to grow at a moderate pace in the forthcoming decades. The water quality impacts arising from changing economic and demographic activities, land uses, specialized land use practices and materials usage levels could have moderate impacts in the near future.

Table 83

POPULATION GROWTH(1)(2)

Lake Ontario basin	1970	1980	2000	2020
SERIES C	2,534,244	3,011,668	4,150,609	5,622,759
SERIES E	2,534,244	2,839,700	3,414,200	3,882,400

DEMOGRAPHIC, ECONOMIC, AND LAND USE CHARACTERISTICS

The categories contained in this section include the projected resident population levels, major economic activity sectors (agriculture, mining, construction, manufacturing, transportation and public utilities, trade, finance, services, and government) and major land use activities (urban lands, croplands, pasture, forests, and other lands). The aim is to provide a general picture of what the future may be for these three categories. While not exhaustive in detail, these major categories form the general background in which the later discussions of materials usages and specialized land usages take place.

Population

The Lake Ontario basin occupies the middle spot in population levels among the five lake basins, has less than 10 percent of the total population. The population has grown steadily since 1950 overall. This growth has been concentrated in Planning Subareas 5.1 and 5.2 with 41 percent and 33 percent growth since 1950. Planning Subarea 5.3 had an initial increase in population between 1950 and 1962, but has declined in population since that time.

Non-residents swell the population of portions of this lake basin during the vacation season. With better means of transportation and increasing participation in winter sports, non-residents are increasing their duration of stay.

Table 84

POPULATION LEVELS: 1950 - 1971[2]

	1950	1962	1969	1970	1971
Lake Ontario basin	1,937,429	2,322,724	2,524,731	2,534,244	2,566,692
PSA 5.1	689,443	830,323	943,927	947,185	967,217
PSA 5.2	1,036,940	1,264,963	1,354,344	1,362,641	1,376,116
PSA 5.3	211,046	227,438	226,460	224,418	223,359

Economics

In most categories, the Lake Ontario basin registered a slightly smaller economic share (earnings by sector/area population) than the Great Lakes as a whole. In the agricultural and governmental sectors, the Lake Ontario basin's economic shares are slightly above the Great Lakes Basin's economic shares for those categories.

The Lake Ontario basin has a per capita income equal to that of the United States as a whole in 1970, but slightly below that of the Great Lakes Basin. Planning Subarea 5.1 is above the basin average per capita income, but Planning Subareas 5.2 and 5.3 are below the basin and the Lake Ontario basin average per capita income. The labor force participation rate relative to total population levels is equal to the Great Lakes Basin rate overall.

Agricultural Production

The major agricultural crops grown in the Lake Ontario basin in order of rank are: oats, commercial vegetables and grain corn. The basin produces almost one-fourth of the Great Lakes total of commercial vegetables. Planning Subarea 5.2 is the chief agricultural producer, with Planning Subarea 5.1 close behind. Planning Subarea 5.3 does not have extensive agricultural production.

Table 85

POPULATION, EMPLOYMENT, PERSONAL INCOME, AND EARNINGS BY INDUSTRY; 1970 (5)

	Great Lakes Basin	Lake Ontario Basin	PSA 5.1	PSA 5.2	PSA 5.3
Population, midyear	29,409,179	2,534,203	947,185	1,362,600	224,418
Per capita income (1967 dollars)	3,777	3,470	3,837	3,329	2,779
Per capita income Rel. (U.S.=1.00)	1.09	1.00	1.10	.96	.80
Total employment	11,493,713	980,490	380,750	523,900	75,840
Employment/population ratio	.39	.39	.40	.39	.34
Total personal income	111,069,256	8,85,101	3,634,497	4,427,043	623,561
Total earnings	90,696,631	6,870,727	2,959,463	3,453,800	457,464
Agriculture, forestry & fisheries	1,121,278	188,509	73,279a	80,300a	34,930a
Agriculture	-	-	-	-	-
Forestry and fisheries	-	-	-	-	-
Mining	139,401	20,009	4,617c	7,300b	8,092a
Metal	-	-	-	-	
Coal	-	-	-	-	-
Crude petroleum & natural gas	-	-	-	-	-
Nonmetallic, except fuels	-	-	-	-	-
Contract construction	5,392,933	373,673	145,626	202,500	25,547
Manufacturing	35,467,905	2,521,628	1,393,826	1,009,400	118,402
Food & kindred products	-	-	-	-	-
Textile mill products	-	-	-	-	-
Apparel & other fabric products	-	-	-	-	-
Lumber products & furniture	-	-	-	-	-
Paper and allied products	-	-	-	-	-
Printing and publishing	-	-	-	-	-
Chemicals and allied products	-	-	-	-	-
Petroleum refining	-	-	-	-	-
Primary metals	-	-	-	-	-
Fabricated metals & ordinance	-	-	-	-	-
Machinery, excluding electrical	-	-	-	-	-
Electrical machinery & supplies	-	-	-	-	-
Motor vehicles & equipment	-	-	-	-	-
Transportation equip., excl. mtr vehs.	-	-	-	-	-
Other manufacturing	-	-	-	-	-
Trans., comm. & public utilities	5,961,189	407,833	119,541	262,400	25,892
Wholesale and retail trade	14,785,401	1,025,634	378,446	578,500	68,688
Finance, insurance & real estate	3,909,791	249,728	99,873	136,500a	13,355
Services	12,379,947	936,184	359,103	516,448	60,633
Government	11,222,068	1,116,140	378,190	637,300	100,650
Federal government	1,924,828	144,542	35,804	95,200	13,538
State and local government	8,643,999	917,735	333,725	500,400	83,610
Armed forces	653,032	53,662	8,661	41,500	3,501

*Employment is for 1960
a-represents 80.0 to 99.9 percent of the true value
b-represents 60.0 to 79.9 percent of the true value
c-represents 40.0 to 59.9 percent of the true value
d-represents 20.0 to 39.9 percent of the true value
e-represents zero to 19.9 percent of the true value
s-too small to project

Table 86

AGRICULTURAL PRODUCTION, CURRENT NORMAL AVERAGE (1958-1972)[2]

Crop	Units	Great Lakes Basin	Lake Ontario Basin	PSA 5.1	PSA 5.2	PSA 5.3
Wheat	Bu.	68,514	4,377	2,036	2,296	45
Oats	Do.	102,135	14,591	4,431	7,562	2,598
Rye	Do.	1,624	230	87	143	–
Barley	Do.	2,089	161	63	86	12
Corn for grain	Do.	349,759	10,824	4,021	6,712	91
Corn silage	Ton	14,962	2,994	828	1,637	529
Soybeans	Bu.	65,426	55	4	51	**
Dry E.D. beans	Cwt.	7,625	1,902	778	1,124	**
Sugar beets	Ton	1,515	–	–	–	–
Potatoes	Cwt.	20,226	4,368	2,040	2,257	71
Fruits	Ton	1,095	204	60	144	–
Comm. vegetables	Cwt.	46,363	11,089	5,121	5,968	–
Alfalfa hay*	Ton	8,991	1,596	460	848	288
Clover & Timothy hay*	Ton	3,070	1,023	185	410	428
Cropland pasture*	Ton	699	105	22	83	–
Improved pasture*	Ton	–	–	–	–	–
Improvable pasture*	Ton	–	–	–	–	–
N.Improv. pasture*	Ton	–	–	–	–	–

*Alfalfa hay equivalents (tons).

**Less than 500 units.

To Convert From	To	Multiply By
Tons (ton)	Kilograms (kg)	907.2
	Metric ton	0.907
Hundredweight (cwt)	Kilograms (kg)	202.5
Bushels (bu)	Hectolitre (hl)	0.352

Livestock

Planning Subarea 5.2 contains the majority of the total livestock in this lake basin. It is the leader in all categories except sheep and lambs and produces over 70 percent of the total number of chickens. Planning Subarea 5.3 produces the least amount in each category, except for turkeys and cattle. Total livestock numbers will not likely decrease in the near future.

Table 87

LIVESTOCK: 1972[3]

	Lake Ontario basin	PSA 5.1	PSA 5.2	PSA 5.3
Swine	45,036	18,947	22,869	3,220
Cows & Heifers Calved	462,507	105,517	220,917	136,073
Heifers,Steers,Bulls, Calves	333,474	76,080	159,285	98,109
Sheep & Lambs	60,434	30,198	28,639	1,597
Horses & Ponies	68,523	20,829	36,059	11,635
Chickens	3,152,725	663,391	2,252,438	236,896
Turkey Hens	12,910	800	7,110	5,000
Turkeys Raised	129,100	8,000	71,100	50,000

Land Use

In the Lake Ontario basin, the total land area encompasses 4,565,000 hectares (11,271,700 acres). Compared to the Great Lakes Basin as a whole, the Lake Ontario basin has less land in urban and cropland uses, and more in pasture-range and forest land. Planning Subarea 5.1 contains more land in urban and cropland use and less in forest and pasture than the other two planning subareas. Planning Subarea 5.3 has the least (4 percent) urban land use, the lease cropland use (19 percent) and the most area in forest land (65 percent). This subarea has had more constant land use patterns and the natural environment acts as a favorable asset to the tourist and recreational economy of the Lake Ontario basin.

Table 88

PRESENT LAND USE: 1966-1967 BASE[4]
(Area Measured By County Boundaries)
(1000 acres)

	TOTAL LAND AREA	URBAN		CROPLAND		PASTURE RANGE		FOREST LAND		OTHER	
		Area	Percent Land Area	Area	Percent Land Area	Area	Percent Land Area	Area	Percent Land Area	Area	Percent Land Area
Lake Ontario basin	11,271.7	667.7	6	3,448.1	30	861.0	8	5,632.6	50	66].2	6
PSA 5.1											
New YOrk	2,458.7	271.1	11	1,055.1	43	162.9	7	871.5	35	98.1	4
PSA 5.2											
New York	5,427.4	250.7	5	1,759.1	32	443.7	8	2,545.7	47	428.2	8
PSA 5.3											
New York	3,385.6	145.9	4	633.9	19	254.4	8	2,215.4	65	136.0	4

To Convert From	To	Multiply By
Acres (acres)	Hectares (ha)	0.405

Currently (1970), in the Lake Ontario basin, 56 percent of the cultivated agricultural lands are in cropland, with hay and pasture accounting for over one-half the cropland. Permanent pasture accounts for 2 percent, and idled cropland 24 percent of the cultivated agricultural land use.

Over one-half the acreage of each type of agricultural land is found in Planning Subarea 5.2, except for hay and pasture, where 48 percent of the total is found, and idled cropland, of which Planning Subarea 5.2 has 49 percent.

Table 89

AGRICULTURAL ACREAGE UNDER CULTIVATION BY CATEGORIES CURRENT NORMAL AVERAGE (1958-1972)[4]

(1,000 acres)

	Lake Ontario Basin	PSA 5.1	PSA 5.2	PSA 5.3
Specialty Crops	234.3	88.4	145.7	.3
Row Crops	457.0	148.1	271.7	37.2
Small Grains	398.4	134.3	208.8	55.3
Hay & Pasture	1,306.0	286.8	620.9	398.3
Total Cropland	2,395.7	657.6	1,247.1	491.0
Idled Cropland	1,052.4	397.5	512.0	142.9
Permanent Pasture	861.0	162.9	443.7	254.4
TOTAL	4,309.1	1,218.0	2,202.8	888.3

To Convert From	To	Multiply By
Acres (acre)	Hectares (ha)	0.405

In terms of crops grown, the major harvested acreage is used for alfalfa hay, clover and timothy hay, and oats. This lake basin generally has less than 10 percent of the total Great Lakes Basin acreage devoted to a particular crop. The largest portion of the total in this lake basin is in clover and timothy hay, with 30 percent of the Great Lakes total.

Land use figures in this section are taken from the Great Lakes Basin Framework Study, Appendix 13 "Land Use and Management", to be consistent with the trends used, from the same source.

Table 90

AGRICULTURAL LAND USE: CURRENT NORMAL ESTIMATES (1958-1972)(2)

Crop	GREAT LAKES Acres	GREAT LAKES Hectares	LAKE ONTARIO Acres	LAKE ONTARIO Hectares	PSA 5.1 Acres	PSA 5.1 Hectares	PSA 5.2 Acres	PSA 5.2 Hectares	PSA 5.3 Acres	PSA 5.3 Hectares
Wheat	1,756.3	710.7	120.3	48.8	55.0	22.3	63.4	25.7	1.9	.8
Oats	1,695.9	686.4	261.8	106.0	75.6	30.6	133.1	53.9	53.1	21.5
Rye	59.8	24.1	6.6	2.7	2.5	1.0	4.1	1.7	–	–
Barley	44.7	18.1	3.3	1.3	1.2	.5	1.8	.7	0.3	.1
Misc. Small Grains	42.6	17.3	6.4	2.6	–	–	6.4	2.6	–	–
Corn for Grain	4,369.5	1,768.2	150.8	61.0	54.3	22.0	95.0	38.4	1.5	.6
Corn Silage	1,220.8	494.1	216.5	87.6	58.6	23.7	122.2	49.5	35.7	14.4
Soybean	2,605.5	1,054.2	2.2	0.8	0.1	–	2.1	.8	–	–
Dry E.D. Beans	755.3	305.6	87.5	35.4	35.1	14.2	52.4	21.2	–	–
Sugar Beets	124.8	50.5	–	–	–	–	–	–	–	–
Potatoes	151.7	61.4	23.4	9.4	11.8	4.8	11.5	4.6	0.1	–
Fruits	600.1	243.2	101.5	41.0	30.4	12.3	71.0	28.7	0.1	–
Comm. Vegetables	520.5	210.6	109.4	44.3	46.2	18.7	63.2	25.6	–	–
Comm. Sod	52.7	21.4	0.5	0.2	0.4	.2	0.1	–	–	–
Alfalfa hay	3,699.1	1,497.0	627.1	253.7	172.1	69.6	334.9	135.5	120.1	48.6
Clover & Timothy Hay	1,921.1	777.3	571.8	231.4	101.0	40.9	222.6	90.1	248.2	100.4
Cropland Pasture	1,041.6	421.5	106.6	43.1	13.3	5.4	63.3	25.6	30.0	12.1
Idle Cropland	7,947.4	3,216.2	1,052.4	425.9	397.5	160.9	512.0	207.2	142.9	57.8
Total Cropland	28,609.2	11,578.2	3,448.0	1,395.2	1,055.1	427.1	1,759.0	711.8	633.9	256.3
Improved Pasture	934.2	378.1	205.8	83.3	46.8	18.9	119.0	48.2	40.0	16.2
Improvable Pasture	2,245.7	908.8	459.9	186.2	116.1	47.0	272.5	110.3	71.3	28.9
N. Improv. Pasture	324.6	131.3	195.3	79.0	–	–	52.2	21.1	143.1	57.9
Total Pasture	3,504.4	1,418.4	861.0	348.5	162.9	65.9	443.7	179.6	254.4	103.0
Total Ag. Land[1/]	32,113.6	12,996.1	4,309.1	1,743.7	1,218.0	493.0	2,202.8	891.4	888.3	359.3

[1/] Totals may not add due to rounding.

Alternative Futures

Any specific set of economic, demographic, and land use projections is subject to considerable conjecture. Therefore, at least two sets of alternative futures are considered. The projections in this report are based on the 1972 Revised OBERS Series C and Series E national economic and demographic projections. Population, personal income, and cropland harvested differences between the two series are caused primarily by different population growth rate assumptions. However, the following additional changes are also contribute to differences in the two projections.

(1) The hours worked per year are projected to decline at the rate of 0.35 percent per year in the Series E data, while the Series C assumed a 0.25 percent rate.

(2) The projected rate of increase in product per man per hour in the private economy is lowered from 3.0 percent in the Series C projections to 2.9 percent in the Series E projections.

(3) Earning per worker in the individual industries at the national level are projected to converge towards the all-industry rate more slowly in the Series E projections than found in the Series C projections.

(4) Income data for 1970 and 1971 and total employment data for 1970 were included in the Series E projections. This additional information was not available for the Series C information, and has caused some changes in certain area projections.

(5) On the basis of the President's 1974 budget message to Congress, a smaller military establishment has been assumed in Series E.

The differences in population growth between the Series C projections and Series E projections lies mainly in the total fertility rates per 1,000 women assumed to be attained by the year 2005. For Series C, the total fertility rates per 1,000 women is assumed to be 2,800 by the year 2005, and for the Series E projections the assumed fertility rates per 1,000 women are 2,100 for the year 2005. The Series E projections move quickly towards a near zero population growth level. Due to the present character of the age structure of the population, a near zero growth is not reached until the middle of the 21st Century. While neither projection trend is an accurate picture of the eventual growth rate in the Lake Ontario region by the year 2020, the probably growth rate will likely fall somewhere in between these ranges.

Demographic Trends

Population projections range from a low of 2,839,700 persons to 3,011,668 persons by 1980, based on the Series E and C projections respectively. Series C projects increased growth throughout the basin for all three time periods. By 2000 the population would grow 1.6 times, and by 2020 would be 2.2 times the population level in 1970. Series E projects that the population will increase 1.35 times by 2000 and 1.5 times by 2020 based upon 1970 levels. Overall, the two projections predict either a gradually increasing population as contained in the Series E projections, or a more rapidly increasing population growth rate, as contained in the Series C data.

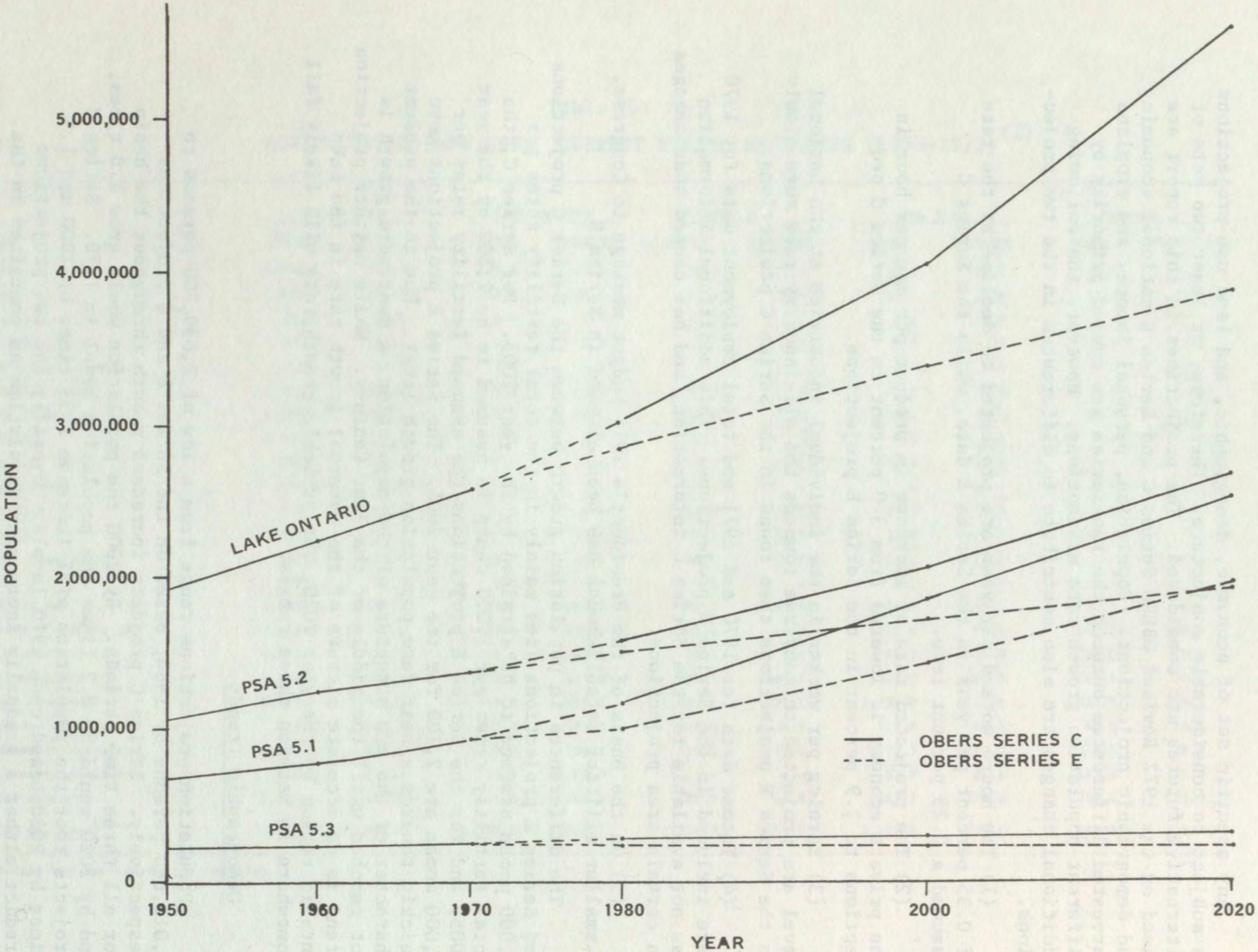

FIGURE 61 Population Levels 1950 to 2020 for Lake Ontario Basin

Series C projections vary between a growth 2.7 times 1970 levels by 2020 in Planning Subarea 5.1 to 1.33 times 1970 levels by 2020 in Planning Subarea 5.3. Series E projections foresee the largest growth occurring in Planning Subarea 5.1, with the 2020 population 1.81 times the 1970 level. Planning Subarea 5.2 will grow by 40 percent in the time period 1970 - 2020, but Planning Subarea 5.3 will have a population growth rate of less than 10 percent.

Table 91

DEMOGRAPHIC PROJECTIONS(1)(2)

	1970	1980		2000		2020	
		SERIES C	SERIES E	SERIES C	SERIES E	SERIES C	SERIES E
Lake Ontario basin	2,534,244	3,011,668	2,839,700	4,150,609	3,414,200	5,622,759	3,882,400
PSA 5.1	947,185	1,184,271	1,110,500	1,786,734	1,442,600	2,604,537	1,716,700
PSA 5.2	1,362,641	1,584,454	1,501,200	2,081,041	1,735,200	2,685,043	1,922,400
PSA 5.3	224,418	225,700	228,000	257,200	236,400	298,600	243,300

Economic Trends

Per capita income levels do not vary greatly between the Series C and the Series E projections in this lake basin. By 2020 the per capita income level will vary by less than 10 percent overall. The major divergence projected is in Planning Subarea 5.3, where by the year 2020, the subarea is projected to have a $14,397 per capita income based on Series C, and a $12,100 per capita income, based on Series E.

Per capita income starts at the U. S. National average, and increases through time above this level. The per capita income relative to the U. S. average in Planning Subarea 5.1 decreases in both projections by 2020. The other two subareas show an increase relative to the U. S. average, with Planning Subarea 5.2 having the largest increase in both projections.

The relationship to the national average is in part dependent upon productivity and overall economic growth, as well as per capita consumption and demand. The employment to population ratio is about five percent greater overall by 2020 in the Series E projections. In all planning subareas the acceleration of the employment to population level is greater in the Series E projections than in Series C. Total earnings in the Series E projections are about 60 percent of thos projections in the Series C data. With respect to earnings by sector, the agricultural decreases to slightly less than one percent in both projections by 2020. Planning Subarea 5.3 has the highest percentage of earnings from agriculture forecasted for 2020 - 3 percent in Series E and 4 percent in Series C.

Earnings in mining account for well less than one percent of total earnings throughout the time period in both projections. Earnings from contract construction will remain at about 6 percent throughout the time period for both projections. Manufacturing earnings as a portion of total earnings are projected to decline in both Series C and Series E. Both will decline about 6 to 7 percent overall, from 36 percent of total earnings in 1980 for Series C and 33 percent in Series E, to 30 percent and 27 percent

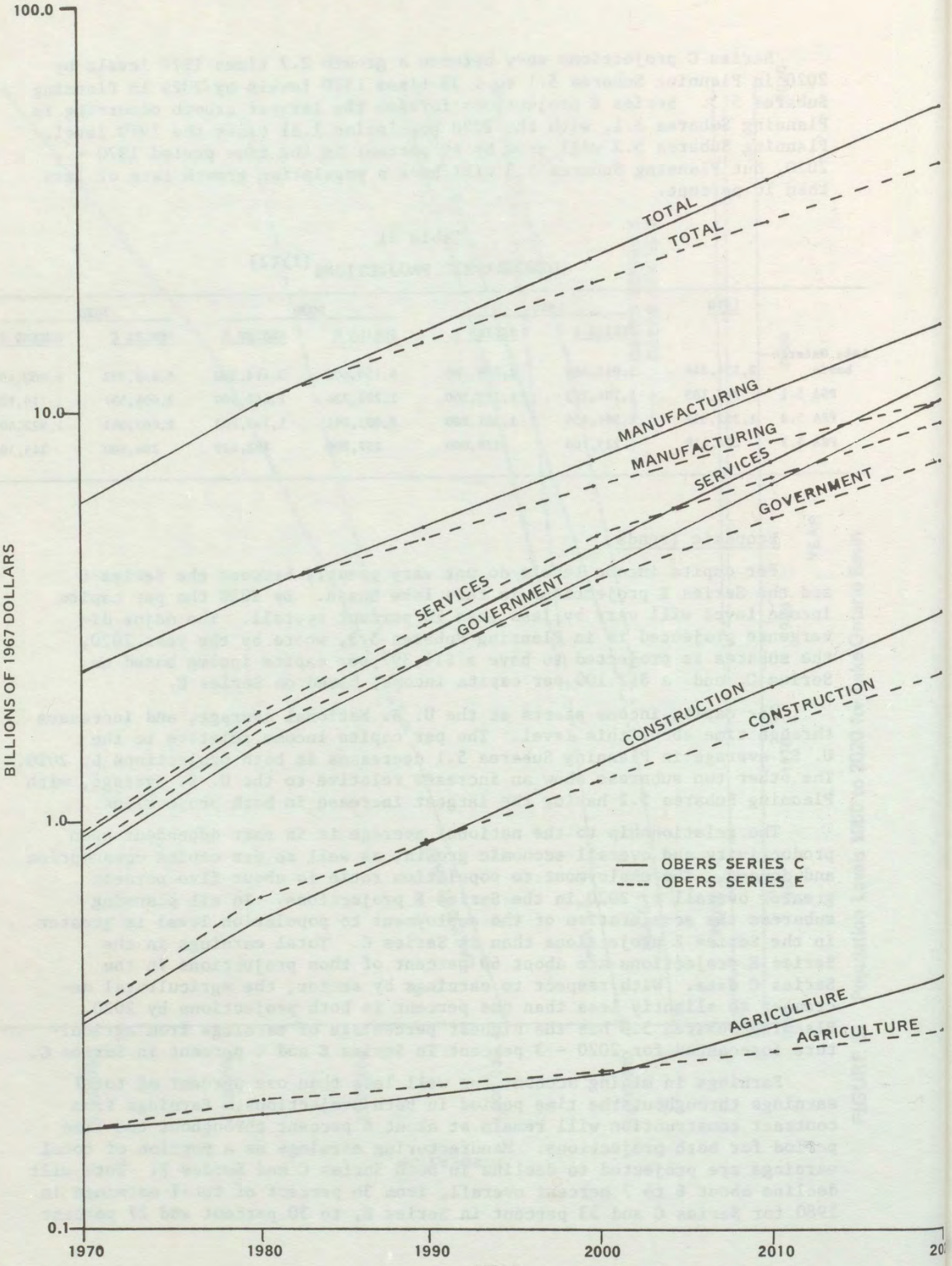

FIGURE 62 Earnings by Sector 1970 to 2020 for Lake Ontario Basin

respectively in 2020. The greatest decline will be in Planning Subarea 5.1, whose earning in manufacturing as a percent of total earnings decline 8 percent in both projections.

Earnings in transportation as a percent of the total are projected to decline slightly in Series C, and to increase slightly in the Series E projections. The transportation sector will be 4 to 6 percent of total earnings in all planning subareas for both projections, except in Planning Subarea 5.2 in Series E. Here, transportation will have 7 to 8 percent of the total earnings.

The wholesale and retail trade sector earnings as a percentage of total earnings remains relatively constant. Series C shows a one percent increase in earnings as a percent of the total between 1980 and 2020, while Series E shows about a one percent decrease. Earnings in this sector are greatest in Planning Subarea 5.2. Earnings in finance, insurance and real estate, as a percent of total earnings will increase by less than one percent in Series C, and by about one percent in Series E for all planning subareas and for the basin as a whole.

Both Series C and Series E project increases in the earnings of the service sector as a percent of total earnings. In Series C the increase is from 15 to 18 percent of total earnings, while Series E projects an increase from 17 to 24 percent of total earnings between 1980 and 2020 for the region.

The projected earnings in the government sector as a percent of the total earnings are 2 percent less in Series E than in Series C. Both are around 17 percent of total earnings in 1980 and increase to 19 and 22 percent for Series E and C respectively. Planning Subarea 5.3 has the largest portion of its total earnings coming from this sector than any of the other subareas. By 2020, 36 to 44 percent of the total earnings in Planning Subarea 5.3 will be from the governmental sector for Series E and C respectively.

Compared with 1970 information of earnings by industry, the proportion of earnings from different sectors of the economy remains relatively stable (less than 5 percent increase or decrease) with the exception of manufacturing and services. Manufacturing is expected to decrease from the current (1970) Lake Ontario average of 37 percent of total earnings to around 27 to 30 percent of total earnings by 2020. Services will grow from 13 percent of total earnings to 18 to 24 percent of total earnings by 2020.

Table 92

POPULATION, EMPLOYMENT, PERSONAL INCOME, AND EARNINGS
BY INDUSTRY: 1970, 1980, 2000, 2020
LAKE ONTARIO BASIN
SERIES C (1)

	1970	1980	2000	2020
Population, midyear	2,534,244	3,011,668	4,150,609	5,622,759
Per capita income (1967 dollars)	3,470	4,850	8,531	14,801
Percapita income Rel. (U.S.=1.00)	1.00	1.02	1.03	1.04
Total employment	980,490	1,193,156	1,687,814	2,315,901
Employment/population ratio	.39	.40	.41	.41
Total personal income	8,685,101	14,607,895	35,408,925	83,224,860
Total earnings	6,870,727	11,367,900	26,939,000	62,318,730
Agriculture, forestry & fisheries	188,509	208,100	257,240	448,740
Agriculture	-	207,740	256,600	447,800
Forestry and fisheries		(S)	(S)	(S)
Mining	20,009	24,430	43,340	80,100
Metal	-	-	-	-
Coal	-	-	-	-
Crude petroleum & natural gas	-	-	-	-
Nonmetallic, except fuels	-	-	-	-
Contract construction	373,673	659,340	1,579,900	3,665,600
Manufacturing	2,521,628	3,958,640	8,300,600	17,492,400
Food & kindred products	-	(D)	(D)	(D)
Textile mill products	-	30,640	44,680	68,870
Apparel & other fabric products	-	69,550	103,900	162,670
Lumber products & furniture	-	40,800	65,460	109,430
Paper and allied products	-	(D)	(D)	(D)
Printing and publishing	-	(D)	(D)	(D)
Chemicals and allied products	-	(D)	(D)	(D)
Petroleum refining	-	(D)	(D)	(D)
Primary metals	-	(D)	(D)	(D)
Fabricated metals & ordinance	-	(D)	(D)	(D)
Machinery, excluding electrical	-	(D)	(D)	(D)
Electrical machinery & supplies	-	(D)	(D)	(D)
Motor vehicles & equipment	-	(D)	(D)	(D)
Transportation equip., excl. mtr vehs.	-	(D)	(D)	(D)
Other manufacturing	-	(D)	(D)	(D)
Trans., comm. & public utilities	407,833	593,900	1,303,710	2,872,960
Wholesale and retail trade	1,025,634	1,755,740	4,297,350	10,212,150
Finance, insurance & real estate	249,728	415,640	1,020,480	2,437,570
Services	936,184	1,710,700	4,599,500	11,417,500
Government	1,116,140	3,921,215	5,472,760	13,569,400
Federal government	144,542	-	-	-
State and local government	917,735	-	-	-
Armed forces	53,662	54,510	85,450	136,560

(D) Deleted to avoid disclosure of data pertaining to an individual establishment

(S) Too small to project.

Table 93

POPULATION, EMPLOYMENT, PERSONAL INCOME, AND EARNINGS
BY INDUSTRY: 1970, 1980, 2000, 2020
LAKE ONTARIO BASIN
SERIES E (2)

	1970	1980	2000	2020
Population, midyear	2,534,203	2,839,700	3,414,200	3,882,400
Per capita income (1967 dollars)	3,470	4,900	8,500	13,800
Percapita income Rel. (U.S.=1.00)	1.00	1.04	1.04	1.04
Total employment	980,490	1,239,700	1,563,300	1,755,600
Employment/population ratio	.39	.44	.46	.46
Total personal income	8,685,101	13,722,200	28,517,800	52,813,700
Total earnings	6,870,727	10,726,100	21,904,300	40,270,700
Agriculture, forestry & fisheries	188,509	208,100	247,400	313,400
Agriculture	-	207,800	246,800	312,200
Forestry and fisheries	-	(S)	(S)	(S)
Mining	20,009	34,000	49,500	70,400
Metal	-	7,900	9,700	12,500
Coal	-	-	-	-
Crude petroleum & natural gas	-	1,100	1,000	1,100
Nonmetallic, except fuels	-	24,900	38,600	56,700
Contract construction	373,673	660,700	1,291,000	2,262,500
Manufacturing	2,521,628	3,576,100	6,430,700	10,745,800
Food & kindred products	-	189,300	258,700	352,800
Textile mill products	-	20,400	23,400	29,900
Apparel & other fabric products	-	42,200	49,300	64,400
Lumber products & furniture	-	48,300	92,400	155,000
Paper and allied products	-	128,300	231,100	385,200
Printing and publishing	-	171,200	353,500	630,500
Chemicals and allied products	-	150,900	293,200	520,200
Petroleum refining	-	3,100	5,100	8,200
Primary metals	-	140,900	172,000	220,900
Fabricated metals & ordinance	-	149,500	260,100	422,700
Machinery, excluding electrical	-	552,400	891,800	1,372,600
Electrical machinery & supplies	-	525,400	936,300	1,605,900
Motor vehicles & equipment	-	109,000	222,600	392,900
Transportation equip., excl. mtr vehs.	-	24,200	42,700	66,500
Other manufacturing	-	1,317,400	2,594,200	4,513,300
Trans., comm. & public utilities	407,833	622,800	1,309,500	2,435,300
Wholesale and retail trade	1,025,634	1,538,700	2,925,100	5,060,300
Finance, insurance & real estate	249,728	481,700	1,115,200	2,171,500
Services	936,184	1,814,900	4,534,900	9,474,200
Government	1,116,140	1,787,500	3,999,800	7,736,000
Federal government	144,542	224,600	486,900	999,400
State and local government	917,735	1,506,600	3,424,300	6,595,600
Armed forces	53,662	56,200	88,100	140,700

(D) Deleted to avoid disclosure of data pertaining to an individual establishment

(S) Too small to project.

Table 94

CROP PRODUCTION 1980, 2000, 2020[4]
SERIES C
(1000 units)

Crop	Units	LAKE ONTARIO Current Normal	LAKE ONTARIO 1980	LAKE ONTARIO 2000	LAKE ONTARIO 2020	PSA 5.1 Current Normal	PSA 5.1 1980	PSA 5.1 2000	PSA 5.1 2020
Wheat	Bu.	4,377	4,272	5,828	9,005	2,036	1,355	1,617	2,656
Oats	Do.	14,591	24,264	18,773	14,892	4,431	4,527	5,039	3,090
Rye	Do.	230	152	226	338	87	57	88	135
Barley	Do.	161	918	1,009	956	63	237	224	197
Corn for grain	Do.	10,824	11,557	9,085	16,514	4,021	4,228	3,325	3,124
Corn silage	Ton	2,994	2,820	3,746	5,263	828	842	1,184	1,583
Soybeans	Bu.	55	15	18	184	4	**	-	-
Dry E.D. beans	Cwt.	1,902	1,275	1,442	1,614	778	592	691	807
Sugar beets	Ton	-	-	-	-	-	-	-	-
Potatoes	Cwt.	4,368	4,490	6,146	8,565	2,040	2,330	3,189	4,444
Fruits	Ton	204	255	366	523	60	63	90	129
Comm. vegetables	Cwt	11,089	14,498	18,390	23,113	5,121	7,600	10,426	14,403
Alfalfa hay*	Ton	1,596	1,461	1,491	1,730	460	453	461	553
Clover & Timothy hay*	Ton	1,023	1,103	1,040	1,053	185	262	193	203
Cropland pasture*	Ton	NA	134	135	200	NA	22	20	33
Improved pasture*	Ton	-	-	569	622	-	-	133	144
Improvable pasture*	Ton	-	-	674	741	-	-	167	182
N. Improv. pasture*	Ton	-	-	115	131	-	-	-	-

Crop	Units	PSA 5.2 Current Normal	PSA 5.2 1980	PSA 5.2 2000	PSA 5.2 2020	PSA 5.3 Current Normal	PSA 5.3 1980	PSA 5.3 2000	PSA 5.3 2020
Wheat	Bu.	2,296	2,902	4,194	6,296	45	15	17	53
Oats	Do.	7,562	15,869	11,206	9,832	2,598	3,868	2,528	1,970
Rye	Do.	143	95	138	203	**	**	**	**
Barley	Do.	86	651	755	731	12	30	30	28
Corn for grain	Do.	6,712	7,300	5,732	13,363	91	29	28	27
Corn silage	Ton	1,637	1,589	2,089	3,034	529	389	473	646
Soybeans	Bu.	51	15	18	184	-	-	-	-
Dry E.D. beans	Cwt.	1,124	683	751	807	-	-	-	-
Sugar beets	Ton	-	-	-	-	-	-	-	-
Potatoes	Cwt.	2,257	2,118	2,899	4,040	71	42	58	81
Fruits	Ton	144	192	276	394	**	*	**	*
Comm. vegetables	Cwt.	5,968	6,876	7,944	8,683	-	22	20	27
Alfalfa hay*	Ton	848	751	786	870	288	257	244	307
Clover & Timothy hay*	Ton	410	483	470	387	428	358	377	463
Cropland pasture*	Ton	NA	83	85	126	NA	29	30	41
Improved pasture*	Ton	-	-	339	371	-	-	97	107
Improvable pasture*	Ton	-	-	406	446	-	-	101	113
N. Improv. Pasture*	Ton	-	-	43	47	-	-	72	84

*Alfalfa hay equivalents (tons).
**Less than 500 units.

To Convert From	To	Multiply By
Tons (ton	Kilograms (kg)	907.2
	Metric ton	0.907
Hundredweight (cwt)	Kilograms (kg)	202.5
Bushels (bu)	Hectolitre (hl)	0.352

Table 95

CROP PRODUCTION 1980, 2000, 2020 (2)
SERIES E
(1000 units)

Crop	Units	LAKE ONTARIO Current Normal	LAKE ONTARIO 1980	LAKE ONTARIO 2000	LAKE ONTARIO 2020	PSA 5.1 Current Normal	PSA 5.1 1980	PSA 5.1 2000	PSA 5.1 2020
Wheat	Bu.	4,377	4,480	4,033	4,718	2,036	1,906	1,423	1,344
Oats	Do.	14,591	17,364	24,305	30,122	4,431	5,194	7,298	9,648
Rye	Do.	230	300	399	542	87	107	142	190
Barley	Do.	161	137	26	17	63	56	10	9
Corn for grain	Do.	10,824	22,702	31,937	40,086	4,021	8,060	11,808	14,512
Corn silage	Ton	2,994	2,471	2,253	1,662	828	768	664	516
Soybeans	Bu.	55	28	20	17	4	**	**	**
Dry E.D. beans	Cwt.	1,902	682	363	222	778	282	154	100
Sugar beets	Ton	-	-	-	-	-	-	-	-
Potatoes	Cwt.	4,368	4,073	3,449	2,653	2,040	1,823	1,544	1,188
Fruits	Ton	204	369	342	401	60	220	272	331
Comm. vegetables	Cwt.	11,089	11,538	12,113	12,982	5,121	5,519	6,047	6,480
Alfalfa hay*	Ton	1,596	1,548	1,469	1,423	460	452	442	399
Clover & Timothy hay*	Ton	1,023	995	950	886	185	190	189	148
Cropland pasture*	Ton	105	134	134	200	22	22	20	33
Improved pasture*	Ton	-	372	571	631	-	84	131	142
Improvable pasture*	Ton	-	505	677	750	-	126	165	179
N. Improv. pasture*	Ton	-	111	116	132	-	-	-	-

Crop	Units	PSA 5.2 Current Normal	PSA 5.2 1980	PSA 5.2 2000	PSA 5.2 2020	PSA 5.3 Current Normal	PSA 5.3 1980	PSA 5.3 2000	PSA 5.3 2020
Wheat	Bu.	2,296	2,537	2,587	3,361	45	37	23	13
Oats	Do.	7,562	9,044	13,009	15,918	2,598	3,126	3,998	4,556
Rye	Do.	143	184	245	340	-	9	12	12
Barley	Do.	86	81	16	8	12	**	**	**
Corn for grain	Do.	6,712	14,467	19,854	25,260	91	175	275	314
Corn silage	Ton	1,637	1,233	1,183	830	529	470	406	316
Soybeans	Bu.	51	28	20	17	**	**	**	**
Dry E.D. beans	Cwt.	1,124	400	209	122	**	**	**	**
Sugar beets	Ton	-	-	-	-	-	-	-	-
Potatoes	Cwt.	2,257	2,051	1,736	1,336	71	199	169	129
Fruits	Ton	144	149	70	70	-	*	*	*
Comm. vegetables	Cwt.	5,968	5,957	5,993	6,424	-	62	73	78
Alfalfa hay*	Ton	848	782	665	616	288	314	362	408
Clover & Timothy hay*	Ton	410	372	306	277	428	433	455	461
Cropland pasture*	Ton	83	83	85	126	-	29	30	41
Improved pasture*	Ton	-	215	343	381	-	73	97	108
Improvable pasture*	Ton	-	300	411	458	-	79	101	113
N. Improv. Pasture*	Ton	-	29	44	48	-	82	72	84

*Alfalfa hay equivalents (tons).
**Less than 500 units.

To Convert From	To	Multiply By
Tons (ton	Kilograms (kg)	907.2
	Metric ton	0.907
Hundredweight (cwt)	Kilograms (kg)	202.5
Bushels (bu)	Hectolitre (hl)	0.352

Livestock Trends

Tables 96 and 97 present the livestock production for eight livestock products, based on OBERS Series C and E data. In Series C, all livestock production is projected to increase throughout the period 1980 to 2020, except for turkey production. In Series E, declines are foreseen for all livestock production except eggs and milk production throughout the time period.

With Series C, each planning subarea share of the Lake Ontario total projected output remains constant through time. In Series E, projected shares vary slightly (less than one percent) between 1980 and 2020. The major shift will be in broilers and turkeys in this projection. Broiler production will decrease to nothing, and turkey production will also be zero in Planning Subarea 5.1 by 2020.

Planning Subarea 5.2 will produce 45 to 49 percent of the total livestock in this lake basin for Series E and Series C throughout the time period 1980 to 2020. The livestock will be fairly evenly split between Planning Subarea 5.1 and 5.2. Beef and veal production will follow the total production levels in proportion per planning subarea for both projections, with the major portion in Planning Subarea 5.2. Pork production is fairly evenly split between Planning Subarea 5.1 and 5.2 with 4 to 11 percent in Planning Subarea 5.3. Lamb and mutton are also primarily found in Planning Subarea 5.1 and 5.2. Series C projects the majority (60 percent) to be in Planning Subarea 5.2, while Series E projects about 47 percent each in Planning Subarea 5.1 and 5.2. Chickens will primarily be found in Planning Subarea 5.2 with 59 to 64 percent of the total. Planning Subarea 5.1 will have 15 to 26 percent of the total depending on the projection used, while Planning Subarea 5.3 will have 10 to 26 percent of the total chickens throughout the time period. Broilers will be reduced to zero by 2020 in Series E projections. In 1980, 66 percent of the broilers are found in Planning Subarea 5.3 in Series E, but in Series C, 42 percent are in Planning Subarea 5.1 and another 56 percent in Planning Subarea 5.2. Most of the turkeys are found inPlanning Subarea 5.2 and 5.3. In 1980, 5 to 8 percent are found in Planning Subarea 5.1, but by 2020 in Series E there are no turkeys found in this planning subarea. Series E shows a greater concentration of egg production in Planning Subareas 5.1 and 5.2, with less than 10 percent of the total production in Planning Subarea 5.3. In contrast, Series C has 19 percent of the total production in Planning Subarea 5.1, 48 percent in Planning Subarea 5.2 and 43 percent in Planning Subarea 5.3. Milk production generally follows the total livestock production with 26 percent in Planning Subarea 5.1, 44 to 48 percent in Planning Subarea 5.2, and 25 to 30 percent in Planning Subarea 5.3.

Table 96

PROJECTED LIVESTOCK PRODUCTION (5)
SERIES C
(1000 units)

Livestock Production	Units	LAKE ONTARIO BASIN 1960	1980	2000	2020	PSA 5.1 1960	1980	2000	2020
Beef & Veal	Lb.	237,313	289,870	406,759	571,450	56,994	75,536	105,996	148,912
Pork	Lb.	18,546	11,238	15,514	21,528	7,974	5,619	7,757	10,764
Lamb & Mutton	Lb.	6,920	4,489	6,273	8,807	4,405	1,505	2,103	2,953
Chicken	Lb.	11,236	11,166	15,372	21,275	2,425	1,684	2,319	3,209
Broilers	Lb.	10,514	2,234	3,049	4,197	4,002	942	1,285	1,769
Turkeys	Lb.	8,100	3,098	4,254	5,882	360	155	213	294
Eggs	Doz.	58,044	45,792	62,995	87,481	13,299	8,777	12,075	16,768
Milk	Lb.	4,714,859	5,672,889	7,769,609	10,723,590	1,097,663	1,482,414	2,030,330	2,802,255

Livestock Production	Units	PSA 5.2 1960	1980	2000	2020	PSA 5.3 1960	1980	2000	2020
Beef & Veal	Lb.	117,611	144,463	202,717	284,794	62,708	69,871	98,046	137,744
Pork	Lb.	9,175	5,108	7,052	9,785	1,397	511	705	979
Lamb & Mutton	Lb.	2,229	2,709	3,786	5,315	286	275	384	539
Chicken	Lb.	8,111	6,592	9,075	12,560	700	2,890	3,978	5,506
Broilers	Lb.	6,456	1,241	1,694	2,332	56	51	70	96
Turkeys	Lb.	2,769	1,549	2,127	2,941	4,971	1,394	1,914	2,647
Eggs	Doz.	41,040	22,122	30,432	42,261	3,705	14,893	20,488	28,452
Milk	Lb.	2,394,290	2,801,412	3,836,844	5,295,600	1,222,906	1,389,033	1,902,435	2,625,735

To Convert From	To	Multiply By
Pounds (lb)	Kilograms (kg)	0.454

Table 97

PROJECTED LIVESTOCK PRODUCTION(2)
SERIES E
(1000 units)

Livestock Production	Units	LAKE ONTARIO BASIN 1960	LAKE ONTARIO BASIN 1980	LAKE ONTARIO BASIN 2000	LAKE ONTARIO BASIN 2020	PSA 5.1 1960	PSA 5.1 1980	PSA 5.1 2000	PSA 5.1 2020
Beef & Veal	Lb.	237,313	130,799	87,525	58,133	56,994	33,526	23,414	15,552
Pork	Lb.	18,546	8,188	3,678	1,556	7,974	3,419	1,536	649
Lamb & Mutton	Lb.	6,920	1,095	719	469	4,405	518	340	222
Chicken	Lb.	11,236	10,800	10,678	9,721	2,425	2,759	2,728	2,484
Broilers	Lb.	10,514	1,438	30	-	4,002	304	18	-
Turkeys	Lb.	8,100	1,490	373	60	360	132	33	-
Eggs	Doz.	58,044	54,132	57,503	58,412	13,299	14,234	15,119	15,357
Milk	Lb.	4,714,859	4,953,185	5,420,497	5,756,468	1,097,663	1,272,835	1,392,862	1,479,165

Livestock Production	Units	PSA 5.2 1960	PSA 5.2 1980	PSA 5.2 2000	PSA 5.2 2020	PSA 5.3 1960	PSA 5.3 1980	PSA 5.3 2000	PSA 5.3 2020
Beef & Veal	Lb.	117,611	59,681	39,334	26,125	62,708	37,593	24,777	16,456
Pork	Lb.	9,175	3,892	1,749	740	1,397	877	394	167
Lamb & Mutton	Lb.	2,229	512	336	219	286	65	43	28
Chicken	Lb.	8,111	6,953	6,874	6,258	700	1,088	1,076	979
Broilers	Lb.	6,456	179	11	-	56	955	1	-
Turkeys	Lb.	2,769	622	156	27	4,971	736	184	33
Eggs	Doz.	41,040	34,784	36,952	37,538	3,705	5,114	5,432	5,517
Milk	Lb.	2,394,290	2,199,461	2,407,030	2,556,199	1,222,906	1,480,889	1,620,605	1,721,104

To Convert From	To	Multiply By
Pounds (lb)	Kilograms (kg)	0.454

Land Use Trends

The projection of both Series C and E is that urban land will increase and will expand over other categories of land uses.

The major difference between the two projections occurs with urban land. Series E projects a 40 percent growth in this category by 1980 while Series C projects a 60 percent growth. However, urban land in Planning Subarea 5.1 is projected to grow at a faster pace and reach a higher level by 2020 in Series E.

Another land use that can be of importance in determining water quality relationships is land used for extractive minerals. Land needs for this purpose are expected to increase about one and one-quarter times by 2020. The primary growth of minerals will be in Planning Subareas 5.1 and 5.2.

Table 98

LAND USE PROJECTIONS - 1980, 2000, 2020

AREA MEASURED BY COUNTY BOUNDARIES(4)

SERIES C

(1000 acres)

	LAKE ONTARIO BASIN				PSA 5.1			
	1966-67	1980	2000	2020	1966-67	1980	2000	2020
Urban	667.7	770.9	909.7	1,067.1	271.1	301.3	341.9	393.3
Cropland	3,448.1	3,408.8	3,356.8	3,297.1	1,055.1	1,040.5	1,020.9	996.1
Pasture	861.0	852.5	841.1	828.3	162.9	160.7	157.7	153.9
Forest Land	5,632.6	5,584.6	5,518.8	5,444.6	871.5	859.5	843.3	822.8
Other Land	662.3	654.9	645.3	634.6	98.1	96.7	94.9	92.6

	PSA 5.2				PSA 5.3			
	1966-67	1980	2000	2020	1966-67	1980	2000	2020
Urban	250.7	322.9	414.0	512.0	145.9	146.7	153.8	161.8
Cropland	1,759.1	1,734.6	1,703.6	1,670.3	633.9	633.7	632.3	630.7
Pasture	443.7	437.5	429.7	421.3	254.4	254.3	253.7	253.1
Forest Land	2,545.7	2,510.2	2,465.4	2,417.2	2,215.4	2,214.9	2,210.1	2,204.6
Other Land	428.2	422.2	414.7	406.6	136.0	136.0	135.7	135.4

To Convert From	To	Multiply By
Acres (acre)	Hectares (ha)	0.405

Table 99

LAND USE PROJECTIONS - 1980, 2000, 2020
AREA MEASURED BY COUNTY BOUNDARIES[2]
SERIES E
(1000 acres)

	LAKE ONTARIO BASIN				PSA 5.1			
	1966-67	1980	2000	2020	1966-67	1980	2000	2020
Urban	677.7	763.8	855.6	935.4	271.1	324.1	366.8	415.1
Cropland	3,448.1	3,405.5	3,366.2	3,330.3	1,055.1	1,028.3	1,006.8	982.4
Pasture	861.0	852.9	844.9	838.4	162.9	158.8	155.4	151.7
Forest Land	5,632.6	5,587.2	5,542.7	5,505.3	871.5	849.4	831.6	811.4
Other Land	662.3	662.3	662.3	662.3	98.1	98.1	98.1	98.1

	PSA 5.2				PSA 5.3			
	1966-67	1980	2000	2020	1966-67	1980	2000	2020
Urban	250.7	292.8	339.7	370.2	145.9	146.9	149.1	150.1
Cropland	1,759.1	1,743.5	1,726.2	1,714.9	633.9	633.7	633.2	633.0
Pasture	443.7	439.8	435.4	432.6	254.4	254.3	254.1	254.1
Forest Land	2,545.7	2,523.1	2,497.9	2,481.5	2,215.4	2,214.7	2,213.2	2,212.4
Other Land	428.2	428.2	428.2	428.2	136.0	136.0	136.0	136.0

To Convert From	To	Multiply By
Acres (acre)	Hectares (ha)	0.405

Table 100

PROJECTED EXTRACTIVE MINERAL LAND REQUIREMENTS (6)
(in acres)

	LAKE ONTARIO BASIN				PSA 5.1			
	1968	1980	2000	2020	1968	1980	2000	2020
Clay & Shale	1	1	2	4	-	-	-	-
Coal	-	-	-	-	-	-	-	-
Gypsum	-	-	-	-	-	-	-	-
Iron Ore	900	1,000	1,200	1,500	-	-	-	-
Peat	8	8	8	8	-	-	-	-
Sand & Gravel	198	271	452	755	57	76	126	211
Stone, Crushed	56	74	124	207	14	18	30	50
Stone, Dimension	-	-	-	-	-	-	-	-
Zinclead	250	500	500	700	-	-	-	-
TOTAL	1,413	1,854	2,286	3,174	71	94	156	261

	PSA 5.2				PSA 5.3			
	1968	1980	2000	2020	1968	1980	2000	2020
Clay & Shale	-	-	-	-	-	-	-	-
Coal	-	-	-	-	-	-	-	-
Gypsum	-	-	-	-	-	-	-	-
Iron Ore	-	-	-	-	900	1,000	1,200	1,500
Peat	8	8	8	8	-	-	-	-
Sand & Gravel	131	177	296	494	10	18	30	50
Stone, Crushed	37	50	84	141	5	6	10	16
Stone, Dimension	-	-	-	-	-	-	-	-
Zinclead	-	-	-	-	250	500	500	700
TOTAL	177	236	390	647	1,165	1,524	1,740	2,266

To Convert From	To	Multiply By
Acres (acre)	Hectares (ha)	0.405

SPECIALIZED LAND USES

The following five categories of specialized land uses -- disposal operations, erosion zones, intensive livestock operations, high density, nonsewered areas, and recreational lands are unique in their specific land drainage aspects which affect water quality. Because of the multiplicity of factors affecting their future, estimates of changes in land-use operations beyond twenty years entail great uncertainties. Projections have been based in part on the opinions of experts in the field as to their expectations of the future near term trends concerning these various land uses.

Disposal Operations

The following four disposal operations -- liquid waste, solid waste, dredge spoil and artificial fill, and deep-well disposal operations -- form the major methods for allocating man's nonproduct outputs to the environment. Overall, the amount of wastes to be disposed of will increase in the future in response to population and economic changes. As will be seen, this relationship will vary according to the type of disposal procedure.

Liquid Waste Disposal

There are a variety of factors which will affect the future trend in utilizing land for the disposal of liquid effluents, both from municipal and industrial concerns. The major limitation in expanding the amount of liquid waste disposal operations is the amount of land required for this practice. If population growth expands considerably in the Lake Ontario basin, resulting in increasing demand for land, liquid waste disposal practices will tend to conflict with other economic uses of land. Consequently, liquid waste disposal operations may tend to become less acceptable practices in the future.

Conversely, if the cost of alternative forms of liquid waste disposal increase significantly, and if population and economic growth do not expand greatly, then land treatment systems for liquid wastes may become an attractive option for many communities and small industrial concerns. One particularly attractive aspect of liquid waste disposal operations is the ability to remove pollutants at a rate of efficiency not usually available without incurring exceptional costs with alternative disposal systems. In this sense land treatment systems are generally competitive on a cost effectiveness basis to alternative disposal methods, assuming that land prices do not increase significantly in all parts of the basin.

Secondly, there is a possibility that such systems can be used in various agriculture and silvicultural operations, enhancing the economic productivity of these operations. Assuming that agricultural and silvicultural operations will continue to experience high rates of demand, liquid waste disposal practices may become economically advantageous for growers to include in their operations. This would enhance the feasibility of using land treatment practices in the future.

However, a limiting factor in the use of liquid waste disposal practices are the variety of public concerns focusing on the perceived incompatibility of such practices with alternative land uses, especially residential activities. Secondly, there are questions concerning the public health, social, and economic impacts that land treatment systems may incur upon adjacent areas. If public attitudes towards land treatment systems focus primarily on the potential adverse effects these systems can generate, this would limit the acceptability of these treatment systems in certain areas. It is likely that land treatment systems for liquid effluents will continue to be used in the Lake Ontario basin. The increase is likely to be small over the next 10 to 15 years, probably about 10 percent above existing levels. They will continue to occur in rural and semi-urban areas generating limited amounts of effluent wastes.

Table 101

PROJECTED WASTEWATER FLOWS REQUIRING DISPOSAL(7)

(mgd)

	1970		1980		2000	
	Municipal	Industrial	Municipal	Industrial	Municipal	Industrial
Lake Ontario basin	368	471	427	572	658	490
PSA 5.1	225	298	256	298	351	377
PSA 5.2	128	188	155	205	289	98
PSA 5.3	15	145	16	69	18	15

To Convert From	To	Multiply By
Gallons (gal)	Liters (l)	3.785

Solid Waste Disposal

The future trends in solid waste disposal will be affected by three factors. Per capita waste generation is unlikely to change significantly except as it is affected by the amount of disposable goods and materials generated in economic activities. The number of waste disposal sites is likely to diminish as more counties convert to larger sanitary landfill operations. Finally, the amount of wastes disposed of into the environment will be affected to some extent by the amount of materials recycled back into the economy.

The generation of solid wastes will increase in line with projected population trends. However, as economic growth continues, per capita disposable income will increase, with a possible tendency toward increasing amounts generated per capita. It is unlikely, however, that within the next 10 to 15 years per capita waste generation will increase significantly beyond current levels.

The number of solid waste disposal sites is likely to decrease over the next ten to fifteen years for two reasons. First, a significant amount of small open dump sites are now being closed in the Lake Ontario basin. Counties are forming larger regional waste disposal systems, relying on fewer sites with larger capacities to handle the waste generated in their area. With the move towards larger sanitary landfill sites, the number of disposal sites in the basin will decrease significantly. However, as a consequence of this policy, the potential severity of impact these newer sites may have on water quality will likely increase several fold, if not properly constructed and sealed, due to the increased volume of wastes contained in these facilities. Thus, it is important to insure that these larger regional waste disposal sites are given proper engineering and environmental attention in their design and maintenance in order to prevent water quality degradation from occurring.

The recycling of waste materials is likely to decrease the volume of waste requiring disposal in the future. However, recycling so far has mainly revolved around reusing glass, paper, and metal materials and has not involved recycling of garbage or general refuse, which are the main producers of leachates. The recycling of reusable materials, therefore, is unlikely to affect the amount of leachates produced in sanitary landfill sites.

In addition, the closing of open dumps in the Lake Ontario basin in many instances has not involved completely sealing the abandoned sites. Rather, the policy has been to abandon the open dumps with a modicum of cover, thereby leaving the site to produce leachates which can eventually infiltrate into ground and surface water areas. It is likely that contamination from these closed dumps will continue and may even increase as refuse decays. Although over a long time span the amount of leachates produced from closed sites will decrease as the materials decompose, it is unlikely that such a reduction in leachates will be achieved within the next ten to fifteen years. Attention to these problems is needed, perhaps requiring open dumps to be properly sealed upon their abandonment to prevent leachate contamination of surface and ground waters.

Table 102

SOLID WASTE DISPOSAL
PROJECTED AMOUNTS OF SOLID WASTE REQUIRING DISPOSAL
(1000 tons)

	1970	1980		1990	
		SERIES C	SERIES E	SERIES C	SERIES E
Lake Ontario basin	1,323	2,210	2,073	3,548	3,096
PSA 5.1	495	869	811	1,472	1,264
PSA 5.2	711	1,163	1,096	1,816	1,602
PSA 5.3	117	178	166	260	230

To Convert From	To	Multiply By
Tons (ton)	Kilograms (kg)	907.2
	Metric Ton	0.907

Dredge Spoil and Artificial Fill

The future trends in dredge spoil and artificial fill activities are dependent on several factors. It is assumed that maintenance dredging of harbors and channels is likely to continue at present or slightly higher than average rates. If large locks are constructed, or large ships desire to use the harbor facilities, there will be a demand for deeper and wider harbors. This would require significant amounts of dredging and increase the amount of dredge spoil in certain nearshore areas. As economic development increases there will be a further increase in the percentage of polluted sediments requiring confinement.

There may be pressures to increase small artificial fill zones to prevent beach and shoreline erosion from occurring in residential and recreational areas.

Table 103

PROJECTED AMOUNT OF ANNUAL MAINTENANCE DREDGE SPOIL[8]
(1000 cubic yards)

	1970		1980		1990	
	Total	Polluted Spoil	Total	Polluted Spoil	Total	Polluted Spoil
Lake Ontario basin	363.6	333.6	387.0	345.8	387.0	345.8
PSA 5.1	270.1	267.0	268.6	264.0	268.6	204.0
PSA 5.2	93.5	66.6	118.4	81.8	118.4	81.8
PSA 5.3	-	-	-	-	-	-

To Convert From	To	Multiply By
Cubic Yards (cu yd)	Cubic Meters (cu m)	.765

Deep-Well Disposal

It is unlikely that deep-well disposal and operations will occur in the Lake Ontario basin in the future to any great extent. New York is attempting to discourage deep-well disposal by regulatory practices. Additionally, due to the lack of suitable geologic zones and the limited amount of economic activities demanding such disposal methods, the use of deep-well disposal techniques is unlikely to experience sufficient demands in the Lake Ontario basin.

Erosion

The following two categories of erosion, lakeshore and riverbank, are likely to remain at the present levels of erosion or even decrease. As will be shown, however, each one has its own unique characteristics which will affect its future trends. With the implementation of management strategies addressed at lakeshore erosion control, lakeshore erosion rates should moderately decline in the near future in specific areas of Lake Ontario.

Lakeshore Erosion

Because lakeshore erosion is tied to overall lake levels, future amounts of lakeshore erosion will be affected by the level of Lake Ontario. The level has been regulated since the development of the St. Lawrence seaway. Continued development of structural shoreline protective measures will reduce the amount of erosion occurring in certain critical areas of eroded clay and silt bluffs. It is expected, therefore, that lakeshore erosion will gradually decrease by about one percent a year.

Riverbank Erosion

There are several trends affecting the amount of riverbank erosion likely to occur in the future. With increased development of land for urban uses in the Lake Ontario basin, the likelihood that erosion of riverbanks will occur is enhanced if no steps are taken to provide measures either in the form of land use regulations and/or structural means to curb riverbank erosion.

Rivers and streams will continue their importance as transporters of nutrients and chemical materials if preventive measures are not taken to reduce the amount of sediments and other materials entering surface and ground waters. Because of the costs associated with regulative control or structural measures to prevent erosion from occurring, it is unlikely that streambank erosion rates will significantly decrease in the future, except insofar as management programs may alter land-use practices with the intent of preventing further erosion of streambanks. If such management measures are effectuated and are successful, then one can expect some decrease in streambank erosion. Otherwise, present erosion rates will remain approximately the same throughout the next ten to fifteen years.

Table 104

TRENDS IN EROSION(9)(10)
(in miles)

	1970		1980		1990	
	Critical Lakeshore	Severe Riverbank	Critical Lakeshore	Severe Riverbank	Critical Lakeshore	Severe Riverbank
Lake Ontario basin	16.8	231	15.1	231	13.6	231
PSA 5.1	12.8	45	11.0	45	9.9	45
PSA 5.2	4.5	109	4.1	109	3.7	109
PSA 5.3	-	77	-	77	-	77

To Convert From	To	Multiply By
Miles (mi)	Kilometers (km)	1.609

Intensive Livestock Operations

Over the next ten to fifteen years, there will be a trend towards larger and more intensive animal feedlots, and a continued demise of small livestock operations in the Lake Ontario basin. This is in response to the increased profitability and effectiveness larger livestock operations provide over smaller ones. Livestock operations, therefore, will increasingly come to be viewed as commercial operations rather than as small rural ventures. Consequently, waste production from these feedlots will tend to be concentrated in particular locales. Waste disposal systems will need to be maintained for water quality.

The increase in number of livestock held in intensive operations should correspond to the increase in total livestock numbers.

Table 105

PROJECTED NUMBER OF LIVESTOCK HELD IN INTENSIVE ANIMAL OPERATIONS(2)(3)(5)
(1000's)

	POULTRY					CATTLE					SWINE				
	1970	1980		1990		1970	1980		1990		1970	1980		1990	
		Series C	Series E	Series C	Series E		Series C	Series E	Series C	Series E		Series C	Series E	Series C	Series E
Lake Ontario basin	2,492	1,902	2,165	2,259	2,185	247	268	246	319	258	14	11	9	13	10
PSA 5.1	448	330	415	392	421	74	85	79	101	82	6	5	4	6	3
PSA 5.2	1,851	1,313	1,575	1,558	1,602	117	126	111	150	115	7	5	4	6	3
PSA 5.3	193	259	175	309	162	56	57	58	68	61	1	1	1	1	1

High Density, Nonsewered Residential Areas

The percentage of households with on-site sewage disposal systems is projected to continue to comprise about thirty percent of the total housing stock in the Lake Ontario basin.

With increasing population, growth and urbanization, more homes will be connected with public seweres in urban areas. In the urban areas throughout the basin, the percentage of nonsewered housing will decrease slightly over time.

Much of the future population will continue expansion into rural and semi-rural areas where development of municipal sewage treatment facilities will be economically difficult to construct. Therefore, on-site disposal systems will continue to be required in many areas of the Lake Ontario basin. In rural areas the percentage of nonsewered houses will probably continue at current rates. With improved on-site sewage disposal technologies and an enhanced ability for on-site systems to dispose of household effluent in an environmentally sound manner, the utilization of on-site disposal could increase. Such technology, however, is not foreseen to significantly affect the number of nonsewered housing in the near future. Likewise, the expansion of sewage treatment plant facilities currently is limited by the costs involved with providing secondary and tertiary treatment. Since many plants are currently over-taxed in terms of their capacity to adequately treat the volume of wastes already collected, the major investment in municipal treatment will continue to be concerned with sewage treatment facilities rather than on improving the collection of municipal wastes. Continued development of recreational homes are associated with the development of individual septic tank systems.

Table 106

NUMBER OF HOUSEHOLDS IN HIGH DENSITY
NONSEWERED RESIDENTIAL AREAS
(1000 units)

	1970		1980				1990			
			Series C		Series E		Series C		Series E	
	Total Nonsewered	Urban	Total Nonsewered	Urban	Total Nonsewered	Urban	Total Nonsewered	Urban	Nonsewered	Urban
Lake Ontario basin	240,769	34,952	283,563	41,901	267,410	41,655	333,911	50,203	292,295	46,148
PSA 5.1	68,150	14,421	85,149	18,001	81,084	17,627	106,808	22,580	93,206	20,263
PSA 5.2	143,597	20,261	167,001	23,608	156,771	23,753	193,172	27,308	168,989	25,605
PSA 5.3	29,022	270	31,413	292	29,555	275	33,991	315	30,100	280

Recreational Lands

Recreational activities in the Lake Ontario basin are likely to grow by about two-thirds by 1990. High quality recreational resources and population pressures are the sources of this increased usage. In conjunction with an expanded use of the Lake Ontario basin will come an intensification of existing facilities usage, increasing the pressure upon these facilities to adequately handle the wastes generated by tourists. Land developed for recreational use is not expected to increase over the coming two decades.

With the expansion of recreational activities, there will be an increase in the amount of wastes to be disposed of - both liquids and solids. In addition, the construction of recreational second homes in rural areas will lead to an increase in numbers of nonsewered housing in these areas. Since recreational pursuits are seasonal, the major impacts from recreational activities will occur in the summer months. However, increasing enjoyment of winter activities such as skiing and snowmobiling has meant an increase in use in the colder months as well.

The specific impacts and the magnitude of impacts resulting from recreational pursuits has not been well documented in the past. Given the likelihood that these activities will increase in the future, more work needs to be done in this field to adequately determine what the magnitudes of impact will be on the Lake Ontario basin.

Table 107

TRENDS IN RECREATIONAL LANDS[12]
(in acres)

	LAKE ONTARIO BASIN			PSA 5.1		
	1970	1980	2000	1970	1980	2000
Swimming	130	130	130	40	40	40
Picknicking	2,750	2,750	2,750	460	460	460
Camping	3,490	3,490	3,490	890	890	890
Parking (General)	470	470	470	210	210	210
Parking (Boats & Water Skiing)	40	40	40	0	0	0
Playfields	1,100	1,100	1,100	300	300	300
Golf	4,770	5,770	5,770	1,000	1,000	1,000
Snowskiing	20	20	20	20	20	20
Sledding	0	0	0	0	0	0
Ice Skating	30	30	30	30	30	30
Boating (Water Area)	378,000	378,000	378,000	48,000	48,000	48,000
TOTAL	391,800	391,800	391,800	50,950	50,950	50,950
(Recreation Days)	67,497,000	90,329,000	133,888,000	2,164,800	28,598,000	41,417,000

	PSA 5.2			PSA 5.3		
	1970	1980	2000	1970	1980	2000
Swimming	80	80	80	10	10	10
Picknicking	1,400	1,400	1,400	890	890	890
Camping	1,300	1,300	1,300	1,300	1,300	1,300
Parking (General)	220	220	220	40	40	40
Parking (Boats & Water Skiing)	30	30	30	10	10	10
Playfields	720	720	720	80	80	80
Golf	4,200	4,200	4,200	570	570	570
Snowskiing	0	0	0	0	0	0
Sledding	0	0	0	0	0	0
Ice Skating	0	0	0	0	0	0
Boating (Water Area)	221,000	221,000	221,000	109,000	109,000	109,000
TOTAL	228,950	228,950	228,950	111,900	111,900	111,900
(Recreation Days)	37,177,000	50,075,000	75,006,000	8,672,000	11,656,000	17,465,000

Table 108

TRENDS IN RECREATIONAL ACTIVITY OCCASIONS ANNUALLY (12)

	Activity	LAKE ONTARIO BASIN			PSA 5.1			PSA 5.2			PSA 5.3		
		1970	1980	2000	1970	1980	2000	1970	1980	2000	1970	1980	2000
LAND-BASED WATER ORIENTED	Swimming	17,829	25,861	40,124	6,079	8,791	13,613	9,650	14,046	21,875	2,100	3,024	4,636
	Beach (55%)	9,805	14,224	22,068	3,343	4,835	7,487	5,307	7,726	12,031	1,155	1,663	2,550
	Picnicking	10,169	12,679	17,177	3,560	4,425	5,984	5,425	6,785	9,232	1,184	1,469	1,961
	Camping	2,053	3,239	5,191	736	1,159	1,885	1,081	1,709	2,800	236	371	506
	Nature Walking	2,459	3,069	4,080	862	1,073	1,423	1,310	1,641	2,191	287	355	466
	Hiking	1,044	1,619	2,514	362	564	874	562	867	1,353	120	188	287
	Sightseeing	11,969	16,009	23,726	4,147	5,525	8,175	6,423	8,624	12,828	1,399	1,860	2,579
	TOTAL ACTIVITY OCCASIONS*	45,523	55,928	92,812	15,746	21,537	31,954	24,451	33,624	50,279	5,326	7,267	10,579
	TOTAL ACTIVITY OCCASIONS(55%)	37,499	50,791	74,756	13,010	17,581	25,828	20,108	27,304	40,435	4,381	5,906	8,493
	TOTAL RECREATION DAYS**	18,208	24,972	37,126	6,298	8,615	12,782	9,780	13,450	20,112	2,130	2,907	4,232
	TOTAL RECREATION DAYS(55%	14,999	20,316	29,902	5,204	7,032	10,331	8,043	10,922	16,174	1,752	2,362	3,397
LAND-BASED OTHER	Playing Outdoor Games	31,635	46,070	75,656	6,959	9,923	15,513	20,262	29,737	49,344	4,414	6,410	10,799
	Golfing	3,386	4,919	8,346	1,188	1,722	2,917	1,804	2,629	4,478	394	568	951
	Bicycling	15,641	18,664	24,637	5,529	6,578	8,365	8,296	9,938	13,418	1,816	2,148	2,854
	Bicycling(25%)***	3,910	4,665	6,158	1,382	1,644	2,091	2,074	2,484	3,354	454	537	713
	Horseback Riding	2,128	2,645	3,796	753	934	1,341	1,128	1,406	2,033	247	305	422
	Horseback Riding(25%)	532	662	948	188	234	335	282	352	508	62	76	105
	TOTAL ACTIVITY OCCASIONS	52,790	72,298	112,435	14,429	19,157	28,136	31,490	43,710	69,273	6,871	9,431	15,026
	TOTAL ACTIVITY OCCASIONS(25%)	39,463	56,316	91,108	9,717	13,523	20,856	24,422	35,202	57,684	5,324	7,591	12,568
	TOTAL RECREATION DAYS	21,116	28,919	44,973	5,772	7,663	11,254	12,596	17,484	27,709	2,748	3,772	6,010
	TOTAL RECREATION DAYS(25%)	15,786	19,525	36,443	3,887	5,409	8,342	9,769	14,080	23,074	2,130	3,036	5,027
WATER SURFACE	Boating	5,552	8,196	12,790	1,970	2,899	4,514	2,939	4,355	6,824	643	942	1,452
	Water Skiing	973	1,706	3,054	351	614	1,095	205	310	473	111	195	345
	Canoeing	383	581	883	134	203	309	187	270	431	44	68	101
	Sailing	346	499	792	119	171	270	3,842	5,832	9,342	40	58	91
	TOTAL ACTIVITY OCCASIONS	7,254	10,982	17,519	2,574	3,887	6,188	1,537	2,333	3,737	838	1,263	1,989
	TOTAL RECREATION DAYS	2,902	4,393	7,008	1,030	1,555	2,475	1,537	2,333	3,737	335	505	796
WINTER SPORTS	Skiing	603	646	800	210	224	277	323	346	431	70	76	92
	Sledding	2,991	3,779	5,992	1,035	1,304	2,058	1,606	2,036	3,248	350	439	686
	Ice Skating	2,446	3,826	6,209	856	1,335	2,161	1,305	2,049	3,339	285	442	709
	TOTAL ACTIVITY OCCASIONS	5,620	7,736	12,223	2,101	2,863	4,496	3,234	4,431	7,018	705	957	1,487
	TOTAL RECREATION DAYS	2,839	3,874	6,092	840	1,145	1,798	1,294	1,772	2,807			
OTHER ACTIVITIES	Driving for Pleasure	26,355	33,103	43,903	9,178	11,493	15,210	14,101	17,774	23,668	3,076	3,836	5,025
	Walking for Pleasure	20,803	25,502	35,688	7,106	8,683	12,104	11,249	13,839	19,460	2,448	2,980	4,124
	Attending Outdoor Games	8,879	11,705	16,937	2,613	3,349	4,638	3,977	5,131	7,149	2,289	3,225	5,150
	Attending Outdoor Concerts	1,099	1,552	2,423	373	526	818	597	845	1,325	129	181	280
	TOTAL ACTIVITY OCCASIONS	57,136	71,862	98,951	19,270	24,051	32,770	29,924	37,589	51,602	7,942	10,222	14,579
	TOTAL RECREATION DAYS	22,855	28,745	39,580	7,708	9,620	13,108	11,970	15,036	20,640	3,177	4,089	5,832
	PLANNING AREA TOTALS****												
	TOTAL ACTIVITY OCCASIONS	168,741	225,821	334,718	54,120	71,495	103,542	92,941	125,186	187,514	21,680	29,140	43,662
	WATER-ORIENTED ACTIVITY OCCASIONS	44,753	61,774	92,457	15,585	21,468	32,015	23,950	33,138	49,960	5,218	7,168	10,482
	TOTAL RECREATION DAYS	67,497	90,331	133,888	21,648	28,598	41,417	37,177	50,075	75,006	8,672	11,656	17,465
	WATER-ORIENTED RECREATION DAYS	17,901	24,709	36,983	6,234	8,587	12,806	9,580	13,255	19,984	2,087	2,867	4,193

*It is assumed that 45% of all swimming is associated with pools and 55% is associated with beaches. For planning purposes, activity occasions and recreation days for land-based water-oriented activities are presented in two manners, one including all swimming and the other including only beach-associated swimming.

**It is assumed that a recreation day consists of 2.5 activity occasions.

***For planning purposes, it is assumed that only 25% of all bicycling and horseback riding needs will be met on designated public recreation areas. The other 75% is assumed to occur on private lands or public sidewalks and streets.

****Total activity occasions and total recreation days include the sum of all activities. Total water-oriented recreation days are the sum of land-based water-oriented recreation days (55%) and water surface recreation days.

MATERIALS USAGE

In projecting agricultural characteristics and materials usage, it should be pointed out that agricultural developments are directly affected by population trends, national and international economic conditions, environmental attitudes, and national agricultural decisions in regards to food production. Changes in any one of these variables will significantly alter any agricultural projection. In addition, technological changes in the types of materials used in agricultural practices can significantly alter the influence these materials may have on water quality. Therefore, it is difficult to accurately project the influence of agricultural practices upon water quality in the future. For the sake of clarity this section assumes that major influences affecting agricultural trends will remain relatively stable, that the future agricultural crops and livestock will mirror current proportions, and that there will be no major shifts in agricultural production practices within the next 10 to 15 years, either in terms of technology or in terms of crop types.

Agricultural chemicals, animal wastes, commercial fertilizers, lime, and salts will continue to be employed at about current usage rates, although specific materials will likely experience greater utilization than others over the next 10 to 15 years.

Agricultural Chemicals

Several trends indicate an increased usage of agricultural chemicals over the next two decades. With continued rising labor costs, the use of agricultural chemicals to control weeds, pests, as well as various forms of fungus and bacteria will continue to be economically attractive in many agricultural operations. The use of chemicals on crops will therefore continue to be used at current or higher rates in the Lake Ontario basin in the near future.

However, there are certain aspects which may tend to decrease the rate of growth in the use of chemicals may have in terms of water quality degradation. It is increasingly becoming apparent that the use of chemicals on crops leaves residues which can infiltrate into ground and surface water areas, and, in certain chemical compounds, can enter into food chain and threaten potentially disruptive influences to higher forms of life.

Concerning specific chemicals, it is projected that herbicide usage may increase about 10 percent by 1990. Since herbicides replace a significant amount of man-hours devoted to weed control, there is a strong incentive to continue the use of herbicides at current or higher levels into the future. Fungicide use may increase about 5 percent in order to control fungus growth on plants. Insecticides, however, may be used with less frequency during the next decade. Its usage is expected to increase over the next 5 years, but then to progressively decrease after that.

A new group of chemicals, bactericides, are coming into greater use in recent years, and may form a significant category of chemicals used on crops in the future. However, at the present time there is little information concerning probable rates of growth in the use of bactericides.

Although the use of chemicals on crops is likely to increase over the next 10 to 15 years, the water quality impact of these chemicals is not so clear. One of the major concerns in using chemicals is the amount of residue remaining which can enter ground water and surface water areas. In the case of herbicides, this is known as carry-over, and in the case of insecticides as persistence. It is believed that the persistence associated with insecticides will be almost entirely eliminated in the next 10 to 15 years, and the carry-over in herbicides will be greater reduced, if not entirely eliminated as new forms of chemicals with little or no residue generation replace the current stock of chemical types now used.

This is not to say that water quality impacts will be eliminated from the use of chemicals on crops, but that with increasing use of chemicals, it is likely that a shift will take place towards less noxious forms of chemicals occurring as a result of less residue by-products production in their usage. In addition, herbicide usage can reduce erosion and attendant pollution problems by reducing the need for continual mechanical cultivation of crops and its disturbance of soils.

Animal Wastes

Livestock numbers are expected to remain relatively stable, but will increase gradually in the Lake Ontario basin over the next 10 to 15 years. The total amount of manure produced from various livestock will therefore increase gradually. However, there are trends toward more intensive livestock operations which will have the effect of increasing the impact of manures in specific locales. Without preventive measures, it is quite possible that certain reaches of ground and surface waters can be contaminated via animal wastes. Specifically large amounts of nitrogen and phosphorus compounds can be leached into the soils from intensive livestock operations due to the corresponding increase in the concentration of wastes. Most of the livestock, and hence most of the animal waste, is in Planning Subarea 5.2. The remainder is fairly evenly divided between Planning Subarea 5.1 and 5.3.

Commercial Fertilizers

Commercial fertilizer usage rates are expected to increase moderately in this lake basin. The greatest increase will be in nitrogen, with lesser increases in potash, and phosphorus rates staying at about the same levels or decreasing slightly. There is likely to be a shift towards liquid fertilizer due to their ease at application.

Trends in agricultural crop production indicate a move towards more intensive cultivation, and it is likely that commercial fertilizer usage will increase in such areas. Higher concentrations of fertilizers in particular areas may increase drainage of nutrients to ground and surface waters.

Lime

Despite projections by the Lime Institute for increased needs for liming materials, lime rates will probably remain at current levels. Therefore, water quality impacts resulting from liming will tend to remain unchanged, except in instances where agricultural crop production has intensified. In these instances, if increased intensity of lime use results this may affect ground and surface waters.

Salts

Several trends in the Lake Ontario basin will be likely to require a moderate increase in the use of salts to prevent road icing in winter months. Bare pavement policies will be demanded by the public for major roadways. Growth in road mileages will increase the amounts of salts needed to prevent icing during winter months. Due to increased salt prices, there will be an incentive to provide secondary and minor road systems with lesser amounts of salts. The rate of salt application may actually decrease in these secondary road systems.

Road de-icing salts affect ground and surface waters through chloride discharges which can, over time, affect the salinity of nearby wells and open water areas. There are moves toward more efficient salt applications and prohibition of salting in areas where ground water and aquifers provide drinking water to nearby residences due to the potential contamination of this supply.

In general, while salting will be continued on major road systems at current application rates, there will likely be a decrease in the amounts of salt used on secondary and minor road systems. In balance, the overall amounts of salts applied will probably increase gradually over time, although applied in a more selective fashion.

Table 109

TRENDS IN MATERIALS USAGE: AGRICULTURE (3)
(1000's)

Materials Usage	Lake Ontario Basin 1972	Lake Ontario Basin 1980	Lake Ontario Basin 1990	PSA 5.1 1972	PSA 5.1 1980	PSA 5.1 1990
Agricultural Chemicals						
Herbicides (lbs)	2,313.8	2,546.2	2,776.5	703.6	773.9	844.3
Insecticides (lbs)	1,949.8	1,949.8	1,852.3	507.1	507.1	481.7
Fungicides (lbs)	1,738.6	1,825.5	1,912.4	558.4	586.3	614.2
Animal Wastes (tons)	9,397.9	9,376.2	9,757.8	2,241.7	2,343.7	2,439.4
Commercial Fertilizers (25 tons)	304.1	326.8	349.7	108.3	116.4	124.5
Lime (tons)	195.1	195.1	195.1	66.8	66.8	66.8

Materials Usage	PSA 5.2 1972	PSA 5.2 1980	PSA 5.2 1990	PSA 5.3 1972	PSA 5.3 1980	PSA 5.3 1990
Agricultural Chemicals						
Herbicides (lbs)	1,295.6	1,425.2	1,554.7	314.6	346.1	377.5
Insecticides (lbs)	1,274.4	1,274.4	1,210.7	168.3	168.3	159.9
Fungicides (lbs)	1,172.8	1,231.4	1,290.1	7.4	7.8	8.1
Animal Wastes (tons)	4,566.6	4,359.2	4,535.5	2,589.6	2,673.3	2,782.9
Commercial Fertilizers (25 tons)	168.4	181.0	193.7	27.4	29.4	31.5
Lime (tons)	93.6	93.6	93.6	34.7	34.7	34.7

To Convert From	To	Multiply By
Pounds (lb)	Kilograms (kg)	0.454
Tons (ton)	Kilograms (kg)	907.2
	Metric Ton	0.907

Table 110

TRENDS IN ROAD DE-ICING SALT USAGE
(1000 tons)

	1972-73	1980		1990	
		SERIES C	SERIES E	SERIES C	SERIES E
Lake Ontario basin	339.1	408.1	384.0	492.2	427.8
PSA 5.1	185.6	232.0	217.6	291.0	250.2
PSA 5.2	123.6	143.7	136.1	166.2	146.7
PSA 5.3	29.9	32.4	30.3	35.0	30.9

To Convert From	To	Multiply By
Tons (ton)	Kilograms (kg)	907.2
	Metric Ton	0.907

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