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Environmental Planning Elements

January 1988

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State Development AND Redevelopment Plan

ENVIRONMENTAL PLANNING ELEMENTS

of the New Jersey State
Development and
Redevelopment Plan

New Jersey Office of State Planning
150 West State Street - CN204
Trenton, New Jersey 08625

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Introduction

New Jersey is the most densely populated state (1,005 people per square mile)—twenty times as populous as many other states. At the same time, large areas of natural scenic beauty, rich in the variety and quality of their resources, still exist. This fortunate condition is possible because approximately 65 percent of the state's population lives in 20 percent of its area. The general concentration pattern has been true for at least 300 years, since the time when the Indians settled and foraged over these lands. Productive soils, moderate climate, and excellent access to navigable waters were key features In early locational decisions for both Indians and English settlers. The land use pattern has been maintained for the most part through the industrial revolution and into the 1960s and even early 1970s as suburban development continued to expand already developed areas.

As the state's economy continues to grow, the quality of the environment has received increasing attention. Fortunately, since the passage of the federal Clean Air and Clean Water Acts, New Jersey's air and water resources have for the most part shown definite signs of improvement, particularly in industrial and urban areas. This is largely due to the state's aggressive environmental control program..

While environmental quality in New Jersey is for the most part considered "good" and "stable or improving," today's land use decisions will have a major impact on the future quality of the environment. Strong state environmental enforcement and the resulting "quality of life" are expected to attract growth in the future. Clean air and water, interesting landscapes, and plentiful water resources are key assets in drawing businesses and their employees to New Jersey.

Two recent trends related to economic growth and environmental protection in New Jersey may be working at cross-purposes. While environmental quality is improving, business decisions based on an array of factors tend to favor suburban and rural locations for service industries, offices, and research establishments, rather than more urban locations. At the same time, populations of cities are decreasing, and development is expanding in agricultural and high-quality natural areas. A related trend is the growth of self-contained "urban villages" in suburban, rural, small-town locations. These trends influencing the location of development will affect environmental quality in the next two decades.

In the late 1970s and early 1980s, market conditions favored office and research park development in a number of transportation corridors, including Route 1-80 in Morris and Warren Counties; Route 287; Route 1-78 in Somerset and Hunterdon Counties; Route 1 in Mercer and Middlesex Counties; Route 206 in Morris and Somerset Counties; and Route 70 in Burlington County. All signs point to a continuation of this trend.

If these two trends continue, infrastructure needed to support development will be implemented in the suburbs and countryside, possibly at the expense of infrastructure and economic renewal in traditional urban centers. Much of the infrastructure for urban centers is in place, although it needs repairs and improvement. Unless adequate funding mechanisms are developed, maintenance of existing infrastructure in urban nongrowth areas may be deferred, at significant environmental and economic cost to the people of the state.

Another possible outcome of the trend toward locating projected growth industries in nonurban areas will be its impact on environmental conservation. On the one hand, market forces in New Jersey favor new service industries rather than the manufacturing industries. Service industries are generally "clean," which means that they will not contribute significantly to the state's already severe problems with hazardous waste disposal.

On the other hand, growth along transportation corridors, which generally excludes large amounts of housing stock, will increase employees' distance to work and may lead to a decline in air quality. With increased reliance on automobiles and increased travel times in growth areas will come increased traffic - congestion, which slows traffic flow and adds even greater levels of air pollutants, including ozone, a pollutant that exceeds National Standards statewide (NJDEP/DEQ, 1986). Moreover, if population densities in already developed areas decrease below economic thresholds for ridership, less emphasis on mass transportation and increased dependence on automobiles will result.

As the demand for housing near New Jersey's job centers increases, further development pressures will be placed on adjacent agricultural lands. Currently, almost one half of the farmland in the state is owned by non-farmers. Over the past five years alone, nearly 10 percent of the valuable farmland in New Jersey has been lost (N.J. Department of Agriculture, 1986).

Development in rural areas also brings increased demand for stream encroachment by highways, bridges, and pipelines, and increased pressures to alter floodplains and remove important natural buffers and habitats along streams. Filling floodplain areas and removing naturally vegetated stream corridors and freshwater wetlands increases flooding and water pollution. Habitat degradation follows. Increased pollution of streams and water supply reservoirs by nutrients and organic chemicals may create even greater problems relating to water treatment and protection of the environment and public health. Also lost are opportunities for public open space, linkages for

trails, scenic areas, and corridors for boating, fishing, and the. like. Currently, the public supply of open space falls 373,472 acres short of statewide goals (Council on New Jersey outdoors, 1987).

Balancing these issues is in part the responsibility of the New ' Jersey State Planning Commission in the creation of the **State** Development and Redevelopment Plan. Among a list of legislative objectives, the plan is to "Represent a balance, of development and conservation objectives best suited to meet the needs of the state* It is also intended to protect the natural resources and qualities of the state including at least;

- Agricultural development areas,
- Fresh and saltwater wetlands,
- Flood plains,
- Stream corridors,
- Aquifer recharge areas
- Steep slopes,
- Areas of unique flora and fauna, and,
- Areas with scenic, historic, cultural and recreational values.

The following report focuses on these and other related elements included in the interest of developing a more complete understanding of New Jersey's environment and development patterns.

Physiography

New Jersey bears the imprint of highly varied geological processes operating throughout hundreds of millions of years. Some of the results are easily recognized today in the diverse relief, varied rock types, complex drainage patterns and soils conditions in the state.

The state encompasses five physiographic land divisions—Ridge and Valley, Highlands, Piedmont, Inner Coastal Plain, and Outer Coastal Plain.

These provinces have been subdivided into fourteen regions, each with characteristic feature*. By knowing the physical and ecological characteristics of these subregions, one can better understand how and why the state has settled in its existing pattern. Early native Americans settled along the Piedmont and Inner Coastal Plain corridor, which comprises about one third of the state. There, they could easily forage for food, farm, and find access to water. Today, New Jersey still has large, relatively natural areas due to the concentration of population in certain areas: the northeastern counties bordering the city of New York; a less concentrated center across from Philadelphia; and an even less concentrated area in Trenton.

; In considering these physiographic subregions, realize that their boundaries are only as distinct as the physical features used to delineate them. While some areas, such as the state's trap rock ridges, are sharply defined, most are delineated based on dominant characteristics such as soils, slopes, vegetation, or land use type.

The map on the following page (Figure 1) displays the physiographic provinces and regions of New Jersey. The chart that follows the map describes the geology and land-use features discussed in the State Land Use Planning Act as well as other important features characteristic of the regions.

The Delaware Ridge, Kittatinny Mountains, and Kittatinny Valley are part of the Ridge and Valley Province. The Delaware Ridge is composed of sands and gravels under a gently rolling surface sloping to the Delaware River. Much of the area is forested, with some farming and dairying. Soil erosion and flooding are major problems.

The Kittatinny Mountains comprise a steep-sided ridge consisting of hard erosion-resistant rock. Elevations reach 1,800 feet at High Point. Precipitation is generally highest in this mountain region. The soils are thin, drainage is excessive, and groundwater supplies are poor. The region is largely forested.

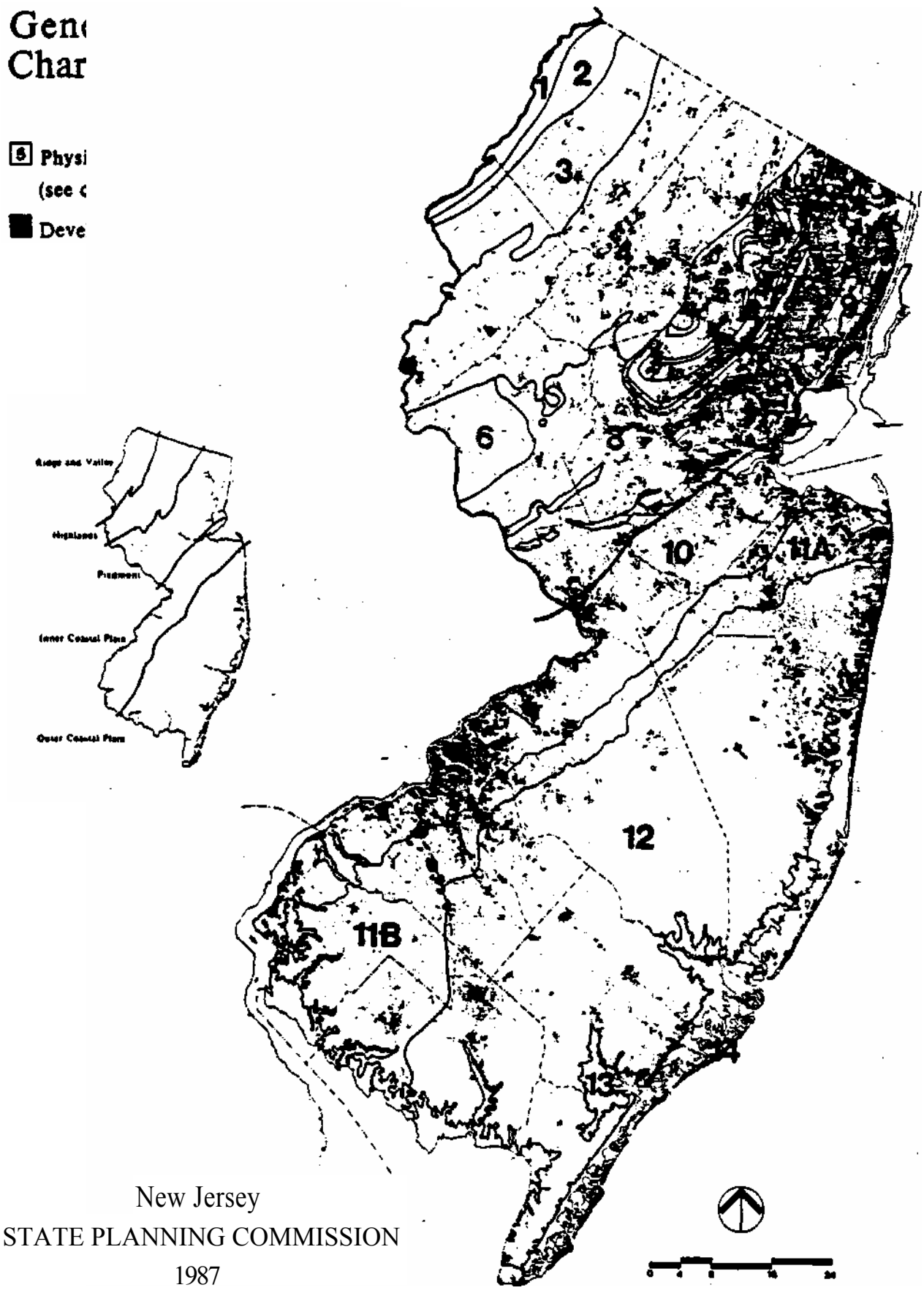
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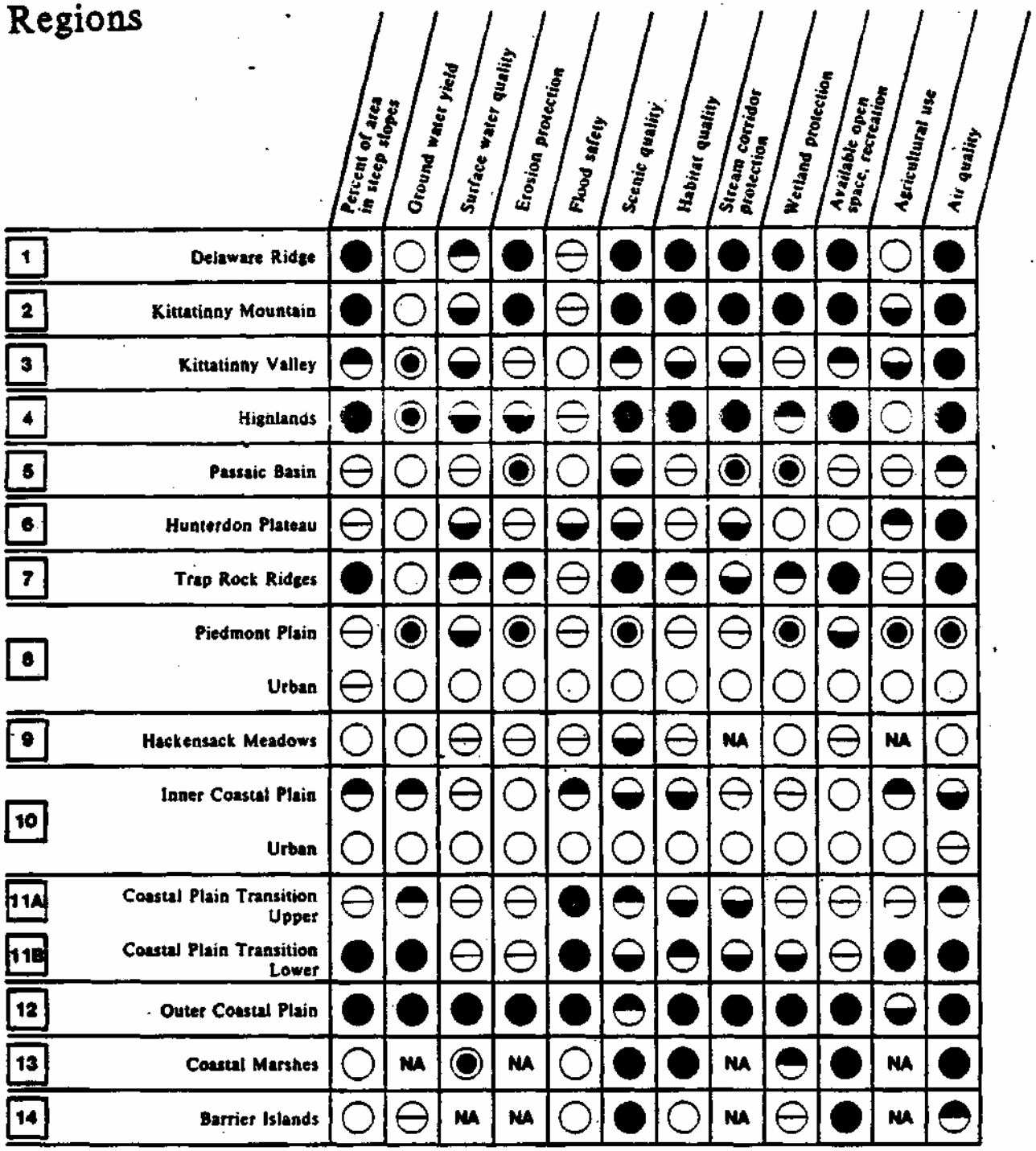
Figure 1

Physiographic Regions



- ● Excellent/High
- ◓ Good
- ◒ Good/Fair
- ⊖ Fair
- ○ Poor/Low
- NA Not Applicable
- ◉ Wide Variety

* The entire state is non-attainment for ozone.
Air quality condition based on CO emmissions all sources.

The Kittatinny Valley is predominantly limestone, with slate ledges. Groundwater supplies are variable but generally poor. Soil erosion is a major problem. -Ridges are mostly forested, while the valleys have been cleared for agriculture, largely dairying. The area is sparsely populated.

The Highlands are higher and more rugged than the adjoining provinces. Rocks are old and very hard. The northern part is mostly forested. Many small valleys in the southern portion have been cleared for agriculture: dairy and poultry, for the most part, with some fruit. They are also currently used for recreation areas and city water supply storage.

Like the Ridge and Valley, the Piedmont is another province with sub-areas. They include the Passaic Basin, the Hunterdon Plateau, the Piedmont Plain, and the Hackensack Meadowlands. The great majority of the population of the state lives in this province.

The Passaic Basin is low-lying and flat, with most of the area being a former lake bed. Soils are heavy clay and silt. Drainage is poor. The Great Swamp is located in the southwestern portion of the area.

The Hunterdon Plateau is a high plateau of slight relief with poor soils formed from argillite and shale.* Groundwater supplies are poor. Most of the area is forested, with some fanning.

The Piedmont Plain comprises gently rolling hills of red soils formed from shale. Much of the area was cleared for farming, which was followed by urban development. This area has the highest population density in the state, and urbanization has already covered many areas of prime agricultural soils. Excessive surface drainage, flooding, and siltation are common in the region. Small wetlands are found frequently, but groundwater supplies are limited.

The Hackensack Meadowlands, in the northeast part of the Piedmont Plain, is a flat, open area characterized by marshland and urban development.

Trap rock ridges are scattered throughout the Piedmont Province. Erosion-resistant rocks have produced high, steep ridges. Soils are thin and stony, with poor drainage, and groundwater is not abundant. Although most of these areas are forested, some farms are present. The trap rock areas are very scenic.

The next province is the Inner Coastal Plain. This flat, low-lying area was formed from loose sediments deposited as a series of terraces. Groundwater is available in good quantities along the southern Delaware River, but farther north and east the supplies become less dependable. This area provides excellent conditions for farming. Again, many acres of prime farmland have been lost to development. The Inner Coastal Plain is the second most heavily populated area in the state.

The Coastal Plain Transition area is hilly in the north and flatter in the south. Groundwater supplies are poor in the north, but excellent in the south. Much of the area is farmed. Soil conditions are not as good as those of the Inner Coastal Plain for fanning, but better than those of the Outer Coastal Plain.

The Outer Coastal Plain is characterized by an almost uniform cover of upland pine forest. Soil is formed on unconsolidated sediments. Groundwater is abundant, and the area has one of the highest yields in the state.' Many extensive marshes and valuable wetland habitats exist. Fires are a serious hazard. The coastal marshes of this area are tidal areas with low-flat grassland appearances. Development is prohibited due to the great value of the marshes as ecological systems and resource concentrations. Sandy barrier islands lie between the coastal marshes and the ocean. These support highly developed resort areas. Coastal flooding is a major hazard for areas below the 10-foot elevation above mean sea level Groundwater is available; however, saltwater intrusion is a problem.

Historic Development Patterns and Their Impacts on the Environment

Since the earliest human occupation, New Jersey's natural environment has been disturbed. Prehistoric peoples first cleared vegetation for villages and cultivation of crops. Extensive cutting of forests provided the wood and bark needed to make utensils, weapons, canoes, and shelters, and to provide fuel. .Indians also modified forest composition by setting fires to drive game for easier hunting, and to increase the amount of open forest habitat preferred by favored game animals. Setting of fires also altered the species composition of the forests, giving preference to species resistant to fire damage. As a result, the first European settlers in New Jersey did not find a vast expanse of virgin forests.

European colonization disturbed the natural environment of New Jersey to a far greater extent than its earlier inhabitants. Like the Indians, the Europeans favored sites accessible to water. The initial European settlements were thus identical to the sites inhabited most densely by Indians: the Delaware, Hudson, Hackensack, Passaic, and Raritan River valleys. In 1664 the state was officially claimed by England, and settlement increased rapidly, spreading from the riverside population centers to the rest of the lowlands in the Piedmont and Inner Coastal Plain provinces. Disturbance of the natural vegetation by the Europeans included clearing of the Piedmont uplands and Inner Coastal Plain for agriculture. It also encompassed use of forests in areas unsuitable for cultivation (steep slopes or wet soils) for firewood, building materials, fencing, household utensils, and grazing (Robichaud and Buell, 1973).

As colonization increased, more land was cultivated, and more forests were cleared through the use of fire. By the time New Jersey became a state in 1778, most of its central portion had been cleared for agriculture. Increases in population intensified the need for wood. Timber was harvested for lumber and fuel for homes, charcoal production, and iron and glass manufacture. Wood was the sole fuel for households and industry until the middle of the nineteenth century. An iron furnace in Union was abandoned

for lack of fuel in 1783 after it had exhausted a forest of nearly 20,000 acres in approximately 15 years (Robichaud and Buell, 1973).

The 19th century brought rapid changes in the demand for natural resources and the environmental impacts incurred by them. Physical and economic environments were dramatically altered by coal mining, transportation improvements, concentrated heavy manufacturing, and trade activity.

After the introduction of coal in 1850, the demand for wood decreased and forests began to recover. However, repeated cutting and frequent damage by fire had permanently altered the woodlands. By 1899, 46 percent of the state had been recovered by forest. The majority of this area was unsuitable to agriculture: the Outer Coastal Plain (68X forested), the Highlands (569s forested), and the Ridge and Valley sections (45* forested). However, these areas were still frequently cut (at 20-25 year intervals) for cordwood to use as fuel, and they were frequently damaged by wildfires. In the more heavily populated areas—the Inner Coastal Plain and Piedmont—only 15 percent and 23 percent were forested, respectively. Much of the cleared area was in agriculture, given the good soils and climatic conditions.

The concept of easy transportation in the corridor between New York and Philadelphia is reported to have begun in 1676 with William Penn, He considered the use of a canal. It was not until 1830, however, that the. Delaware and Raritan Canal began construction. By September 1833, the full canal was opened, linking the Delaware River and Raritan River basins, in the following year. The industrial revolution was beginning. Canal water diverted from the Delaware River powered several mills in the early years and allowed cheap transportation of coal to New York from mines in Pennsylvania. The canal also helped farmers and industrial purveyors get their produce and finished goods to market. It clearly benefited both Trenton and New Brunswick in their growth as regional centers*

By the 193 Os the D&R Canal took on a new role as an important water supply selling water to industries moving out of central cities because it could no longer turn a profit by transporting boats. Canal water from the

Delaware was cheaper than well water. In 1944, the canal was rehabilitated as a major water conduit. Today nearly 75 million gallons of water a day are diverted for use in central New Jersey. In 1973, the canal was put on the National Historic Register, and in 1974 it was established as a 3,155 acre State Park. It continues to be a major source of potable water.

The canal apparently reinforced the development of the corridor between New York and Philadelphia, because since the middle of the 19th century, little has changed with respect to the amount of disturbance of forested land. in the rest of the state. Forty-seven percent of New Jersey's forested land, or 2,120,000 acres, is located in counties within the Pin elands region. Another smaller concentration of forested land is located in the northern part of the state in the ridges of the northern Highlands, and Kittatinny Mountain in the "Ridge and Valley section. The only areas of the Piedmont that are still wooded are diabase and basaltic ridges, swamp lowland areas, and state parks. In the Inner Coastal Plain area, only the more poorly drained areas remain wooded.

While disturbance was stabilized for some years, the trend is changing. In 1986, new growth concentrations along transportation corridors (Routes 1-80, 1-78, and 1-206, U.S. 1, and N.J. 70 and 73) are evident. The map of Developed Land (Figure 2), which was compiled from 1984 LANDSAT satellite imagery, shows that new development has occurred along major transportation corridors, breaching the ridges that have historically impeded growth. The concentrations of people in the Piedmont and Coastal Plain are apparently shifting to linear and scattered patterns of lower density. If left unchecked, this growth pattern will likely result in a reduced amount of natural areas and forested lands.

Historic District.

The distribution of cultural and historic resources relates closely to the distribution of population centers and natural resources.' The distribution of historic districts in New Jersey is represented on the map (Figure 3) of Historic Districts and Scenic Areas.

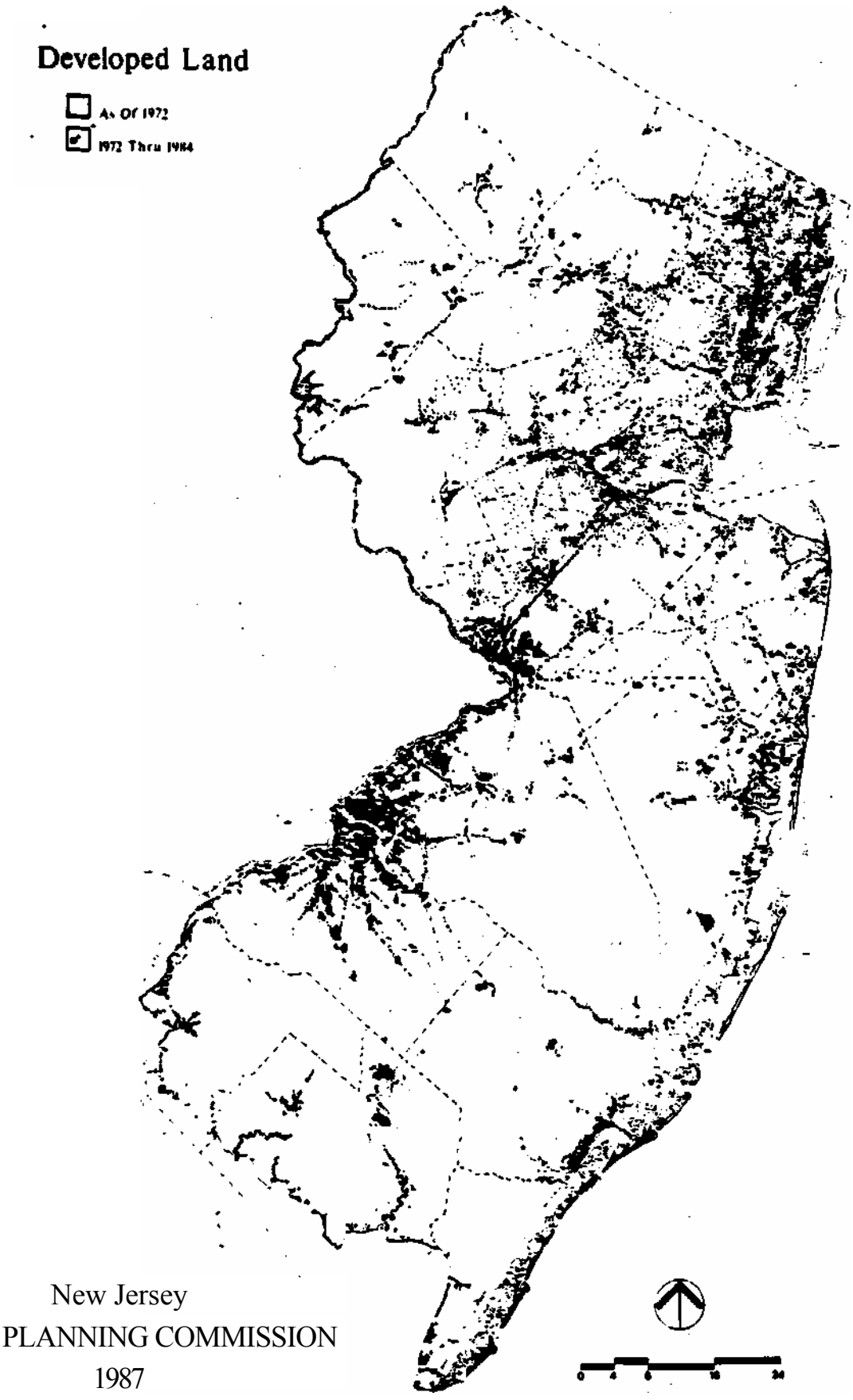

Developed Land
As Of 1972
1972 Thru 1984
New Jersey
STATE PLANNING COMMISSION
1987

Figure 2

Delaware was cheaper than well water. In 1944, the canal was rehabilitated as a major water conduit. Today nearly 75 million gallons of water a day are diverted for use in central New Jersey. In 1973, the canal was put on the National Historic Register, and in 1974 it was established as a 3,155 acre State Park. It continues to be a major source of potable water.

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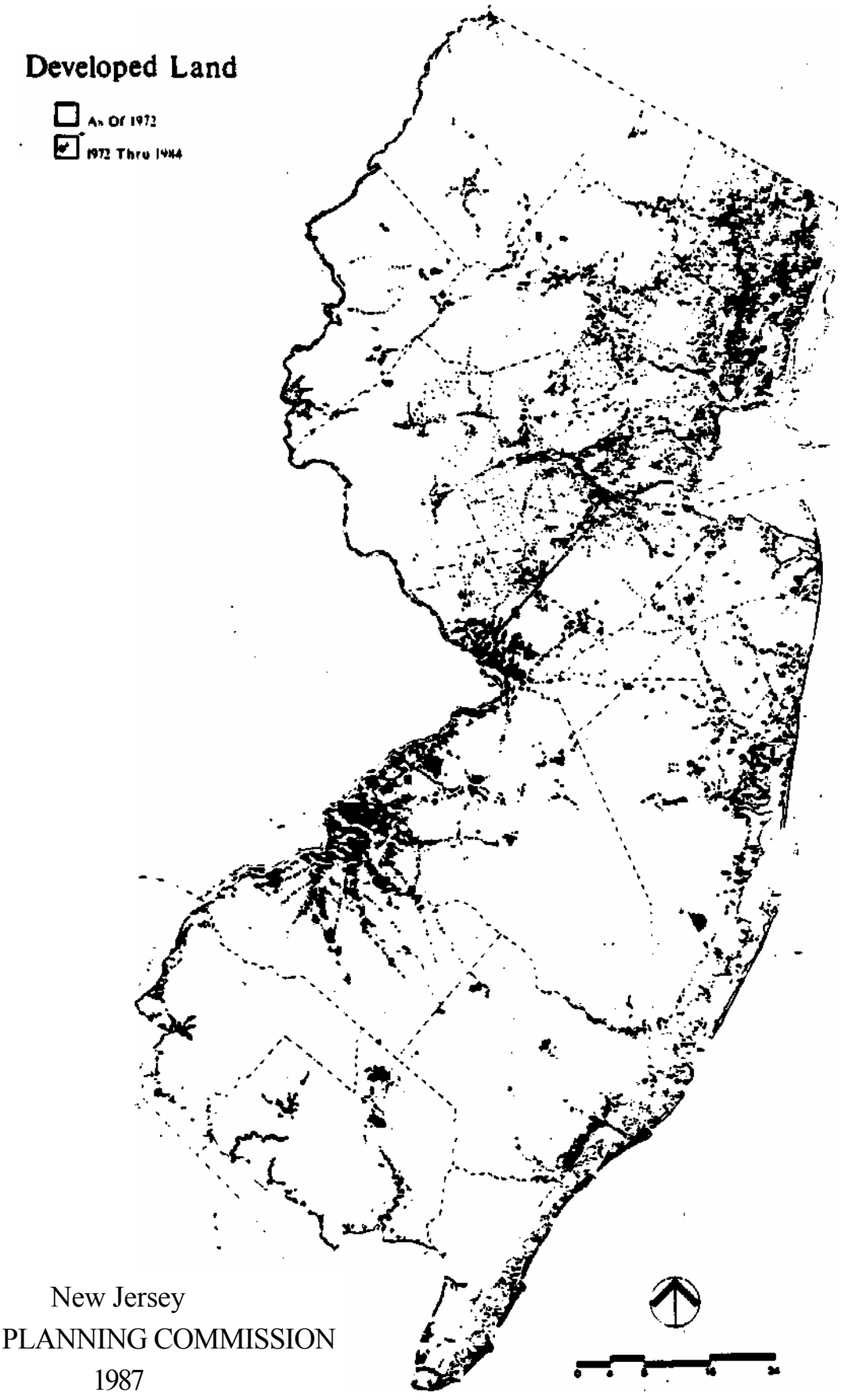
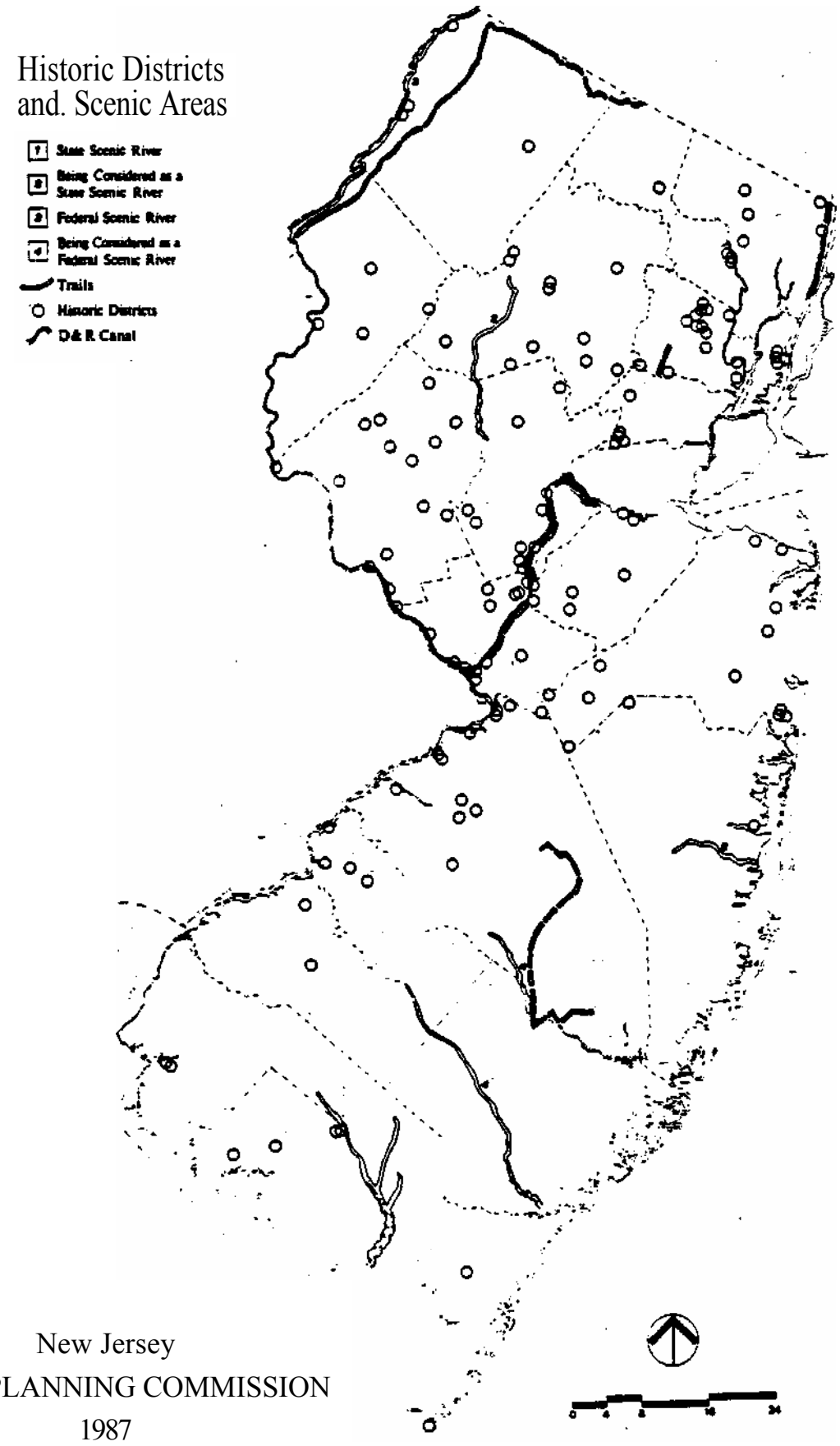


New Jersey
STATE PLANNING COMMISSION
1987

Figure 2


Historic Districts
and. Scenic Areas
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Being Considered as a State Scenic River
Federal Scenic River
Being Considered as a Federal Scenic River
Trails
Historic Districts
D&R Canal
New Jersey
STATE PLANNING COMMISSION
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Figure 3

Information for this map was derived from the publication produced by the Office of New Jersey Heritage (1984) and the USGS topographic maps located at the Office of New Jersey Heritage that contain the locations of historic districts and places in the state.

Scenic Areas

Scenic and recreation areas are also important resources. Significant long trails in New Jersey are the Appalachian Trail, in the northeast corner of the state; the Batona Trail, in the heart of the Pinelands; the Delaware and Raritan Canal Towpath, which cuts across the middle of the state and continues north along the Delaware River to Bull's Island; and the Long Path segment in Palisades Interstate Park, which continues into the state of New York.

New Jersey contains approximately 6,400 miles of freshwater rivers and streams in addition to the major ocean and bay areas that surround the state. The nature of these rivers and streams .ranges from the upper Delaware and surrounding cold water, fast-moving trout streams in the northwest .corner of the state, to the warmer, calmer waterways of the Pinelands. Major river basins located within or adjacent to the state include the Hudson and Delaware Rivers to the east and west; the Hackensack, Passaic, and Musconetcong in the north; the Raritan and Millstone in the central portion of the state; and the Egg Harbor, Maurice and Mullica Rivers, which flow from the Pinelands. These waterways provide for a variety of recreational activities, as well as serving as important environmental and scenic resources.

The New Jersey Office of Lands Management was contacted to identify rivers in the state that have been included or are under consideration for inclusion in federal or state wild and scenic river programs. New Jersey has several wild and scenic rivers that have received varying levels of protective designation. The Delaware River from the Delaware Water Gap north to the New York state line is the only river segment in the state currently included in the Federal Scenic Rivers program. Portions of two river systems are being considered for inclusion 'in the Federal program: the Great Egg Harbor River in Atlantic County, and the Maurice, Manumuskin, and Monantico Rivers in Cumberland County.

The state of New Jersey has enacted its own program for protection and preservation of wild and scenic rivers. It is administered &y the Department of Environmental Protection's Division of Parks and Forestry. The only river segment currently designated as a State Wild and Scenic River is a section of the Mullica River in Cam den, Gloucester, and Atlantic Counties, running from Lower Atsion to Batsto. This river segment lies completely within the new Pinelands Commission's protection area. Portions of Cedar Creek in Ocean County and the Lamington River in Morris, Hunterdon, and Somerset Counties are being studied for inclusion into the State Wild and Scenic Rivers Program.

Agriculture

Over time, agriculture in New Jersey has been closely linked with growth and change in nearby metropolitan areas--New York and Philadelphia. It has been a major land use in New Jersey since the 1700's. By 1860, nearly 3 million acres, or 62.5 percent of the state's total land area, was farmed. Throughout the nineteenth century, however, large numbers of people left the rural countryside for better advantages in the growing industrial areas. Concentrations of people in urban areas helped develop important new markets for vegetables, and fruit.

In 1900 New Jersey had around 34,000 farmers. By 1987, New Jersey had only 7,600 farms and farmland had dropped to 850,000 acres. Approximately two-thirds of existing farmland was harvested crops. Only 13.1 percent of the total cash crop in 1986 was field crops. Another way to consider these numbers is to recognize that 35 percent of the land accounted for 87 percent of the income. While more farmland is being preserved now than in the past ten years, concern continues. Many of the 850,000 acres currently being farmed are owned by nonfarmers. Estimates of nonfarm ownership range up to half the total current farmland.

Between 1950 and 1985 New Jersey lost half of its farmland (830,000 acres) at an average rate of loss of 24,000 acres per year. In the last two year that rate of loss has almost doubled. In that time New Jersey lost an additional 90,000 acres and an additional 1,100 farms.

Very few people are able to become farmers today, given the cost of land (about $4,000 per acre for this land use) and the size of capital investment needed. However, families still want to farm, and agriculture is a major economy in New Jersey. In 1985, the estimated cash receipts of all commodities were $591.5 million. This was a 10% increase over 1984 due to an outstanding growing season.

The Agriculture Retention and Development Act of 1983 (N.J.S.A. 4:1C-11) was passed in order to ensure the preservation of agricultural lands in New Jersey. The primary means of preserving these lands is by the formation of farmland preservation programs. Two types of preservation programs were specified by the Act: a Farmland Preservation Program, and a Municipally Approved Farmland Preservation Program. The starting point for benefits to the landowner under both types of preservation programs is the agreement to establish an eight-year deed restriction on the agricultural land. Participation by farmers in both types of programs is voluntary.

A Farmland Preservation Program is established by landowners making application to the County Agricultural Development Board. Once a deed restriction has been established under this program, three types of benefits are available to the farm owner:

- The ability to sell a development easement to a County Agricultural Development Board.

- Grants for soil and water conservation practices, consisting of 50% state funds and 50% from the landowner.

- The ability to construct approved farm structures.

A Municipally Approved Farmland Protection Program requires the approval of both the County Agricultural Development Board and the local municipality. This program provides the above benefits to the landowner, as well as these additional benefits:

- Agreement from the municipality not to exclusively zone that area for agriculture for the next 11 years.

- Prohibition on the use of eminent domain powers on those lands.

- A strong presumption against nuisance suits.

- Exemptions from water and energy use restrictions.

The approval of the local municipality is required under either type of program for the sale of development easements.

Either type of preservation program can only be established within a certified Agricultural Development Area (ADA).

The regulations specifying the criteria to be used in identifying ADA'S are contained in N.J.A*C. 2:76-1 et seq. These regulations define an ADA as an area where agriculture shall be the preferred, but not necessarily the exclusive, use of that land. The four primary criteria for defining ADA'S are as follows:

- Encompasses productive agricultural lands that are currently in production or have a strong potential for future production in agriculture, and in which agriculture is a permitted use under the current municipal zoning ordinance or in which agriculture is permitted as a non-conforming use;

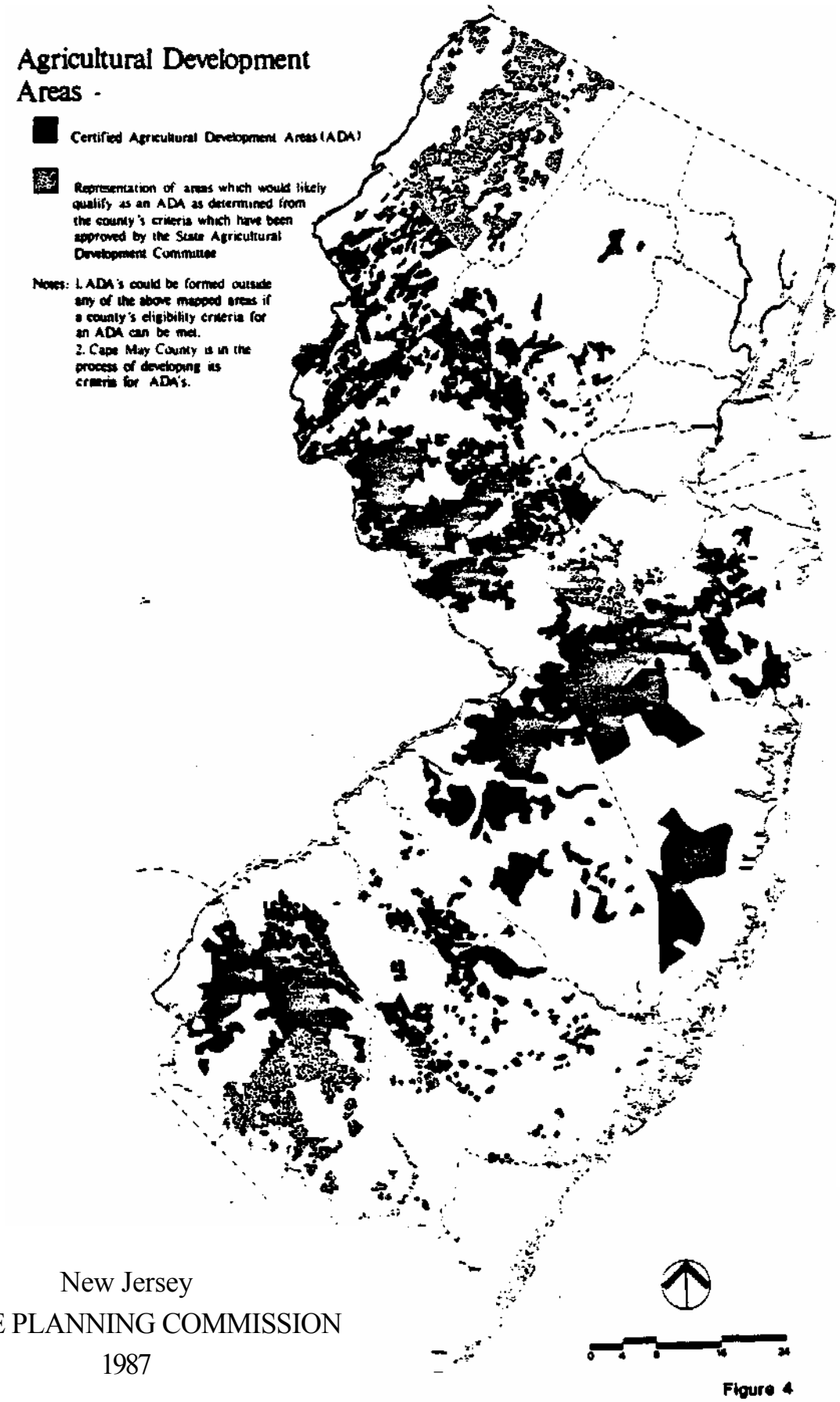
- Is reasonably free of suburban and conflicting commercial development;

- Comprises not more than 90 percent of the agricultural land mass of the county;

- Incorporates any other characteristics deemed appropriate by the board.

The legislation also required each. County's Agriculture Development Board to establish criteria, identify and delineate ADA'S, and submit its criteria and maps to the State Agriculture Development Committee. The criteria and the accompanying ADA'S were then to be reviewed and certified by the Committee. Criteria considered by the County Boards in delineating their ADA'S include soils; local land use plans and ordinances; likelihood of nonagricultural development; accessibility to roads, water, and sewer; land ownership; minimum size of an ADA; type of agricultural activities; and natural features.

The New Jersey Department of Agriculture has transferred the ADA maps of 14 counties onto a state base map at a scale of 1:250,000 (Figure 4). Counties whose ADA's are shown in black are those for which the State Agricultural Development Board has certified both the criteria used in delineating ADA's, and the mapped ADA'S. In these counties, landowners desiring to establish a preservation program need only petition the County Agricultural Development Board (for a Farmland Preservation Program), or both the County Board and the local municipality (for a Municipally Approved Farmland Preservation Program).



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STATE PLANNING COMMISSION
1987

Figure 4

Landowners in Sussex, Cumberland and Middlesex Counties (shown in dot pattern on the map) must first petition the State Agricultural Development Board for the designation of an ADA. This ensures that their lands meet the criteria for ADA's as established by their counties. Once the ADA is approved, landowners then follow the same procedure described immediately above. Current information on the status of each county's program was obtained from Robert Baumley of the New Jersey Department of Agriculture.

The map of ADA'S shows where each county has determined that agricultural preservation efforts and resources should be concentrated. The mapped ADA'S represent lands where agriculture is currently functioning. This map was available from the New Jersey Department of Agriculture in draft form at a scale of 1:250,OOQL.

In addition to the ADA map, a map displaying Prime Agricultural Areas has been prepared by the New Jersey Department of Agriculture (Figure 5). This map reflects the soil characteristics for both field and special crop agriculture. Such soils are also very well suited for new development. When the map of ADA's is compared with the map of Prime Agricultural lands, it can v be seen that a high coincidence occurs; however, some ADA'S do not contain Prime Agricultural lands.

Air Quality

New Jersey has high levels of air pollution relative to many other states. New Jersey is heavily industrialized; has four million registered cars, more miles of highway per square mile, and more cars per mile of highway than any other state; and is home of some of the major firms in the world.

In general, the industrial revolution brought us not only advanced technology, but also varied forms of air pollution. The chart below shows the percentage of emissions used by a particular activity, for each

Prime Ag Lands

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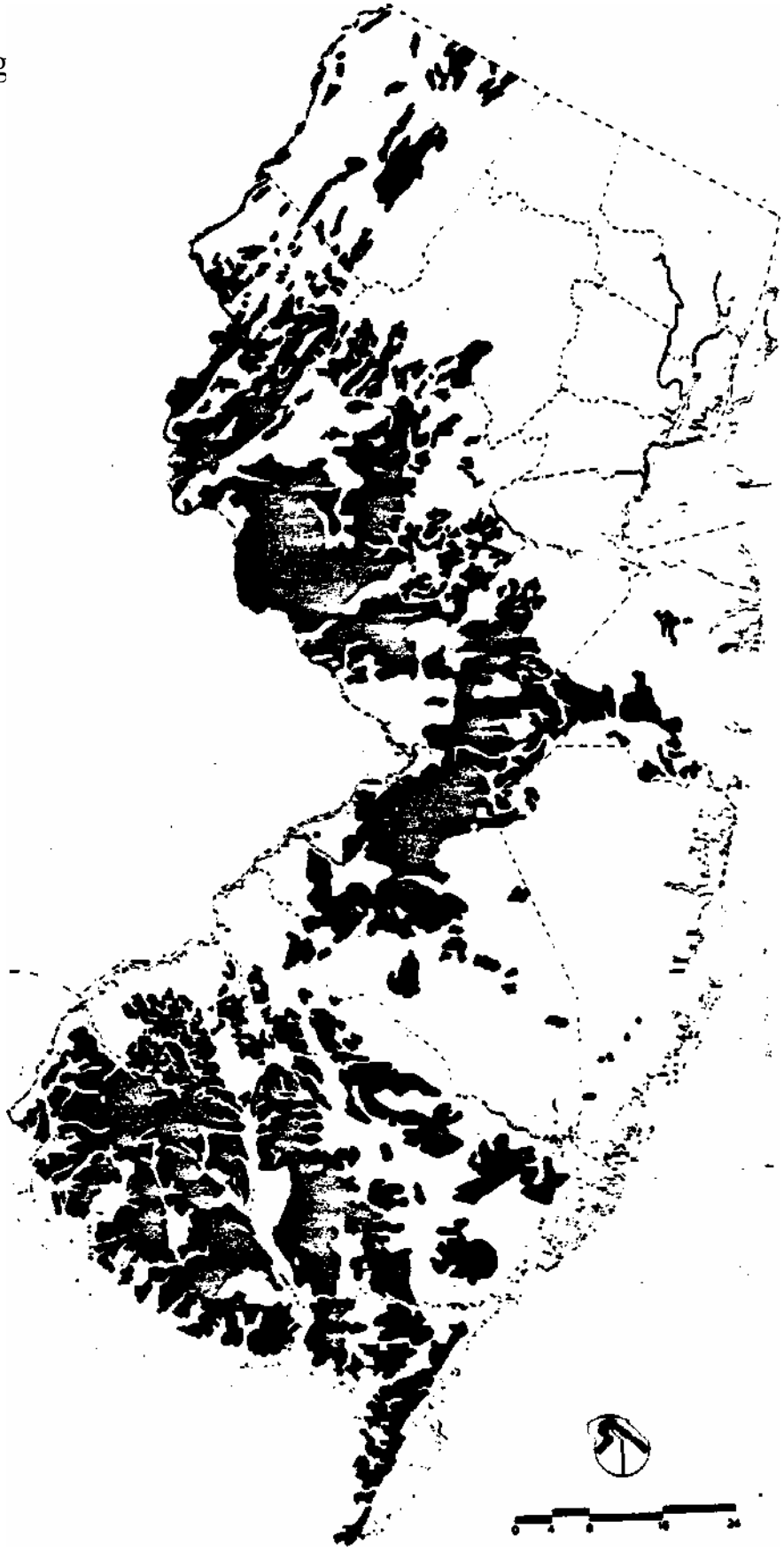
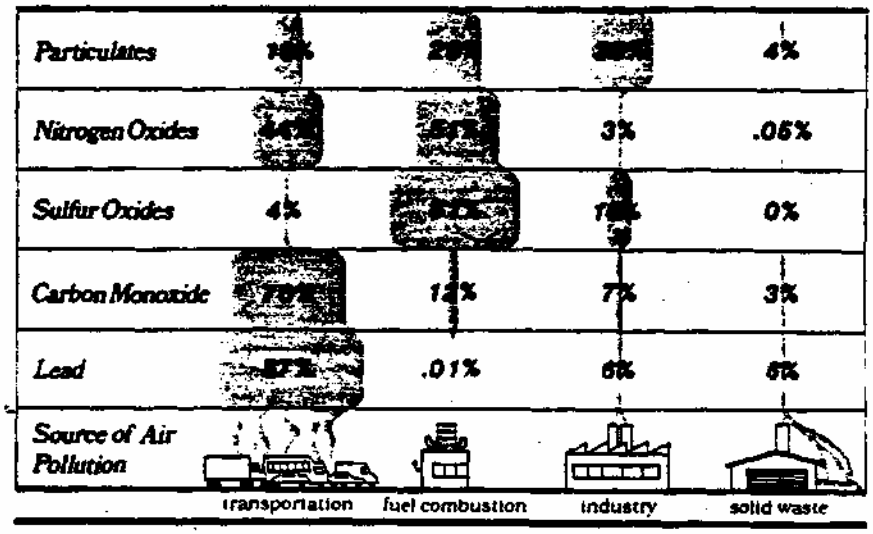


Figure 5

pollutant. Total percentages for each pollutant are less than 100%, due to existence of minor activities not shown on this chart (USEPA, 1984).



The quality of New Jersey's air has noticeably improved since the passage of state and federal pollution legislation in the late 1960s and early 1970s. Soot, smoke, and fly ash no longer cloud industrial areas. Cities are far freer of noxious fumes, and other dangerous pollutants—particularly lead—have been sharply reduced. This progress has been attributed to emission controls on stacks, and to tighter standards for new car emissions.

Air quality in New Jersey is improving. However, in the future, greater reliance on coal for expanded electric generation, incineration of municipal solid waste and sewage sludge, and private industry emissions will compete for emission approvals. It will also remain important to protect resources such as the Brigantine Wilderness Area in the National Wildlife Refuge, which is a federally listed Class I air quality area (Figure 6) and has special conditions required to maintain its high-quality environment.

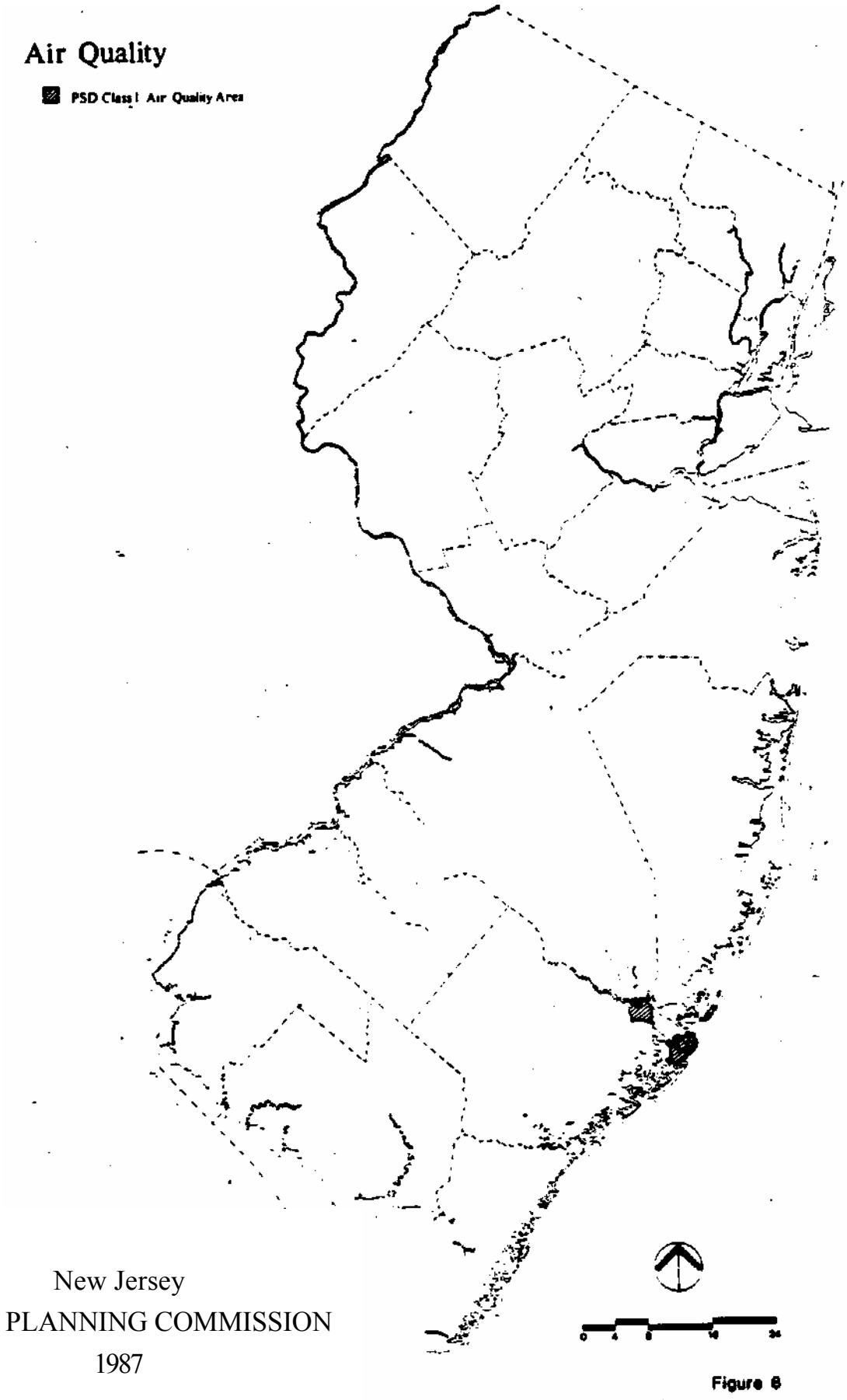


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Figure 6

Persistent problems, such as ozone, carbon monoxide, and participate matter, and emerging threats such as acid precipitation and airborne toxic substances, will require new commitments to bring them under control. In terms of the State Development and Redevelopment Plan, the use of automobiles and the resulting levels of ozone will be a major consideration.

Ozone

Ozone is New Jersey's most widespread and persistent air pollution problem and may have a major impact on growth management in the state. Problems in managing ozone stem from the fact that ozone is transported from other areas to New._ Jersey, just as New Jersey air is transported to other locations. Concern is centered on its health effects—aggravation of respiratory and cardiovascular illness, impairment of cardiopulmonary functions--as well as the damage it inflicts on crops, such as alfalfa, corn, potatoes, rye, soybeans, and wheat, and on certain trees, shrubs, and garden vegetables.

Ozone, which is the principal component of "smog," is formed in the atmosphere in complex chemical reactions. Hydrocarbons and nitrogen react in the presence of sunlight to form ozone downwind from their sources. Efforts to reduce ozone have centered on controlling hydrocarbon emissions. Motor vehicles and industrial processes are major sources of these emissions in New Jersey. The more vehicle miles traveled, the higher the ozone levels. Other sources include printing operations, industrial and domestic solvent use, architectural coating, metal coating, vehicle refueling, and storage and distribution of petroleum products.

Currently, the entire state fails to meet National Ambient Air Quality Standards (NAAQS) for ozone. The state's plan to bring New Jersey into compliance with federal ozone standards calls for additional emissions controls and transportation control strategies, including effective incentives for mass transit. If New Jersey cannot come under compliance, it could lose federal highway and sewage treatment funding, incur sanctions to bar issuing permits for new sources, suffer a moratorium on growth, and lose 105 funds.

To limit ozone emissions disincentives can be established by:

a.) requiring more stringent emission offsets for stationary sources based upon land use decisions. NJDEP regulations now provide for emission offsets based on distance between sources (NJAC 7:27-18:4). The concept could be expanded to differentiate between growth and non-growth areas. The concept now applies only to industries requiring source control permits, predominantly manufacturing industries. It could be expanded to service industries as well. This can be done by either coupling the direct and indirect motor vehicle travel emission of a facility to the source permit requirements, or

b.) requiring, an indirect source review of such facilities and perhaps, residential developments of 50 or more units which each contribute at least 5 tons of volatile organic substances per year* This concept would require the industrial or residential developer to compensate for the increased traffic by obtaining reductions of emissions at a predetermined offset ratio which would counteract the adverse effect of the additional burden on air quality. The application could, alternatively, offset the emissions deficit by demonstrating the existence of an enforceable and verifiable ride sharing program that reduces vehicular traffic proportionately, or ,

c.) requiring emission fees which would subsidize environmental measures such as mass transportation in future development. In this "case, the developer would contribute monies deemed adequate to a trust fund. The fund would be available to finance measures to offset adverse environmental effects (Berkowitz, 1987).

Particulate Matter

Participates are particles of dust which, when inhaled, can make breathing more difficult and increase susceptibility to respiratory infections.

They are also a nuisance, with effects ranging from soiled clothes to impaired visibility. The primary (health) or secondary (welfare) standards for participate matter are attained everywhere in New Jersey, although several industrial areas are near the limit.

Sources of participates are extremely varied. They include all forms of combustion, industrial processes,- agricultural tilling, construction and demolition activities, and vehicle exhaust. Areas such as roads and parking areas generate a large amount of "fugitive dust," which is a major .constituent of participate pollution.

Carbon Monoxide

Carbon monoxide is a toxic gas which, when inhaled, replaces oxygen in the blood. High concentrations impair vision and judgment, and cause headaches, dizziness and ultimately death. People with heart disease are especially sensitive.

Carbon monoxide is a localized pollution problem in areas where there is heavy automobile traffic and 'restricted air circulation, e.g., congested intersections and areas where cars frequently stop and start. Motor vehicle exhaust accounts for the vast majority of carbon monoxide emissions in New Jersey.

In 1982, the State Implementation Plan (SIP) identified 15 Central Business Districts (CBDs) as areas of non-attainment and 305 areas (inter-sections) as areas of potential non-attainment^ Unlike ozone, carbon monoxide is highly localized. A plan designed to limit growth in open areas is therefore not applicable. Instead, the opposite is true since density, rather than location, is the limiting factor. In some cases an upper bound on carbon monoxide emission density must be established which can be directly related to vehicle density. Development in high density areas should focus on reducing ambient concentrations of carbon monoxide.

Examples of such planning initiatives include:

a.) encouragement of mass transportation
b.) limiting on-site parking facilities
c.) traffic restrictions in central business districts
d.) allowing commuter trip by private vehicle only on designated days called "drive days" (i.e., bi-weekly trips only according to last numerical digit on license plate) e.) limits
on building site density (upper limit).

At first glance these proposals seem to contradict the overall system to redevelop Older Urban Centers. Upon closer examination NJDEP, Division of Air Quality, feels these proposals could benefit contained growth areas like the Hudson Waterfund by affirmatively addressing their unique condition. The quality of life that is strained by such high density development on a limited land area can be enhanced by imposing explicit controls that benefit the immediate population. This constitutes a high degree of planning sensitivity ultimately complementing the need to redevelop urban areas (Berkowitz, 1987).

Lead.

Lead is highly toxic pollutant which is nevertheless regulated as a conventional air pollutant, with an ambient standard, because it is so widespread". Airborne lead accumulates in the body, affecting the blood-forming, nervous, and kidney systems. Children are particularly susceptible to lead poisoning. Auto exhaust from the combustion of leaded gasoline is the primary source of lead in the air.

New Jersey is now in compliance with National Ambient Air Quality Standards for lead. Conversion to unleaded gasoline is the principal cause of improvement. There is still need for evaluation and regulation to prevent unhealthy levels from lead industry sources.

Sulfur di-oxide and Oxides of Nitrogen

Two other conventional pollutants—sulfur dioxide and nitrogen oxides -- are under control in New Jersey. Sulfur dioxide and nitrogen oxides can cause respiratory illness and aggravate other health conditions. Nitrogen oxides are lung irritants. Nitrogen oxides also contribute to the formation of ozone and acid rain. Sulfur .dioxide is the major contributor to acid rain. Principal sources of nitrogen oxides are motor vehicles and electric utility and industrial boilers. The major source of sulfur dioxide is the burning of fossil fuels for heat and electrical power generation.

For nitrogen oxides, unhealthful levels have not been recorded in New Jersey for over' a decade; however, small increases have been observed in recent years. Limits on the sulfur content of fuels, particularly coal and residual fuel oil, have brought great reductions in the exposure of the population to this pollutant. However, there may be locations where unhealthy levels may occur from time to time.

Toxic/Hazardous Material

Some air pollutants are harmful to people and require control under a separate section of the law, which provides for National Emission Standards for Hazardous Air Pollutants (NESHAPs). These substances include asbestos, beryllium, mercury, vinyl chloride, benzene, and arsenic. Others may be added to the list as research continues.

Very small concentrations of these pollutants may cause cancer, birth defects, genetic damage, or other serious health conditions long after initial exposure to them. NESHAP regulations set tight limits on emissions of hazardous pollutants from industrial sources, rather than on focusing ambient concentrations which are appropriate for more widespread conventional pollutants. In addition to the NESHAP, under the federal Clean Air Act, New Jersey identifies and regulates toxic air pollutants independently. The current list of toxic substances consists of 11 volatile organic substances.

An extension of the list, including a number of metals and their compounds, is being considered.

Sources of toxic/hazardous air pollutants include synthetic organic chemical manufacturing, the petroleum industry, mineral mining, smelting and refining, and solvent and waste disposal.

Radon is a natural product produced by the decay of radioactive minerals. The gas is released through the soil to the atmosphere. The Highlands sections as well as other nearby areas of New Jersey, have parent rock material that contain these radioactive minerals. Concentrations of radon found in other areas are possibly due to sediments eroded from this parent rock. Residential basements can trap gases, that are normally released through ground transmissions. Radon trapped in these areas of poor circulation can reach dangerous levels and pose a health hazard. NJDEP is studying the radon situation. The Department believes that proper venting of homes can minimize health risks from radon gas.

Acid Precipitation

Deposition of airborne acids, commonly known as acid precipitation or "acid rain," is a serious problem in the northeastern U.S. and southeastern Canada. Sulfuric acid and nitric acid are deposited in rain and snow or fall to earth in dry form. Lakes may become extremely acidic in regions where the surrounding soil and rock are thin, coarse, or not sufficiently alkaline to neutralize the acids in runoff before it enters them. Acid precipitation has caused certain fish populations to decline and in some cases, to disappear entirely. There may also be adverse effects on forests, crops, soils and structures. New Jersey lies in the path of highly acid precipitation. Limited monitoring finds a pH in the average range. . .for northeastern states (NJDEP/DWR, 1986).

Acid rain is largely a result of fossil fuel combustion. Electric utilities, particularly coal-fired boilers, produce most of the sulfur

dioxide and about one-third of the nitrogen oxides that combine with water to form the acids. Many of the power plant emissions originate in the Ohio River Valley in- facilities without air pollution control devices. New Jersey's industries may also contribute to the problem.

Two areas of New Jersey appear to be most sensitive to acid deposition—the Pinelands of southern New Jersey and portions of the Highlands and Ridge and Valley provinces of northern New Jersey. Although the Pinelands have become more acidic as a result of natural processes, the plants and animals in the ecosystems 'may not be able to tolerate further increases in acidity as a -result of acid precipitation. In northern New Jersey certain areas are underlain by bedrock with low buffering capacities. While most streams in northern New Jersey appear to adequately buffer acid deposition, some lakes and impoundments have experienced reduced pH levels (increased acidity) or are extremely susceptible to reduction in pH (NJDEP, 1986),

Research at some lakes in northern New Jersey has shown that increasing acidity results in increased levels of trace metals such as lead, zinc, and aluminum in the lake waters. However, a majority of lakes in the north-western portion of the state have clay minerals in bottom sediments that act to neutralize acids. Streams in the northwest were thought to have sufficient buffering capacity to prevent increases in acidity, but recent research has indicated that buffering capacity of streams in the northwest may be overridden by snow melt to the point where pH is reduced and trout reproduction inhibited. Conclusive evidence on the adverse effects of acid precipitation is still being sought through continued monitoring and research (NJDEP, 1986).

Water Resources

Overview

The waters of New Jersey are important for water supply and recreation and provide a variety of aquatic habitats throughout the state. The quality of surface waters ranges from excellent to poor. These waters are heavily influenced by the state's land uses and population centers.

Generally, streams and rivers originate in rural, undeveloped forested or agricultural lands before entering suburban/urbanized areas. Waterfront development and redevelopment is now occurring in an intense manner along the main stems of rivers, streams, lakes and estuaries, and on barrier islands.

Water quality and water use may be major growth management factors in New Jersey over the next several decades. Since the drought of 1960, which caused a serious water crisis, a major planning effort to secure adequate water supplies has been under way. This effort has two main thrusts: to ensure a sufficient supply of drinking water from both ground and surface water sources, and to maintain the quality of the supplies. A related concern has been to improve the delivery system so that water is available in areas of high demand.

The General Water Resource Characteristics map (Figure 7) provides general information regarding water supply. Presently, population concentrations in northeastern New Jersey are served principally by surface water supplies that are sometimes remote reservoirs or distant watersheds. These supplies may be supplemented by wells. Less populated areas in the Coastal Plain are supplied primarily by groundwater.

Currently there are approximately 630 purveyors of water, both public and private, in the state. Approximately 75 percent of the water supplied by these systems is the responsibility of the largest 25 purveyors (NJDEP/DWR, 1982). However, water shortages have continued to exist. In many areas the

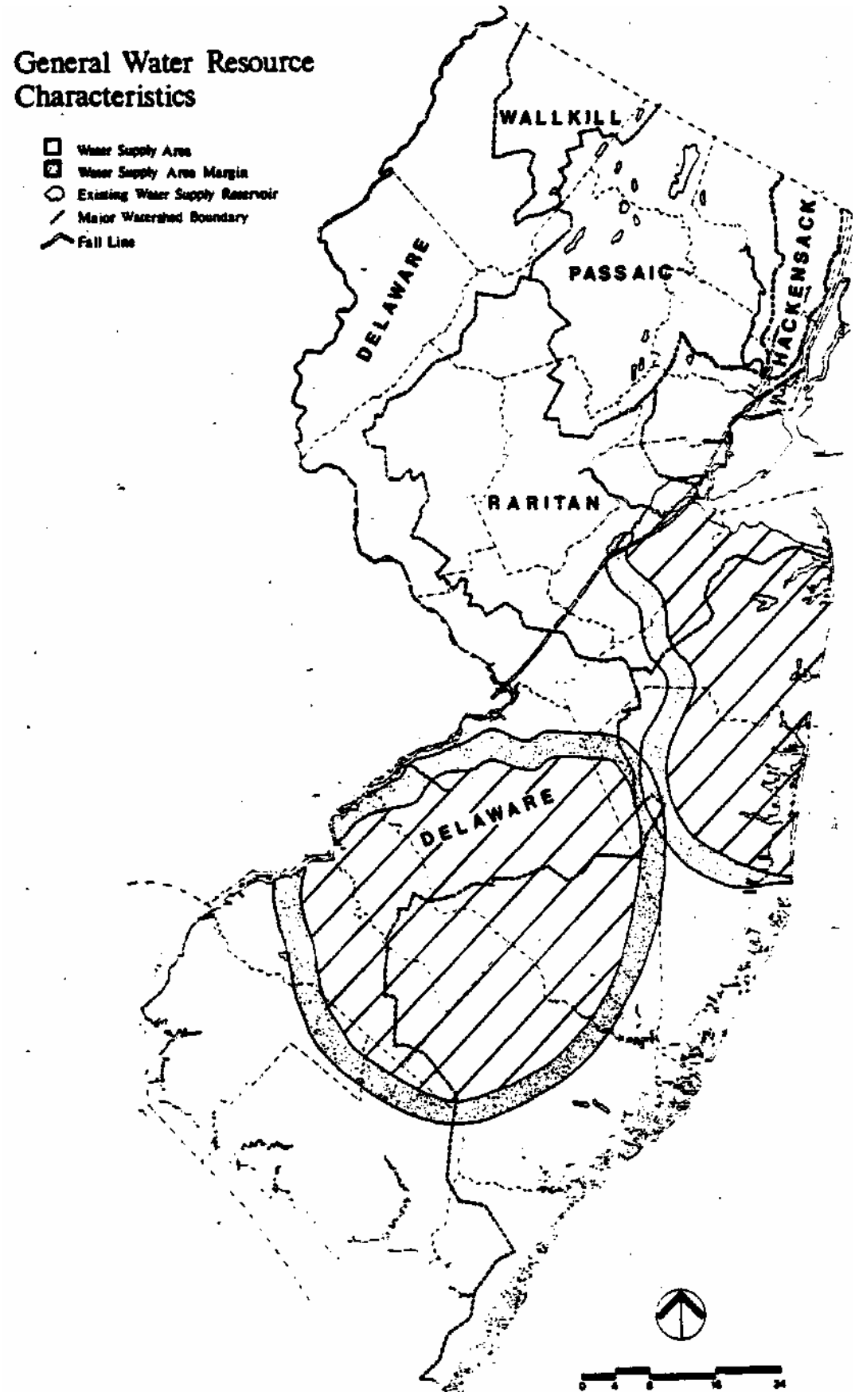

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Figure* 7

ability to deliver potable water in adequate amounts cannot keep pace with growing demand, even during non-drought years. New surface water storage facilities and better protection of aquifers will be required to coordinate demands created by growth. A list of over $500 million in related capital improvements and studies is contained in the recent publication, "Major Improvements in New Jersey's Ability to Withstand Future Droughts and- Water Emergencies (NJ DEP/DWR, 1985).

To emphasize the importance of New Jersey's ground water to its citizens and industries, in 1985-NJDEP petitioned USEPA, under the Safe Drinking Water Act, to declare practically the entire state as a sole source aquifer. This petition recognized the vulnerability of the state's groundwater to many known potential pollutants and emphasized the importance of groundwater to the potable water supply.

Studies are being done to better understand the water supply situation. Currently, the geology of the state is being remapped in the COGEOMAP project, COGEOMAP is a joint effort of the U.S. Geological Survey and the New Jersey Geological Survey (NJGS). The map is expected to be completed in 1990.

In addition to this effort, the New Jersey Department of Environmental Protection, Division of Water Resources, is completing an aquifer classification study in support of the revision of New Jersey Ground Water Quality Standards. Classification will relate to water supply and quality as follows:

Class I	--Ecologically Important
Class II	— Potable Ground Water Supplies
Class III	— Potable Water Use is >95fc from surface water, or the area has severe groundwater pollution problems.

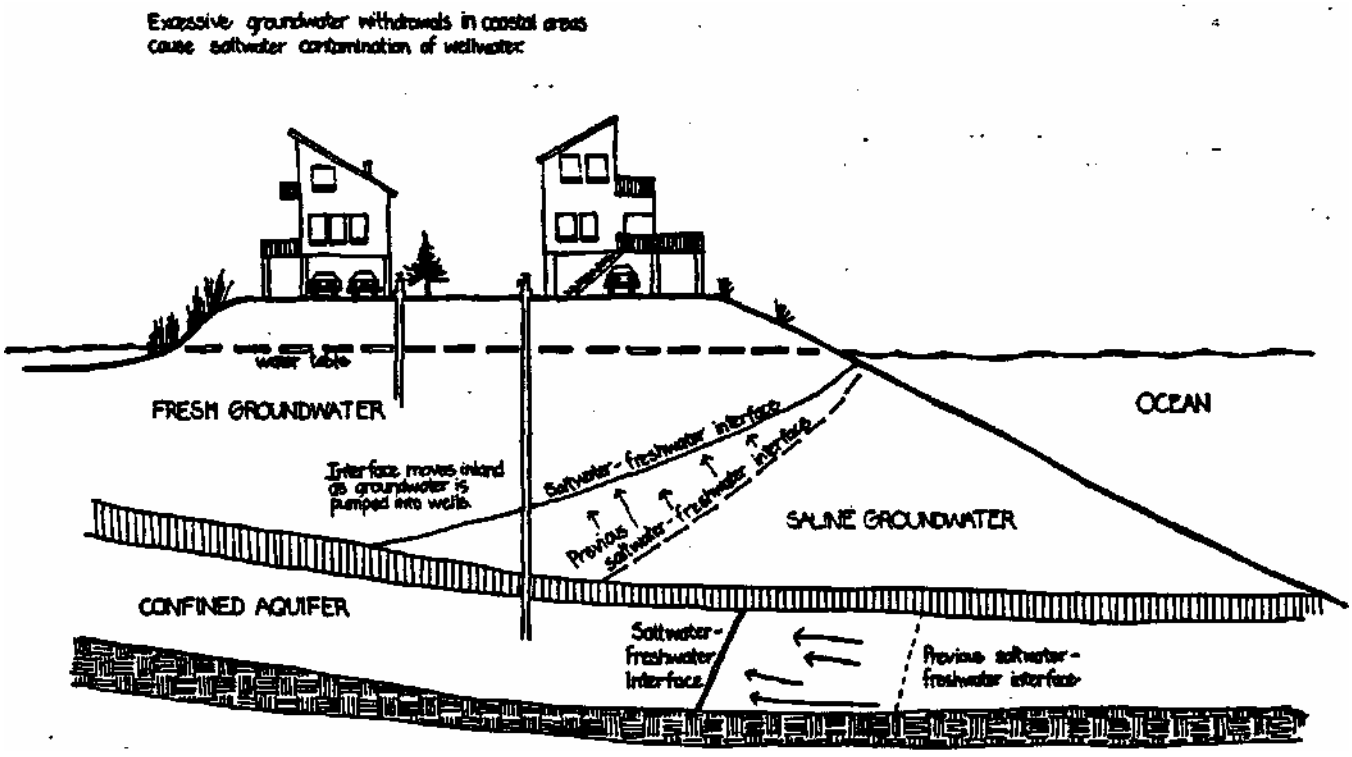
Class II is further subdivided into IIA, IIB, and IIC based on weighted numerical scores for (1) groundwater yield, (2) depth of groundwater, (3) population using aquifer, (4) percentage of population in area using aquifer,

and (5) treatability (ambient quality). This study is expected to be mapped and ready in late summer of 1987. Data are not available at the present time (Carter, 1987).

Other studies are being undertaken to characterize the ability of groundwater supplies to support growth and the measures necessary to manage groundwater resources for future use.

For example, in coastal areas, overpumpage of groundwater can cause intrusion of saline ocean, bay, or tidal stream waters into freshwater aquifers. The affected part of such an aquifer becomes unsuitable for water supply. This has actually occurred in a bedrock aquifer near Newark (NJDEP/DWR, 1985) and along the coast. In designated "water supply critical areas" within the coastal plain, alternative surface water supplies of over 55 mgd will be needed by the year 2020 to compensate for overpumping of groundwater, if growth in water supply critical areas is to continue. Other parts of the state are under study for water supply critical area designation.

Saltwater Intrusion



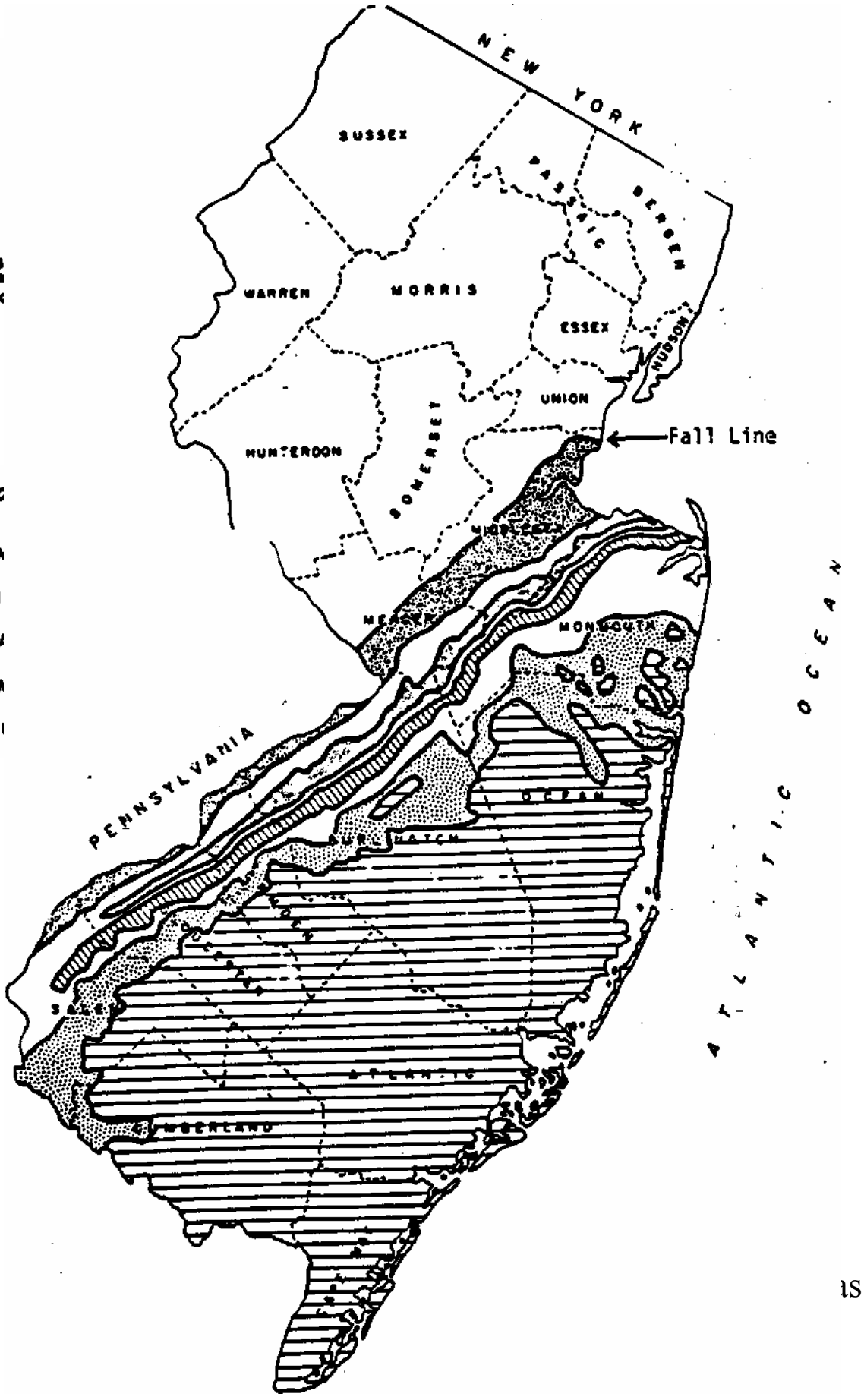
Water Supply,

Groundwater. " Groundwater is found in aquifers—water-bearing rocks or sediments. The amount of water a well yields depends upon the physical properties of the aquifer it taps and the characteristics and thickness of rocks in the well. Coarse-grained sediments and fractured or porous rock generally yield more water than fine-textured ones.

Currently about one-half of New Jersey's residents, about four million people, rely on groundwater for drinking. Of the 622 community public water systems in the state, 558 obtain all or part of their supplies from groundwater sources (U.S. EPA, 1985). Groundwater is also important in providing base flow to most of New Jersey's rivers and streams. An estimated 67 to 69 percent of the base flow of Coastal Plain streams is attributable to groundwater discharge (Havens et al., 1980). A smaller percentage is likely in hardrock areas.

Groundwater South of the Fall Line. An estimated 500 mgd is being pumped from Coastal Plain aquifers (Havens et al., 1980). Groundwater accounts for 75% of municipal and domestic supplies in this area and provides water to 2,126,170 people. Purveyors supplied over 275 million gallons per day from groundwater in the Coastal Plain. •

Wells drilled in the Inner and Outer Coastal Plain draw large amounts of mostly high-quality water from buried sand and gravel deposits. The ~ Inner and Outer Coastal Plain form the largest section of the state, covering over 4,400 square miles or 56 percent of the total area. The geology of the region is a series of layers of overlapping, southeasterly dipping and thickening sediments that form both confined and unconfined aquifers. The confined aquifers generally outcrop along the Inner Coastal Plain. Confined aquifers or aquifer systems include the Potomac-Raritan and Magothy, Englishtown, Mt. Laurel-Wenonah and Kirk wood formations (Figure 8).



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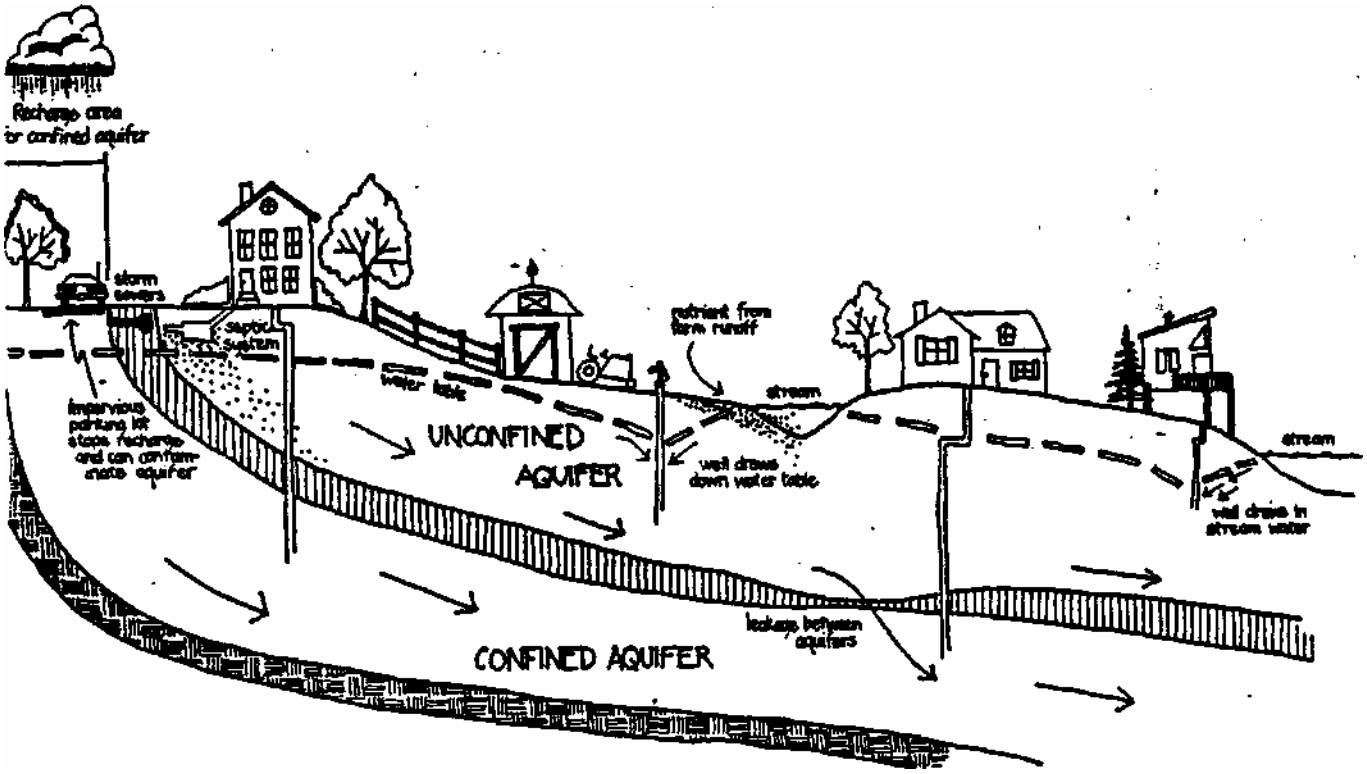
Havens et al.

Figure 8

Confined aquifers are recharged at the ground surface along the outcrop in aquifer recharge areas and by vertical leakage of groundwater through confining layers, especially where the aquifers are heavily pumped.

Aquifer recharge areas (see graphic) directly mentioned in the State Planning Act are not currently mapped for New Jersey. The N.J. Geological Survey has been asked by the state's Department of Environmental Protection to prepare a proposal to map aquifer recharge areas. The proposal is for a million-dollar, four-year study related to the need for mapping future ability to manage aquifers. This program for management is extremely complex and not easily regulated. "

Groundwater Systems



The approximately 17-trillion-gallon unconfined Cohansey Aquifer underlies the Pinelands and extends beyond its boundaries. The Cohansey Formation's volume and water quality are critical to the future integrity of the area. Significant groundwater withdrawals within or adjacent to the Pinelands will result in unacceptable stress to the important ecological resources of the National Reserve (Moore, 1987). The Pinelands Commission is concerned about the impact of future growth on the periphery of the Pinelands[1] boundaries. It is thus doubly important that the groundwater in the Cohansey be maintained.

Groundwater North of the Fall Line. The Piedmont, or Triassic Lowlands, is the second largest geologic region in the state, encompassing over 1,600 square miles. Mudstone, sandstone and conglomerate rocks with interlayered igneous rocks characterize this area. Brunswick shale is the dominant formation and causes the reddish color of the soil. Wells here are drilled in hard rock. Groundwater is found in fractures and joints of formations, and its flow is complex and difficult to predict. In certain northern portions of the region, glacial material was deposited over these consolidated rocks. These stratified deposits of sand and gravel are typically the' most productive groundwater-bearing formations in the Piedmont*

The Highlands and Ridge and Valley provinces are made up of ridges and valleys of crystalline and sedimentary rocks. The upland areas contain thin soils, while the valleys may be filled with up to 350 feet of glacial sand and gravel, silt and clay. Groundwater supply here is variable and generally less than most other areas. As in the Piedmont, water is stored in cracks and fractures, but water movement in the Highlands and Ridge and Valley provinces is restricted to localized areas, and no regional groundwater flow is thought to exist. The limestone valleys provide larger volumes of water stored in cavities. Nearly 90 percent of local residents rely on groundwater.

Surface Water. Surface sources are very important in the hard rock Piedmont portions of the state and will become increasingly important to the Coastal Plains. Diversions of surface flow for potable water supply, industrial process and cooling purposes, agricultural irrigation, and maintenance of reservoir impoundment levels are common throughout the state. In fact, water diversions are so great that the State's three largest rivers, the Delaware, Passaic, and Raritan, all have passing flow requirements. The map showing the watersheds and reservoir location is found on the following page. Thirty reservoirs are currently in use or considered for emergency supply, and five are under construction or proposed (Table l)(Figure 9). The map' was prepared from NJ DEP's 1:250,000 Drainage Basin map and 1:24,000 USGS .quadrangle maps. Approximately 40 percent of the state's population is served by these .reservoirs. The NJDEP's Bureau of Water Allocations, as mandated in the State Water Supply Management Act (N.J.S.A. 58A:1 et. seq.), requires water diversion permits for all withdrawals of more than 100,000 gallons per day. As early as 1985, allocations were issued in the amounts of approximately 1,300 million gallons per day for potable supply, 660 mgd for agricultural use, and nearly 4,000- mgd for industrial purposes (NJDEP/DWR, 1986).

Water supply concerns are .critical in all major river basins. They encompass both availability and distribution. Due to the age of the extensive water supply system, future state funding will be needed for both facilities and treatment. Treatment costs may rise because hydrocarbons and organic chemicals in these water bodies may react with standard chlorine treatment methods to create more toxic or carcinogenic compounds. - The need for alternative treatments is being investigated; however, the problem is also a matter of watershed management, which could reduce the rate or eliminate the opportunity for these pollutants to enter the system (NJDEP/DWR, 1982).

Of particular note is NJDEP's program to restrict saltwater intrusion and contamination through the designation of Critical Area No. 2, which covers the Burlington-Camden-Gloucester County Area. The cutbacks in groundwater pumping imposed in this area will require additional diversion of the Delaware River water of approximately 20 mgd, later increasing to 40 mgd.

New

Water Resources

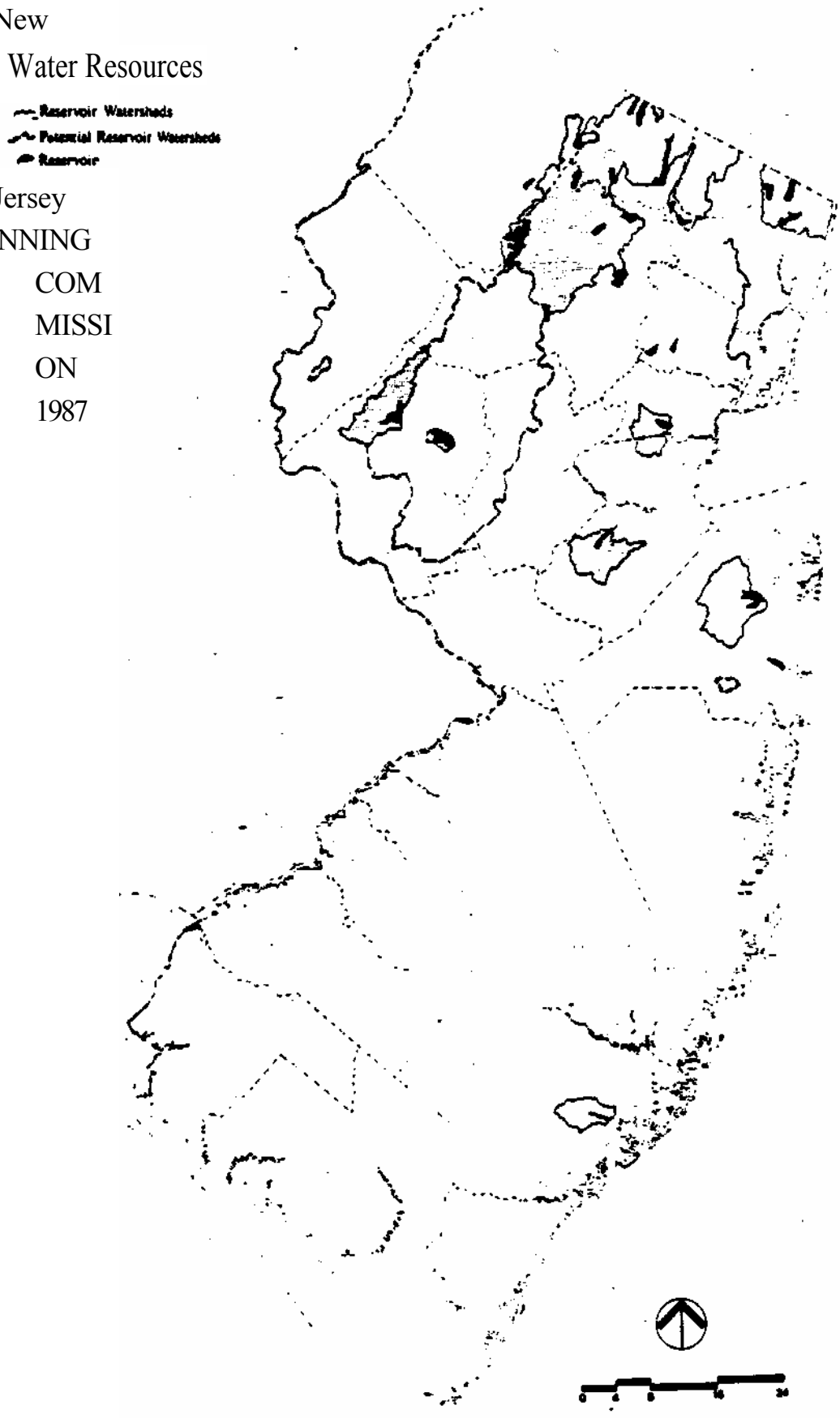


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Figure* 9

Table 1. Public Water Supply Reservoirs In New Jersey

BASIN	HAP NO.	RESERVOIR	STREAM	COMMENTS
Raritan River	1	Spruce Run Reserv.		
	2	Round Valley Reserv.		
	3	Ferrington Lake	Lawrence Brook	Currently not used because of sediment
Passaic River	4	CaniBtear Reservoir		Newark Water Dept. H
	5	Oak Ridge Reservoir		n
	6	Clinton Reservoir		N
	7	Echo Lake ,		w
	8	Charlottesburg Reserv.	Confluence of Macopin & Pequennock Rivers Off-line near Canoe Br.	Off-line pumped storage
	9	Canoe Brook Reserv. 1		
	10	Canoe Brook Reserv. 2		
	11	Canoe Brook Reserv.. 3		Jersey City Water Dept
	12	Splitrock Reservoir		
	13	Boonton Reservoir		
	14	Pompton Lake		Point of divergent pumping to Wanaque end Oredell R.
	15	Wanaque Reservoir		
	16	Greenwood Lake		
	17	Clyde Potts Reserv.	Whippeny River	Small reservoir at Randolph Twp./Mendhem border
	1B	Kikeout Reservoir	Pompton River	Kinnelon Township Off-line
	19	Point View Reservoir	Pompton River	pumped storage
Rahway River	20	Orange Reservoir	West Brench Robinson's Brench	Middlesex Water Dept. Currently not used because of sediment
	21	Middlesex Reservoir.		

Table 1. Public Water Supply Reservoirs in *Hem* Jersey

BASIN	MAP NO.	RESERVOIR	STREAM	COMMENTS
Hackensack River	22	Oradell Reservoir		Diverts from Saddle R.
	23	Woodcliff Lake		and Wanaque South Project
	24	Tappan Lake		Partly in New York State
	25	De Forest Lake		In New York State
Navesink River	26	Swimming River Reserv.	Swimming River	
Atlantic Coast	27	Atlantic City Reserv.	Absecon Creek	
	28	Glendola Reservoir,	Shark River	
Delaware River	29	Lake Hopatcong		Has been used 1n drought emergencies
Walk11I River	30	Morris Lake/Newton		Not water supply reservoir unless email local water department uses
FUTURE AND IN-PROGRESS RESERVOIRS;				
Atlantic Coast	P-1	Manasquan Reservoir Project	Manasquan River	Oak Glen Reserv. off-stream 8-mgd aide-channel spillway active project
Raritan River	P-2	Six-Mile Run Reserv.	Six-Mile Run	
	P-3	Confluence Reservoir	North and South Branch	Currently under study
Delaware River	P-4	Merrill Creek	Merrill Creek	Low flow augmentation for Delaware River under construction
Passaic River	P-5	Monkavllle Reservoir	Wanaque River	Upstream from Wanaque Res. entirely In same watershed; under construction

This diversion cannot be obtained from the Delaware River without compensating, low flow augmentation through the F.E. Walter Reservoir Modification Project. In addition, the lack of storage for such How .augmentation would require a cessation of new water allocations in all areas tributary to the Delaware River under a basin-wide agreement.

Water Quality

Groundwater. Overall ground water quality in New Jersey is good. But groundwater levels of contamination vary with location. Thick, permeable surface sediments may provide an excellent opportunity for good yield and low well construction costs, but these surficial sediments offer little protection from pollution sources. The ideal groundwater condition is a productive aquifer buried or confined beneath layers of impermeable material that retard the infiltration of pollutants.

Confined aquifers are most vulnerable where they intersect the ground surface. Unconfined (or water table) aquifers are especially prone to contamination. It is especially important to consider the impact of land use activities on these vulnerable areas. Where land uses have the potential to pollute groundwater, appropriate control measures should be applied. Sometimes pollutants also gradually seep through semipermeable beds, and thereby contaminate even the deeper confined aquifers. Total security can only be achieved by preventing all infiltration of pollutants. These conditions underscore the need for household hazardous waste cleanup activities, oil recycling programs, and the like.

Contamination problems have resulted in loss of groundwater quality in several local areas in New Jersey. Table 2 and the graphics show some of these. From 1970 to 1985 pollution has led to the closure of 109 municipal and 667 domestic wells.

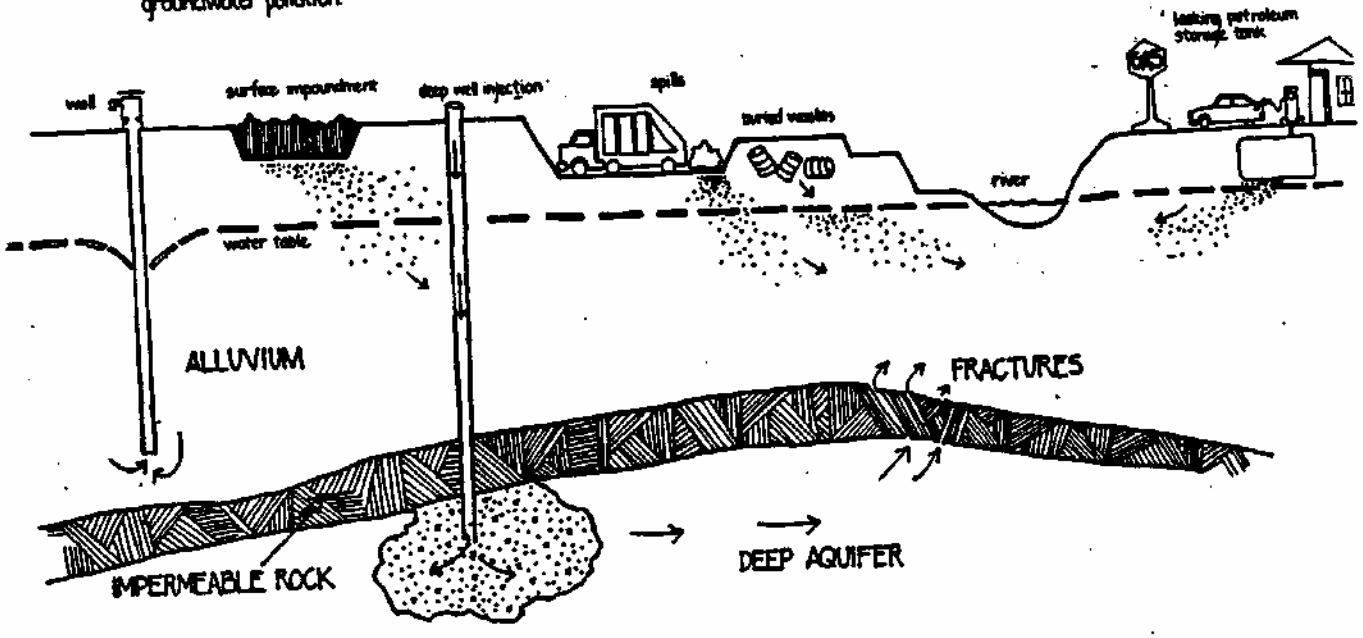
Table 2. Groundwater pollution investigations and well closures (1970-1985)

	Coastal Plain	Piedmont	Highland/ Ridge & Valley	Totals
Groundwater pollution investigations	288	281	124	693
Municipal closures	58	38	13	109
Private closures	608	34	25	667
Total domestic wells	n.a.	71,000	47,800	119,467

NJDEP

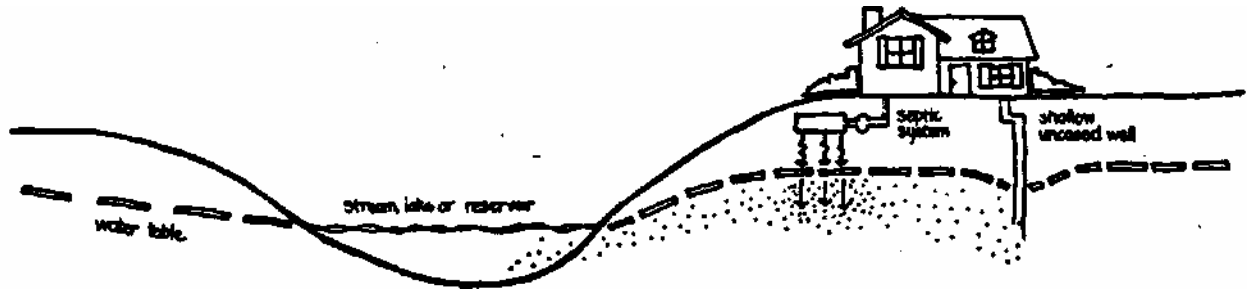
Industrial Contamination

Industrial wastes are disposed of in many forms and in many areas. Some of the wastes cause severe groundwater pollution.



Domestic Contamination

A poorly designed septic system can cause both well and surface water contamination.



During this period, NJDEP responded to nearly 700 groundwater pollution cases. The primary causes of well closures have been high levels of hydrocarbons and other organic chemicals. In addition, minute amounts of organic chemicals and metals generally not hazardous to the public health have been found to be widespread in New Jersey's groundwater system (Tucker and Burke, 1978). A large number of unpermitted, nonpoint sources of pollution are also thought to exist. These sources include underground storage tanks, surface runoff, land application of pesticides, spills and leaks, buried wastes, certain types of lagoons, and surface impoundments. Pollution of surface water can also contribute to groundwater contamination.

A significant concern is the large number of known and suspected sites that contain hazardous waste. Almost 1,000 sites have been initially identified. Six hundred fifty-five are known to need remediation measures. About 60 have already been cleaned up. Ninety-nine of the known sites are listed as National Priority List Superfund sites. Currently, 300 enforcement actions are under way regarding predominantly industrial site pollution and spills (NJDEP/DWR, 1986).

Domestic contamination is also a concern. Nutrients and fecal coliform can contaminate wells and nearby waterbodies. Permits are required by local health officers for individual residential septic tanks. State permits are required for 50 or more septic units. Many innovative technologies have been created to link multiple residential or mixed use developments to central septic tank units in unsewered areas.

A Mew Jersey Pollution Discharge Elimination System (NJPDE5) Discharge to Groundwater Permit is required for the construction of new community on-site subsurface' disposal systems, defined singly in N.J.A.C. 7:14A-1.9 as "an on-site subsurface disposal system which serves five or more realty improvements as defined in N.J.A.C. 58:11-23 £l fifig. or any on-site subsurface disposal system receiving domestic waste and serving one or more realty improvements where the design flow is greater than 2000 gpd,"

A permit is also required for expansions of existing facilities that cause any part of the disposal system to meet the definition of a community on-site subsurface disposal system. Existing facilities that meet this definition currently, do not require a permit except when they require repairs, alterations, or improvements. Existing facilities may be required to obtain a permit in the future, however.

For all projects with discharges of sanitary wastewater from other than single-family residences, a Treatment Works Approval is necessary for construction of the building's sewers, collection lines, and treatment systems. This includes the following types of facilities:

- Systems with two or more connections, .
- Office buildings, or commercial establishments with flows greater than 400 gpd, and
- Treatment systems not in conformance with standards.

If the treatment system incorporates flow conservation devices and/or recycle systems that alter the quality of the effluent such that it no longer resembles typical domestic sewage, review of the treatment works approval may determine that a discharge to groundwater permit is necessary.

A permit for a system with five or more housing units requires all the endorsements, consistency reviews, and a co-permittee, as mandated by the Statewide Water Quality Management Plan. Section 2.14 of the Realty Improvement Sewerage Facilities Act specifically prohibits multiple connections to one septic system unless "it is most impractical or impossible to construct separate individual systems for the same pursuant to these standards. Permission may be granted by the administrative authority for joint use. . . only if the facts are established to its satisfaction and assurances given that only one legal entity will be responsible for the maintenance and operations of said system."

Environmental Cleanup Responsibility Act (ECRA) regulations requiring site analysis and cleanup during real estate transactions have discouraged redevelopment of abandoned industrial sites. At the same time, competition for land has created proposals for development of abandoned landfill facilities. The state's landfill capacity cannot accommodate the relocation of this volume of waste. Currently, up to 60 percent of municipal solid waste is slated to be disposed of out-of-state until the 16 proposed resource recovery plants and 17 proposed new state-of-the-art landfills are developed over the next five years (Sondermeyer, 1987).

Surface Water Quality

As well as providing a source of drinking water, surface waters serve as an important foundation for recreation in the state. NJDEP estimates that combined peak day demand for swimming, motor boating and fishing in New Jersey in 1980 was nearly three million activity days. Freshwater swimming comprised 40 percent of the total, saltwater swimming 47 percent, freshwater boating and fishing 3 percent, and saltwater boating and fishing 10 percent. By the year 2000, combined peak day demand for these activities is expected to be over 3.5 million activity days (NJDEP, 1984b). Overall, swimming is the second most popular outdoor recreation activity in the state, fishing is seventh, and motor boating is seventeenth. Maintenance and- improvement of water quality in the state is critical from a recreational standpoint.

A variety of aquatic habitats are found throughout New Jersey. Freshwater habitats vary from coldwater trout streams in northern New Jersey, to acidic Pinelands "streams in southern areas of the state. Tidal streams and rivers, coastal bays, and estuaries are used by anadromous fish, and various ocean fishes also spawn, nursery and migrate through the state's coastal waters.

Streams

Water quality conditions cited below are based on a review of surface water quality data collected from 1981 through mid-1985. Swimmable status is based primarily on levels of fecal coliform (an indicator bacterium) found in each waterway. Swimmable water quality was defined as a fecal coliform level of 200 MPN/lOOml or less. Fishable status was based on the amount of dissolved oxygen available during critical periods (such as low flow and warm weather), the presence of high un-ionized ammonia concentrations, extreme fluctuations in stream pH, and the presence of toxic or hazardous substances in the waterway or its aquatic life (areas where fishing advisories or bans have been issued). Five descriptive conditions were then formulated to characterize water quality (NJDEP/DWR, 1986):

Excellent - No or minimal pollution present. Swimmable and fishable uses are met throughout the year.

Good - Generally low amount of pollution. Fishable goal will likely be met, but swimmable status may not be achieved.

Fair - Pollution will vary from moderate to high levels, especially during critical periods. Fishable goal will usually be met, but water will likely be unsuitable for swimming.

Poor - Pollution is found in high amounts. Attainment of fishable clean water goal is limited; water is unsuitable for swimming.

Very Poor - Pollution occurs at extremely high levels, causing severe stress to stream life; no in-stream uses are achieved.

Surface water quality in New Jersey ranges from excellent to poor. Most rivers and streams are considered fair to good, a condition which has, for the most part, been found to be true over the past five years.

Surface water quality requires control of pollutants from both point sources (sewage treatment plants, industrial processing) and nonpoint sources (runoff from road surfaces, parking lots, agricultural fields, rooftops and the like). . "

A number of major conclusions can be made regarding New Jersey's stream water quality during the past five years and whether long-term changes are occurring (NJDEP/DWR, 1986). These conclusions are as follows:

- o Water quality conditions in the state's rivers and streams continues to be relatively stable; that is, most waterways have shown little significant change during the past 5-8 years.

- o Eighty-nine percent of the monitored freshwaters of the state meet at least one of the national goals for swimmable and fishable clean water. Yet fecal coliform and phosphorus are found at elevated concentrations in most_ streams and rivers. As a result, only 29 percent of the monitored freshwaters meet both clean water goals.

- o Trend analyses of water quality data show 25 waterbodies as having experienced no major changes in conditions. Seven rivers/streams improved and six showed degradation. These data were collected between 1977 and 1986 at over 70 ambient monitoring stations.

- o Increased dissolved oxygen (in 40 percent of the streams reviewed), along with declining nitrogen-containing compounds (60 percent) and total mercury (45 percent), were the most frequent changes state-wide. The increases in dissolved oxygen and reductions in nitrogen compounds are thought to be the result of higher-level treatment

plants. The decline in total mercury may be due to better industrial wastewater treatment and decreases in the overall use of mercurial- compounds.

- o The greatest water quality improvement of the early 1980's in Mew Jersey occurred in the Raritan River below Manville, where a major industrial discharge was eliminated,- improving water quality conditions from poor to good[1].

- o Approximately 1,500 permitted point source discharges are present in New Jersey. - Nearly 500 of these are municipal wastewater discharges, with the remainder being industrial (industrial process wastewaters, cooling waters and stormwater runoff discharges). Currently, about 20 municipal facilities are providing only primary treatment. Three-quarters of these are presently being upgraded or eliminated.

- o Nonpoint sources were identified as affecting water quality to some degree in all watersheds. The primary nonpoint sources. were agricultural and urban/suburban runoff. Pathogens (fecal bacteria), sediments, and nutrients were the most common nonpoint pollutants.

Caution must be practiced in attempting to interpret additional conclusions from the trend analyses results. The trend analysis procedure is designed to detect changes over time, and not cause and effect relationships (NJDEP/DWR, 1986a).

The Stream Water Quality map (Figure 10) shows the streams assessed here as meeting the fishable and swimmable waters goals. The map was developed from Table 11-4 of "Water Quality Trends and Conditions for New Jersey's Rivers and Streams." (NJDEP/DWR, 1986 a).

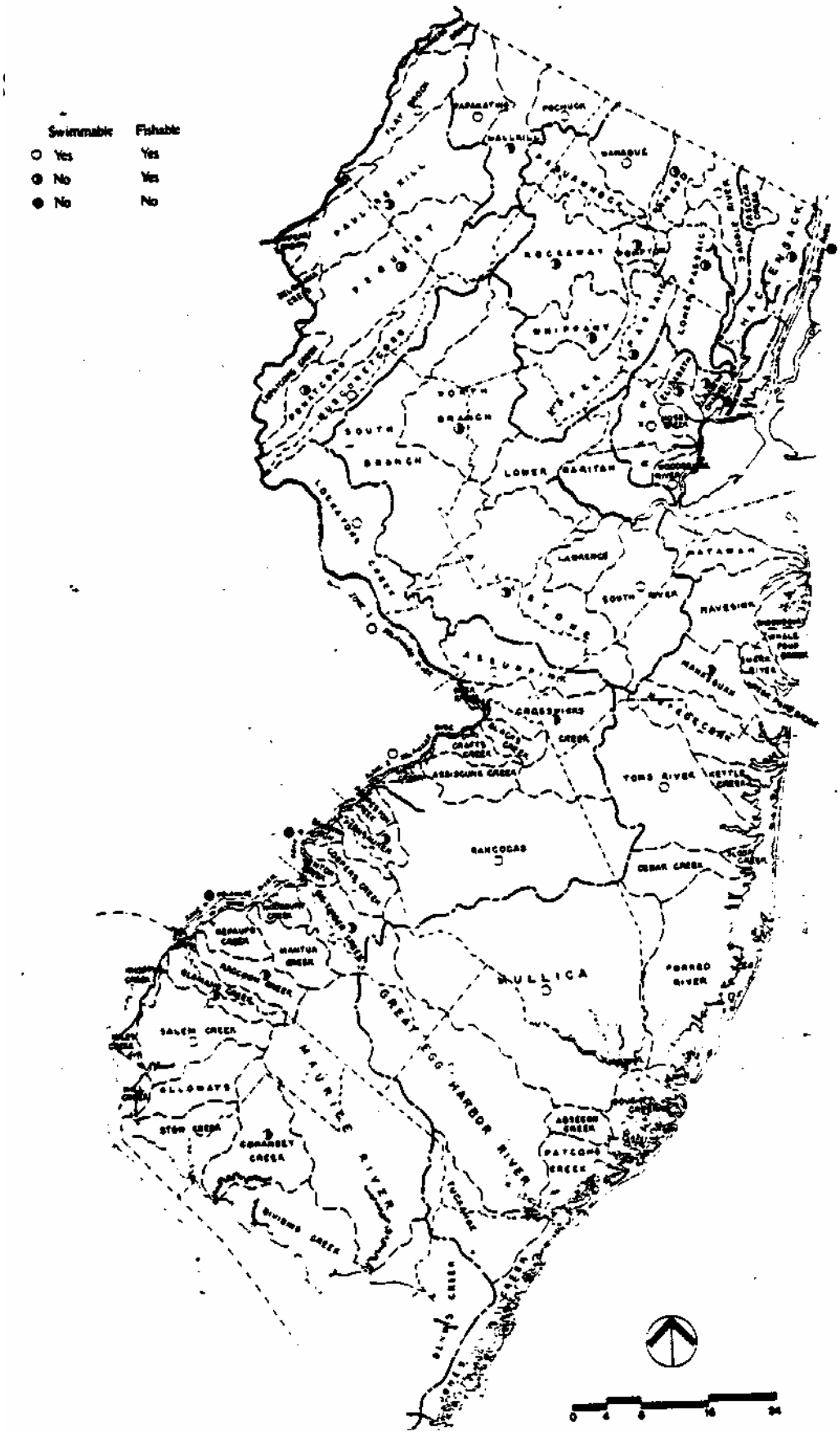


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Figure 10

New Jersey has acted to designate certain waters of high quality as meriting protection from any measurable change (including calculable or predicted changes! in existing water quality. These are called Category 1 waters. Water quality characteristics in such waters that generally fall below the water quality criteria (except as due to natural conditions) are to be improved in order to maintain designated uses where this can be accomplished without adverse impacts on organisms, communities, or ecosystems of concern. The map of Category 1 watersheds (Figure 11) was compiled from 1:24,000 U.S.G.S. quadrangle data available at the NJDEP Division of Water Resources.

Fish propagation and maintenance goals are being attained throughout most of New Jersey's freshwaters. In addition, no new toxics have been identified as contaminating freshwaters in the state during the past few years. Only 12 percent of the freshwaters monitored do not meet or only partially meet the fishable goal. These waters are all located in urbanized areas that suffer from large amounts of point source effluent and nonpoint runoff.

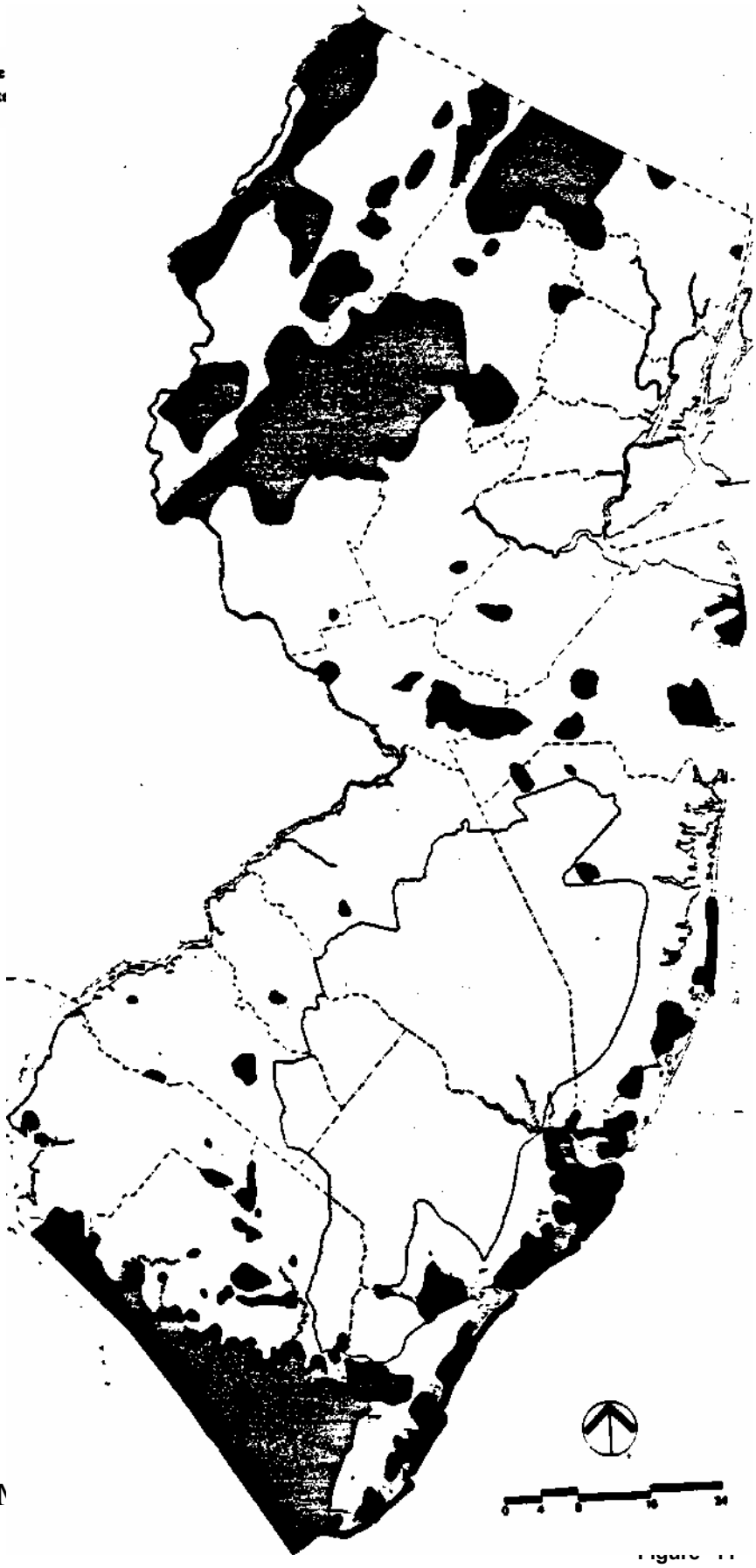
New Jersey's rivers and streams contain excessive fecal coliform concentrations, and as a result, 63 percent of the monitored freshwaters do not meet the swimmable goal, and 8 percent meet it only periodically. Runoff from developed and agricultural lands is thought to be the prime source of fecal coliform. Other sources include improperly operating/discharging sewage treatment plants, on-site septic systems, and natural sources (such as domestic pets, wildlife and waterfowl).

In 1972, an estimated 21 percent of monitored stream miles met both swimmable and fishable goals. Now nearly 30 percent of the state's total stream distance is meeting the two clean water goals. The percentage of stream miles partially meeting the goals has decreased somewhat, from 69 percent in 1972 to about 60 percent. The stream mileage not achieving either goal has remained relatively constant at 10 to 11 percent of the total.

Surface

Category One
Pineland Wat

Water
Quality



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The Clean Water Act of 1977 provided fluids for the planning and construction of sewage treatment facilities. The presence of approximately 1~,500 permitted wastewater discharges in New Jersey, approximately 500 of which originate at municipal wastewater treatment facilities, indicates that point sources heavily influence water quality in the state (NJDEP, 1985b). Currently, a moratorium exists on nearly 200 existing facilities due to either lack of treatment capacity or the low quality of treated effluent.

NJDEP has described the problem as being significant. Very little reserve sewage capacity exists statewide. Any existing funding proposals are only for remediation of existing problems. The high numbers of expansions and funding requests preclude adequate follow up. Funding requests can only be tied to committed capacities of approved proposed developments. These wastewater treatment facility development and expansion decisions are tied to Wastewater Management Plans, which must be prepared by municipalities and approved by the NJDEP Water Resources Division, Water Quality Management Element. Any new facility or expansion of an existing facility that requires a permit must have a municipality or a sewerage/ municipal utilities authority as a co-permittee.

Because of the limited availability of sewers, many new developments are proposing land-based disposal systems of all types and sizes. This increases concern over long-term system performance and water quality protection. Also, development densities often being too low for efficient future sewerage hookup may create future problems.

Existing sewered areas are important in developing growth management strategies. Currently, NJDEP does not actively keep up-to-date map data on all sewer systems. The Sewered Area Map (Figure 12) was developed from data contained in and compiled from county 208 plans and from sewer service maps compiled by counties. Because new applications constantly arise for new or expanded service, this map will need continual updating.-

Sewered Areas

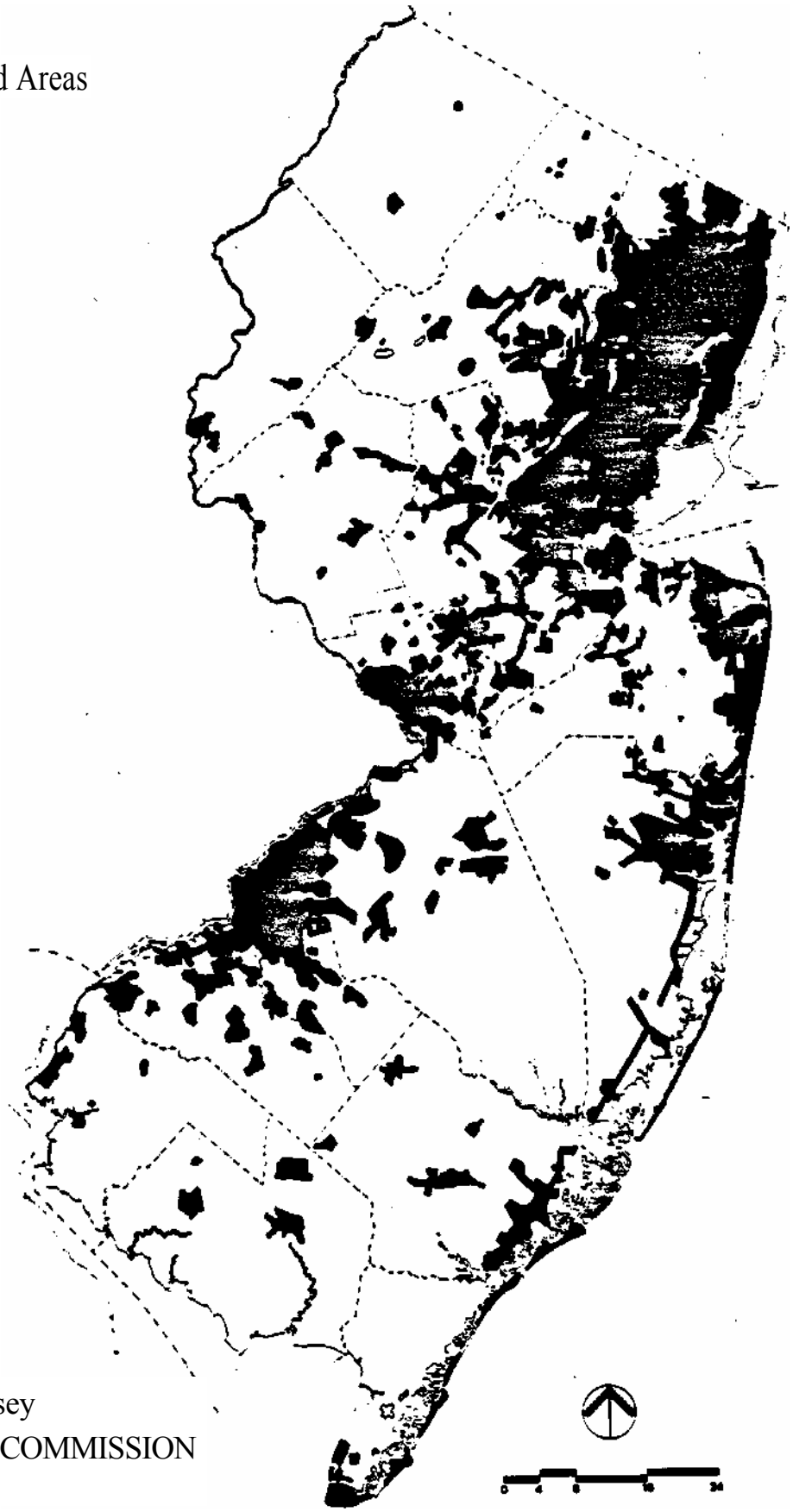

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Figure 12

Lakes

Lakes in New. Jersey are a major recreational resource, with peak day demands in excess of 1.2 million activity days (NJDEP, 19845). Nevertheless, there are many indications that lakes are being increasingly threatened by loading of sediments, nutrients, and toxic substances (ASIWPCP, 1985). This may lead to deteriorating water quality and eutrophication. In 1985, 19,000 acres of the state's lakes were impaired by nonpoint sources. Over 5,000 acres were known to have moderate or severe degradation, with over 11,000 acres listed as threatened with impairment. An additional 1,400 acres suffer from both point and nonpoint source water pollution. Sediments, nutrients, and pesticides are the primary and known nonpoint pollutants affecting New . Jersey's lakes} urban and agricultural runoff and land disposal (including on-site septic systems) are the significant nonpoint sources.

A major problem with many lakes (impoundments) in New Jersey is maintenance requirements as a result of their advanced age. The chronic issue of funding for dredging, weed control, and dam rehabilitation needs to be addressed at the state level if the recreational value of many of our lakes is to be maintained.

Estuaries

The ocean-and estuarine waters of New Jersey are a highly valued resource. Between 70-80 percent of New Jersey's recreational and commercial fish catch is dependent on estuaries. Over a million nonresident anglers are drawn to New Jersey every year to fish. The state's waters support varied and rich aquatic life and contain commercial and recreational resources. In 1984, commercial harvest of shellfish was valued at $46.1 million. Marine fishing is also highly significant.

New Jersey's estuarine and coastal waters share the quality and pollution problems that pervade much of the northeastern United States coast. The proximity of the state's coastal waters to some of the world's largest metropolitan and industrial centers has had negative effects on their water quality. In the Hudson-Raritan estuarine complex that separates New Jersey from New York, very high fecal coliform bacteria and nutrient levels result in severe stress to the system, especially during summer. The oxygen demand of the system also results in periodic low levels of dissolved oxygen.

Bacterial pollution from runoff and sewage treatment plant discharges has resulted in contamination of shellfish growing areas to the extent that one-quarter of the State's bays, estuaries and ocean waters have been closed or partially closed" to harvesting (NJDEP/DWR, 1986).

Contamination by toxic and hazardous substances is also present throughout these waters, with high PCB and chlordane levels found in certain fishes of the region. This has resulted in fishing bans and advisories for all northern New Jersey coastal waters and New Jersey-New York interstate waters.

Wetlands

Once regarded as wastelands with little or no value, wetlands are. now recognized nationally as vital links in our ecological system. New. Jersey's tidal and non-tidal marshes, swamps, and bogs are examples of wetlands. Soil and. plant characteristics unique to these areas depend on the land being periodically covered or saturated with water during the growing season.

Tidal and non-tidal wetlands benefit both the natural environment and mankind. They provide a measure of flood control by storing flood waters during storm events, and then releasing them slowly over time. Water stored

in wetlands can be particularly important during droughts. Wetlands also serve as a natural buffer against wind and wave damage, protecting land along estuaries and large lakes where these types of damage could lead to a significant loss of property. Wetlands may also improve water quality by serving as a sink for excess" sediments, nitrates, phosphates and organic matter being carried in the water column. They also act as a buffer between land and open water by intercepting nutrients and sediments contained in runoff.

Along with their physical and chemical role, wetlands serve as habitat and overwintering areas for waterfowl and other birds, as well as habitat for mammals, reptiles, amphibians, and fish. Many bird species rely on wetlands as resting and feeding areas during migration. Both tidal and non-tidal wetlands are used as nursery and feeding grounds by many species of fish, particularly those important to commercial and sport fisheries. The loss of wetlands not only impacts mankind and the animal species dependent on the wetlands for survival; it also results in a loss of plant species unique to these areas.

Several definitions of wetlands are used in New Jersey: those presented by the Corps of Engineers (federal definition), the U.S. Fish and Wildlife Service, and the state of New Jersey (Pinelands Comprehensive Management Plan, 1980 and Pinelands Protection Act, N.J.S.A. 13:18-1 to 13:29; Coastal Wetland Protection Act, N.J.S.A. 13:9A-1 to 13:9A-10; and the Freshwater Wetlands Protection Act, which has not yet been made law). Most of the definitions are similar and are based on either the Corps of Engineers or Fish and Wildlife Service Standards.

The U.S. Fish and Wildlife Service defines wetlands as follows:

> ...lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: at least periodically,

the land supports predominantly hydrophytes; the substrate is predominantly undrained hydric soil; and the substrate is nonsoil and is saturated with water or covered by shallow water at some time during, the growing season of each year (Cowardin et al., 1979).

The Corps of Engineers defines wetlands as:

...areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (Federal Register 42: 37128).

Both the Corps' of Engineers and the Fish and Wildlife Service delineate wetlands on the basis of three parameters (Sanders et al., 1985):

- Hydrology--soil is inundated either permanently or periodically at mean water depths less than or equal to two meters, or soil is saturated to the surface at some time during the growing season of the prevalent vegetation

- Vegetation - prevalent vegetation consists of plant species adapted to anaerobic soil conditions

- Soil - soils present have been classified as hydric, or they possess characteristics that are associated with anaerobic soil conditions

The U.S. Fish and Wildlife Service requires only one of the parameters to be positive for an area to meet the requirements for wetland designation; the Corps of Engineers requires positive indicators for all three parameters (Sanders et al,, 1985). The U.S. Fish and Wildlife Service has classified wetlands into five systems: marine (open ocean and its associated coast-line), estuarine (salt and brackish marshes and brackish waters of coastal

rivers and embayments), riverine (rivers and streams), lacustrine (lakes, reservoirs and large ponds), and palustrine (marshes, bogs, swamps, and small shallow ponds).

According to the National Wetland Inventory, during the mid-1970's New Jersey had 916,000 acres of wetland and 413,000 acres of deepwater habitat. Approximately 19 percent of the state's surface area was wetland. Fresh-water wetlands made up the majority of wetland types, comprising 600,000 acres or 67 percent of the total wetland area. Estuarine wetlands made up 32 percent. Atlantic County had the greatest wetland acreage (148,149 acres), followed closely by Burlington. (136,297 acres) and Ocean (128,531 acres). Wetland acreage of the remaining counties is as follows: Cumber-land (98,950), . Cape May (89,581), Salem (58,987), Morris (40,264), Gloucester (36,844), Monmouth (32,700), Sussex (30,771), Middlesex (24,022), Warren (12,637), Mercer (11,819), Somerset (11,127), Bergen (10,084), Essex (6,833), Hunterdon (5,450), Passaic (5,042), Hudson (3,897), and Union (3,053). The distribution of wetlands within the state is mapped on Figure 13. The map was developed using the National Wetlands Inventory at the 1:24,000 USGS quadsheet scale and compiling at statewide map.

The control of activities in wetlands in New Jersey falls under the jurisdiction of the Corps of Engineers and several state agencies. Currently, tidal or coastal wetlands receive the most protection from both state and federal agencies. The Corps of Engineers has permit jurisdiction for discharge of dredged or fill material into waters of the United States through Section 404 of the Clean Water Act of 1977 (formerly the Federal Water Pollution Control Act, 33 U.S.C. 1344). The Rivers and Harbors Act of 1899 also provides some control at the federal level. The state of New Jersey protects tidal wetlands through the Wetlands Act of 1970 (N.J.S.A. 13:9A-1 et seq.), the Waterfront Development Law of 1914, and the Coastal Area Facility Review Act of 1973 (CAFRA, N.J.S.A. 13:19-1 et seq.). Tidal wetlands are also protected through the comprehensive management plans and protection measures contained in the Hackensack Meadowlands Reclamation and Development Act (N.J.S.A. 13:17-1 et seq.) and the Pinelands Protection Act

Wetlands

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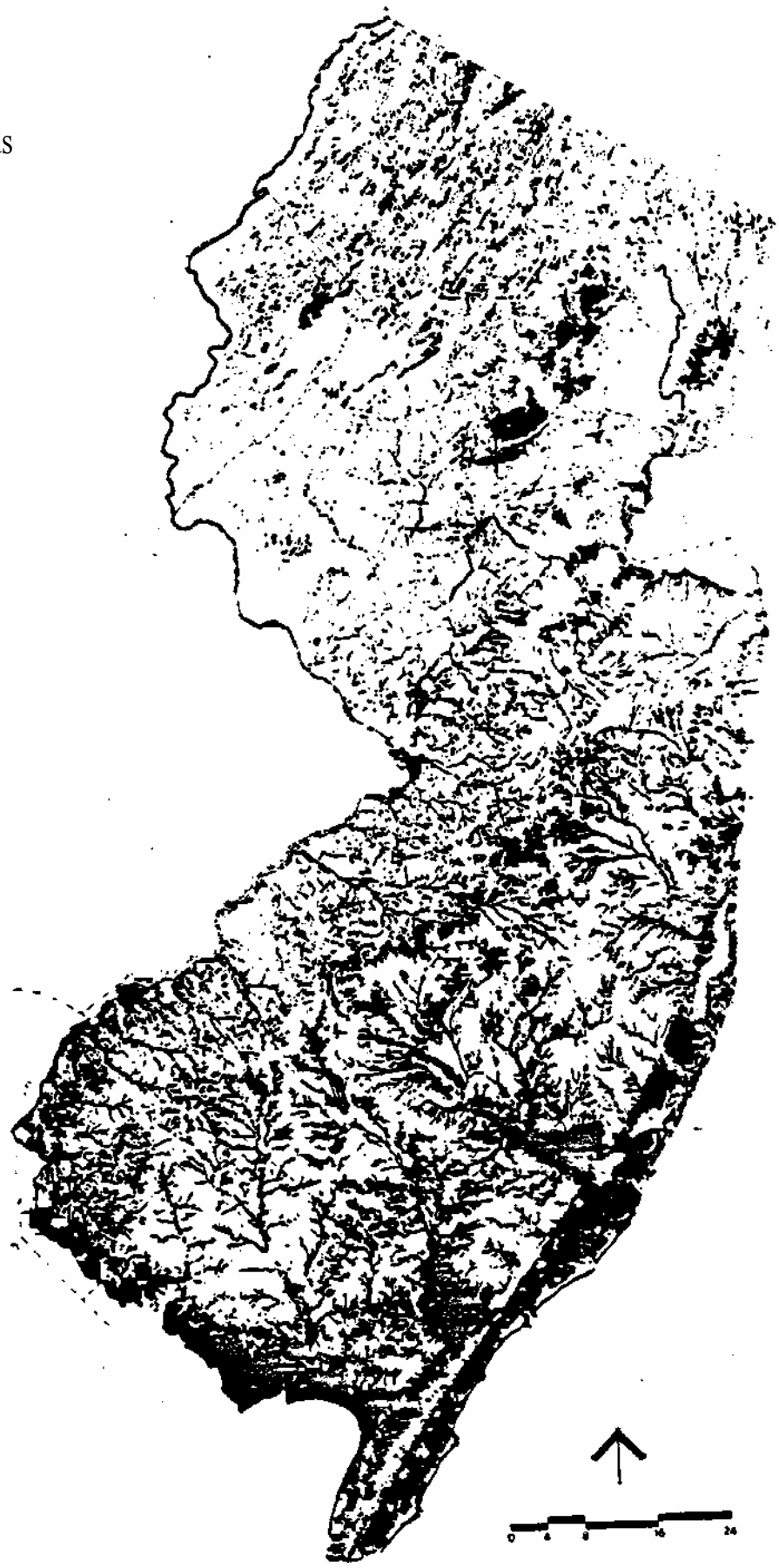

Figure 13

(N.J.S.A. 13:18A-1 et seq.). Executive Order 11990, "Protection of Wetlands," requires federal agencies to develop guidelines to minimize destruction and degradation of wetlands and to preserve and enhance wetland values.

Freshwater or non-tidal wetlands are protected under the Freshwater Wetlands Protection Act.

The New Jersey Freshwater Wetlands Act, which takes effect in July of 1988, secures state delegation of the freshwater wetlands permit jurisdiction that is currently exercised by the Corps of Engineers. Both tidal and non-tidal wetlands are also protected by the New Jersey Department of Protection's 201 Water Quality Construction Grants Program, which has been effective .at preventing building construction in wetlands (Tiner, 1985). The protection results from special conditions placed on sewer grants to municipalities.

The Municipal Land Use Law (N.J.S.A. 40:55D-1) grants municipalities general authority to include conservation plan elements for protection of natural resources, including wetlands. The Flood Hazard Area Control Act (N.J.S.A. 58:16A-50 et seq.) extends legal protection to certain wetlands.

Other wetland protection activities include:

- o New surface water or ground water discharges, or existing surface water or groundwater discharges proposing major modifications, that require permits under the Water Pollution Control Act (N.J.S.A. 58:10A-1 et seq.)
- o Certification by NJDEP pursuant to Section 401 of the Clean Water Act (33 DSC 1251 et seq.)
- o Sewer systems regulated by N.J.S.A. 58:10A-1 et seq.
- o Stream encroachment permits issued pursuant to N.J.S.A. 58:10A-1 et seq.

- Water Quality Management Plan consistency determinations and amendments
- Dam permits pursuant to N.J.S.A. 58:4 and pursuant to N.J.A.C. 7:15-1 et seq.

Stream **Corridors**

"Stream corridor" is a term that applies to the productive .bands of vegetation that follow the edge of streams as well as ponds, lakes, and wetlands. When left in their natural condition, they help protect or buffer water resources and aquatic systems from pollution and disturbance by adjacent land uses.

These surface waters are valuable resources that supply potable water, provide recreation, and form an essential part of the scenic beauty of the state. In their naturally, vegetated state, these buffer areas play a key role in maintaining a healthy wildlife population and in purifying and protecting our water supply. Wetlands store water in dry periods, help maintain water quality, settle out silt, maintain groundwater supplies, aid in flood protection, and provide fish and wildlife habitats.

Because of the branching pattern of the stream and wetlands networks, many people in both residential and rural areas are within walking or biking distance of these corridors. Sections of stream corridors can be integrated into development designs to function as pedestrian ways linking residential sections with parks and commercial areas. Streamside trees provide visual variety in the landscape and act as visual screens and noise attenuators.

Once lost, these water resource amenities and services are difficult, if not impossible, to replace. Costs for replicating these "services" are extremely high and are often borne by taxpayers.

In recent years, concern has increased over the degradation and loss of important aquatic systems. Pollution from stormwater runoff has been shown to. significantly influence water quality in the state (NJDEP, 1986). The increasing awareness of the relationship between land use and water quality has underscored the need for sound ecological management of near-water land.

One of the most effective measures to prevent or reduce contamination from surface runoff containing silt, oils, chemicals, and bacteria is to restrict development on lands bordering surface water areas and to prevent the direct drainage of stormwater into waterways from impervious areas located upland. These buffer strips adjacent to water bodies trap sediment, filter chemicals, stabilize stream banks, and allow for infiltration of runoff and absorption of nutrients. In addition, buffers provide plant and wildlife habitats and visual diversity (Figure 14). Currently, many streams, wetlands, and natural lakes have relatively undisturbed vegetation along the water's edge. Many of these riparian lands are too wet, steep, rocky, or shallow to be easily cultivated or developed. Still, farming and construction of new buildings along developable edges cause unnaturally high loadings of sediment, nutrients, chemicals, and bacteria to surface water resources.

Stream Corridors

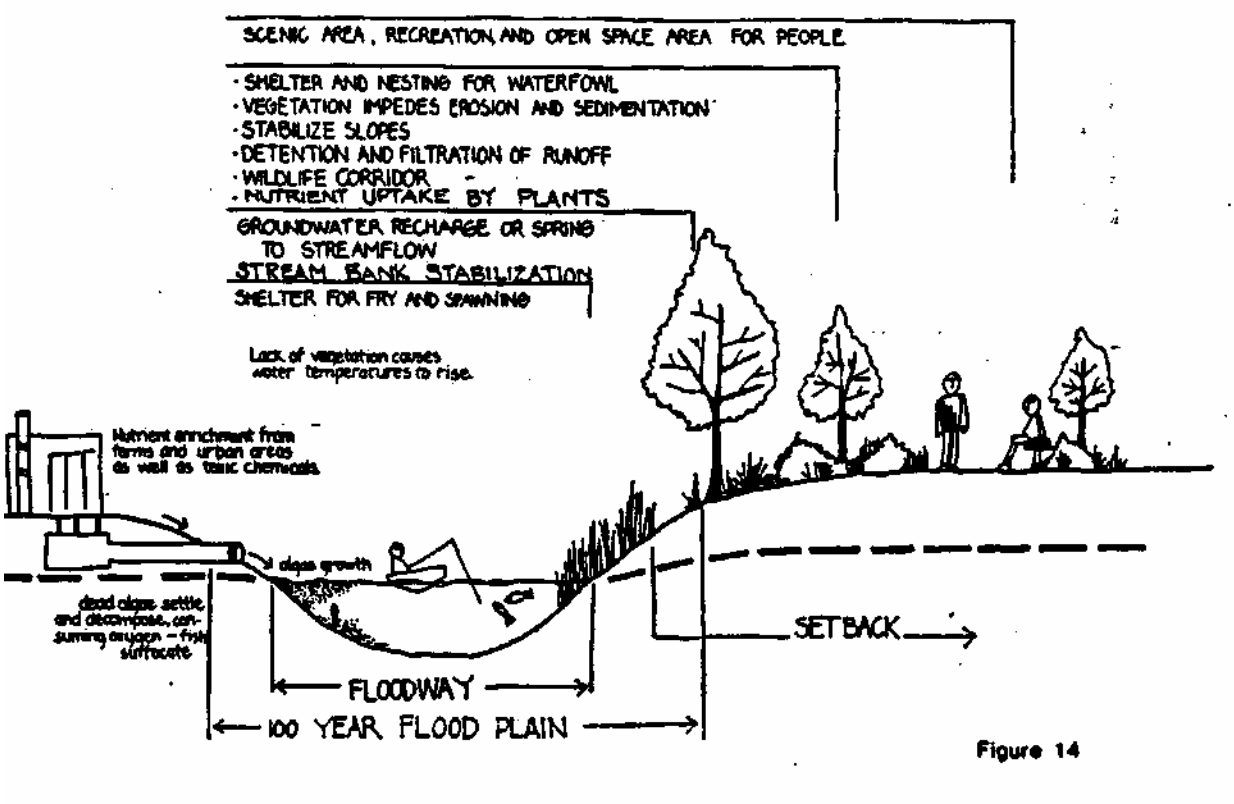

Figure 14

The introduction of metals, hydrocarbons, and other chemicals into water bodies that act as water supplies may cause further concern. Standard chlorine treatment methods for water purification create new chemicals—chlorinated hydrocarbons—that are known to cause cancer. If new treatment methods for water purification are required, additional costs will be borne by taxpayers and residents who buy their water from private suppliers. In order to manage the resource before the problem occurs, a management strategy to stop non-point pollution from entering surface water sources is required on a watershed basis.

New Jersey already has recognized the need for vegetated buffers and has developed regulations for vegetated buffers that aid in food, cover, and streambank erosion protection through the Freshwater Wetlands Protection Act and in the Pinelands (Roman & Good, 1985). Other states have also developed ideas for vegetated aquatic buffers, as shown in Table 3. The majority of these states have relied on scientific studies and professional judgment based on a number of considerations.

Numerous studies have shown how vegetative buffers act as natural filters and reduce runoff (Wong et al., 1981; Karr and Schlosser, 1977; Dillaha, Sherrand and Lee, 1986). The question of how wide the buffer should be depends on what impact is being managed. The following sections describe different roles for vegetated buffers.

Forests and fields produce relatively low levels of nutrients, which help maintain the natural balance in streams. Other land uses produce greater quantities, which can cause pollution. The effects of different forms of development on water quality vary.

A major step toward protecting water quality is the realization that aquatic systems do not end at the water's edge. • Rather, they encompass streamside vegetation and riparian soils whose saturated extent fluctuates according to wet and dry periods. These soils are the major source of natural runoff to streams. They are integral to the maintenance of the aquatic system's physical and biological purity. If aquatic systems are to

Table 3

Water Resource	Buffer Width	Comment
Reservoirs Connecticut		
Hackensack Meadowlands	250 feet 250-500 feet	Measured from high waters
Lakes		
Maine	250 feet (fixed)	
Wisconsin	1,000 feet	
Streams		
. Maine	75 feet (fixed) 100	
Maryland	feet (fixed) 100 feet	
California	minimum	Coastal areas. Other considerations can increase width
New Jersey	25 & 50 feet (fixed)	Trout-associated waters are 50 feet.
Wisconsin	300 feet	
North Carolina	75 feet <200 feet proposed)	
Wetlands		
Massachusetts	100 feet (fixed)	Development strictly limited.
California	100 feet minimum	Coastal areas. Other considerations can increase width required.
NJ Pinelands	50-300 feet	Evaluation system. Majority are greater than 200 feet from wetland boundary.
NJ Freshwater Wetlands	25-150 feet	

be preserved, this additional margin beyond the water's edge must be protected, not just along wetlands but along all streams as well.

Several ideas have been applied to mapping these areasor providing setbacks (Rogers, Syz and Sullivan, 1975; Rogers and Golden,1976; Palfrey and Bardley, 1983; NJDEP/DWR, 1983; and N.J.S.A. 7:13-55.1).Clearly, with concern over future water treatment issues and general waterquality, more work needs to be done to investigate stream corridor protection.

There are two principal ways of defining buffers: the boundary may be a fixed distance from stream banks, or the boundary may vary, or float, depending on specific natural features adjacent. to the waterway. Fixed buffer widths have varied from 25 to 300 feet (Thurow et al., 1975). The width of floating- buffers may depend on the sensitivity of the stream, the presence of wetlands, steep-sloped terrain, mature woodland habitat, poorly drained soils, scenic features, or other factors of local significance. An example of such a system which is in use in New Jersey is the Buffer Delineation Model for New Jersey Pineland Wetlands (Roman and Good, 1985). Additional work in this area is being conducted at Rutgers University for the New Jersey Department of Environmental Protection, Division of Coastal Resources,

The main advantage of fixed-distance buffers is the ease of administration. A fixed buffer, however, cannot control development activities on sensitive Areas outside the set distance. On the other hand, variable-width approaches to buffers require extensive investigation and evaluation. The presumption in this report is that a minimum fixed buffer provides a first-level safeguard. Additional factors could be included at the county and local levels to embrace more site-specific features. It should be emphasized that vegetative buffers are not a substitute for detention or retention basins or other sediment or runoff control measures. Buffers serve many important functions and act as a safeguard to land use activities that induce non-point source pollution.

Trout Waters Protection

Trout are highly sought gamefish that require very high-quality surface water and habitat for spawning or nursery purposes or for survival throughout the year. Trout production waters are included in New Jersey's Surface Water Quality Standards as Category I watersheds. Healthy trout populations require cool, clear, oxygen-rich water free of serious pollution. In streams, trout require a favorable habitat rich in pools and riffles, with silt-free gravel beds and rubble, an absence of artificial obstructions to fish movement, and abundant streamside vegetation (preferably trees, in most cases). Shading of trout streams by vegetation is especially important in New Jersey, where summer water temperatures are already marginal for trout in many cases. Trees also provide cover and food for the insects and other invertebrates in , the food web on which trout depend. Therefore, trout waters are some of the most pristine found in the state.

NJDEP and its predecessor agencies initiated efforts to identify trout waters and recognize them in official Surface Water Quality Standards in the 1960s. Subsequently, some of the initial areawide WQM Plans recognized the environmental sensitivity of trout waters, and assigned them a "moderate[11] to "high" priority for planning activities. In 1979, the Department's Division of Water Resources and Division of Fish, Game and Wildlife initiated the "New Jersey Trout Waters Protection Project" to increase the recognition accorded programs for trout protection and restoration.

One product of the project was the report entitled "Basic Information About New Jersey Trout Waters" (July 1982; revised October 1983). Included in that report, and also cited in the Department's Flood Hazard Area Regulations, is a report entitled "Classification of New Jersey Waters as Related to their Suitability for Trout." This publication is periodically revised to contain the most current listing of trout waters. It also identifies the particular species of trout (brook, brown, or rainbow) found in each of New Jersey's trout production streams. The report was used in the drafting of the Department's present Surface Water Quality Standards.

The Trout Waters map (Figure 15) shows the approximate locations of land in trout production and trout maintenance watersheds. Sources of information include the "Basic Information About New Jersey Trout Waters" report, which provides the approximate locations of these watersheds on an Il"xl7^{lt} map that includes stream networks and county and municipal boundaries. Trout production and trout maintenance waters have also. been mapped on U.S. Geological Survey 7.5 minute topographic maps, which are available for inspection in the offices of the Division of Water Resources, Bureau of Planning and Standards. For the Department's regulatory functions, the official reference is NJDEP's Surface Water Quality Standards.

In the present Surface Water Quality Standards (N.J.A.C. 7:9-4), the great majority of New Jersey's fresh surface waters (outside the Pinelands) are classified as FW2. Categories within FW2 that relate to trout are FW2-TP (trout production), FW2-TM (trout maintenance), and FW2-NT (nontrout) (NJDEP/DWR, 1985). On May 21, 1984, comprehensive Department Flood Hazard Area Regulations became effective (N.J.A.C. 7:13-1.1 et seq.). These regulations include special provisions for the protection of trout waters as well as additional provisions for the production of fisheries statewide.

Trout waters (and their watersheds) are a valuable natural resource whose recognition in municipal master plans should be encouraged. Ordinances pursuant to the Municipal Land Use Law would be very useful to control the removal of trees and other vegetation within 50 feet of either bank of perennial trout waters (NJDEP/DWR, 1985).

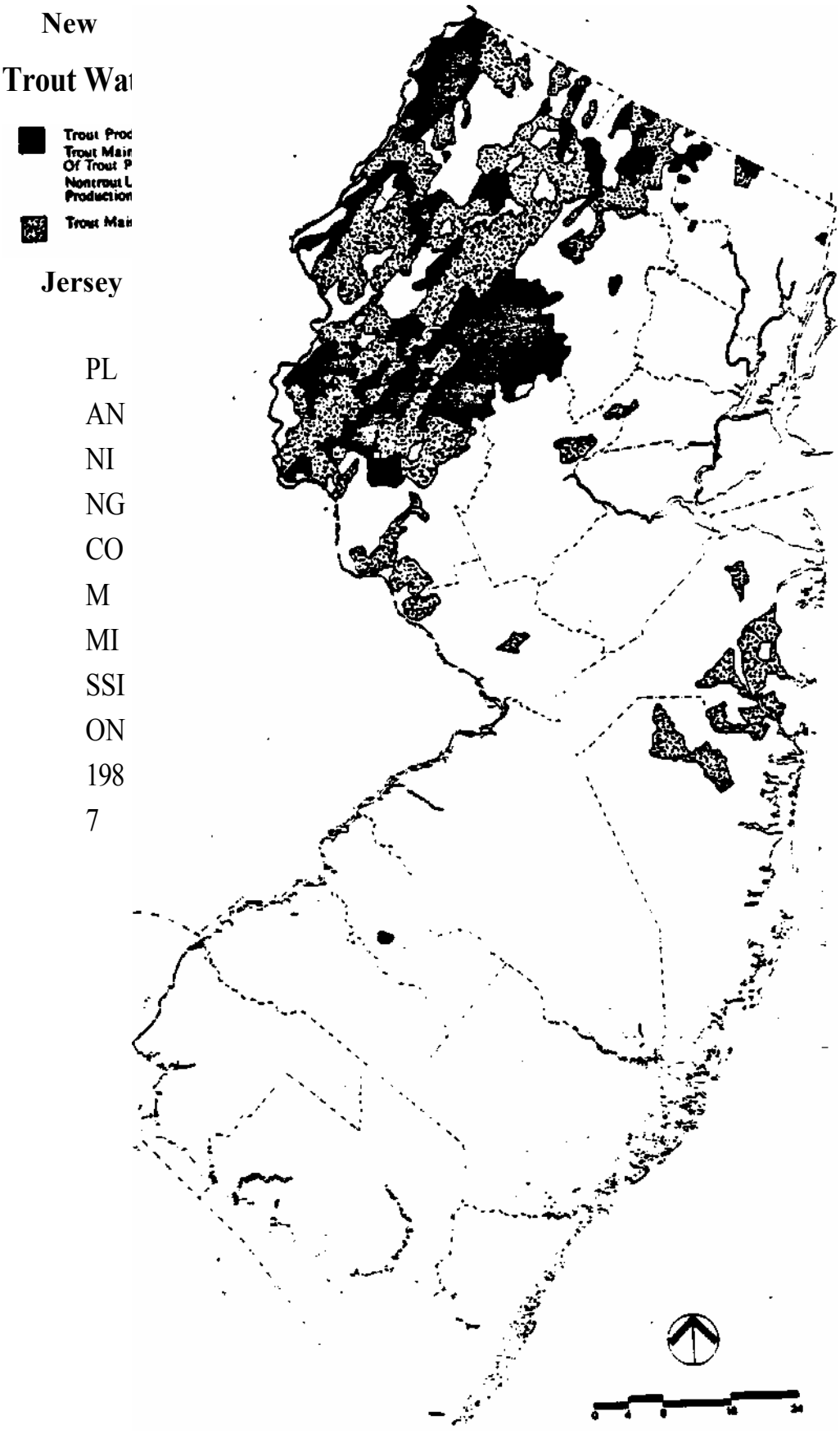
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Figure* 15

Flooding

The risk of and associated damage posed by flooding within water basins around the state of New Jersey comprise another important public health and safety and environmental planning concern. The large number of residents and structures in floodplains indicates a need for development of strategies and programs to mitigate damages flooding might produce. From a growth management perspective, the. identification of water basins with a high need for flood control planning also indicates areas where policies designed to expedite growth should be carefully examined in light of risk.

One objective of New Jersey's Flood Control Master Plan was to identify the relative need for flood protection planning in 107 hydrologic planning units (HPU's) throughout the state. The plan ranked the HPU's into high, medium and low priorities for flood protection planning. This was done using a variety of descriptive parameters for all the HPU's, including area; average growth rate; population, residential structures, . commercial and other structures, and transportation routes located within the 100-year flood plain; and the monetary value of flood damage between 1955 and 1980.

These factors identified HPU's where flooding had historically produced,
or would under current development conditions produce, heavy human and
property losses* A weighting and scaling technique that assigned importance
values to the parameters was used to rank the HPU's in the three planning
priority categories. . .

The results of the ranking are shown in the accompanying High and Medium Priority Hydrologic Planning Units in Figure 16. This information was obtained from the Flood Plain Management Section of NJDEP's Division of Water Resources. Thirty high-priority HPU's were identified, of which 23 are located in the Arthur Kill, Hackensack, and Passaic River basins. These are areas that have historically had flooding problems, where there is a high intensity of development within the 100-year floodplain, and where there was good documentation

available on damages associated with previous floods. Rivers with high priority for flood control planning include the

Rahway, the Mid and Lower Passaic, the Green Brook, the Elizabeth River, and the lower Raritan Rivers.

Twenty HPU's were identified as having a medium priority for flood control planning. Watersheds falling into this category include Whale Pond Brook, the Manasquan River, the Paulins Kill River, and both the North and South Branches of the Raritan River. These watersheds tend to be located at the edge of, or beyond, current high-density suburban and urban development. They also tend to contain many of the fastest-growing areas in the state, most of which have been made accessible by the extensions of major highways.

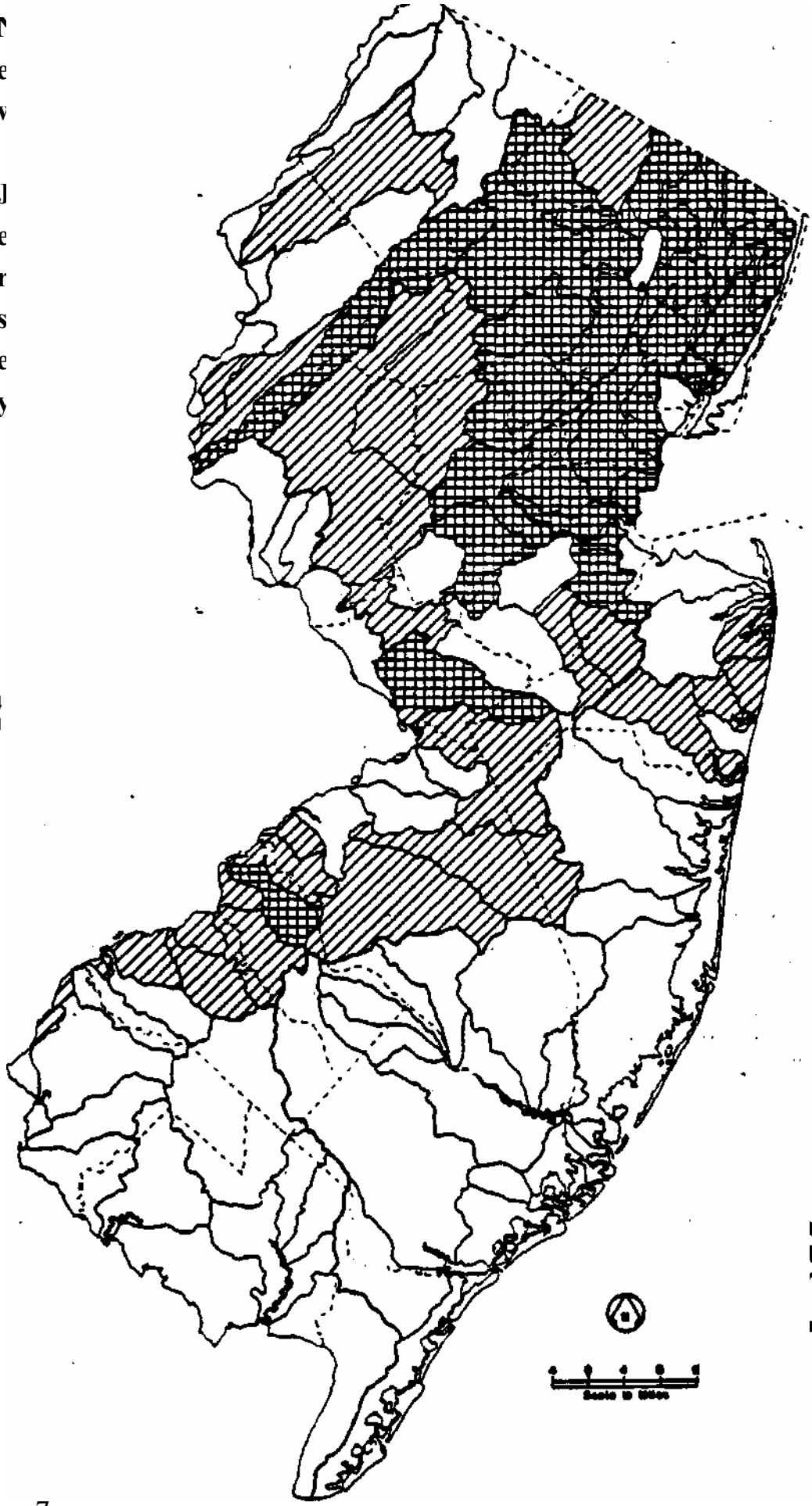
While this study indicates the priority, of areas for flood control planning studies, it does not necessarily indicate priority for the expenditure of state and federal funds for flood control projects. It did not consider completion of flood protection projects since the last time major damage occurred, ongoing flood protection planning studies, or potential damages associated by floods other than the 100 year flood. It should be noted that most, if not all, of the damages entered in the data base and used to rank the HPU's are associated with floods of less than the 100-year flood event.

Unique Plants (Threatened and Endangered Species)

The wide variation in physiography and climate in New Jersey is largely responsible for a correspondingly wide range of vegetation. Within each of the five physiographic provinces there are many variations in plant communities. Each represents an adaptation of the plants to a particular ecological situation. Forest types fall into two major categories: the hardwoods, located mainly in the Ridge and Valley and the Inner Coastal Plain; and the Pine Forests, located in the sandy soils of the Outer Coastal Plain.

Figure 16

High and Medium Priority Hydrologic Planning Units



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As noted earlier, two million acres of New Jersey, 46 percent of the land, is covered with woodlands. State-owned forests—Wharton (102,917 acres), Stokes (15,394 acres) and Lebanon (27,661 acres)—comprise about 15 percent of the total acreage. Large tracts are also found in state parks and on other state-owned property. The heavily developed Piedmont and Inner Coastal Plain have proportionately fewer woodlands than other parts of the state; however, even there large wooded tracts cover the slopes of the Sourland and Watchung Mountains and the Hudson River Palisades and are found in Middlesex, Monmouth, and Salem Counties.

The hardwood forests of the Coastal Plains are predominately beech,
white oak, sweet gum, and red maple. Pine forests and savannas are also extensive, as are white cedar swamps in wet areas that are burned frequently. The. mixed oak forest occupies the majority of the Piedmont,
with hickory also predominant. Much of the Highlands is covered by hemlock-white pine northern hardwood forests with alternating deciduous, coniferous, and mixed forest communities. Sugar maple, beech, yellow birch, hickory, eastern hemlock, and white pine are the main species. Other
sections of the Highlands are within the oak-chestnut forest region. The
steep mountain slopes of the Ridge and Valley province are heavily forested
with oak-type hardwoods cut through by hemlock and laurel ravines' and
scattered stands of white pine._ The oaks have replaced the now extinct
mature American Chestnut. . ' ,

Plant species other than trees are also numerous and varied. Many northern species thrive in the woods, fields, and swamps of the Highlands and in the Piedmont, reaching the southern limits of their ranges in the central section of New Jersey. Southern species are common in the Coastal Plain where they, in turn, reach their northern limits.

Since 1984, the NJDEP Division of Parks and Forestry, Office of

Natural Lands Management, has joined with the Natural Heritage Program in assembling a database on threatened New Jersey plant species through the work of its Natural Heritage Program. The state has plant records that -go back to the nineteenth century, and thorough investigations have spanned the state from

north to south, east to west. Recent plant records were assembled in levels of designations corresponding to high, moderate, and periodic occurrence of species. This map (Figure 17) was prepared by of Office of Natural Lands Management for the Office of State Planning Study in January 1987.

Wildlife

Wildlife abound in New Jersey. New Jersey's diverse landscapes support a rich abundance and variety of fish and wildlife. Over 600 species of vertebrates inhabit New Jersey. New Jersey is one of the best places in the nation for birding, whether in the Hackensack Meadowlands or Liberty State Park, in the wilderness of the Highlands or the tip of Cape May County. Birding is considered to be New Jersey's best natural resource recreation. The presence and diversity of wildlife are excellent indicators of the general health of the environment.

Many common species, such as the white-tailed deer and the bluefish, have great economic importance while others, like the creek chubsucker and the red-locked salamander, are little known and little utilized. Currently over 53 species are listed as threatened or endangered. Some, like the osprey, have been successfully brought back (NJDEP/DFGW, 1980). Many of these wild populations need to be intelligently managed if they are to provide maximum benefits for man. These renewable natural resources contribute significantly to the quality of life for those who live and work in the Garden State.

New Jersey's fish and wildlife resources are important for economic, recreational, and aesthetic as well as biological reasons.

In several cases, national concern over wildlife habitat protection has been a major factor in land use decisions. In both the New Jersey Pinelands Comprehensive Management Plan and the Maryland Critical Areas Program (to conserve the Chesapeake Bay), wildlife protection has been one of the major

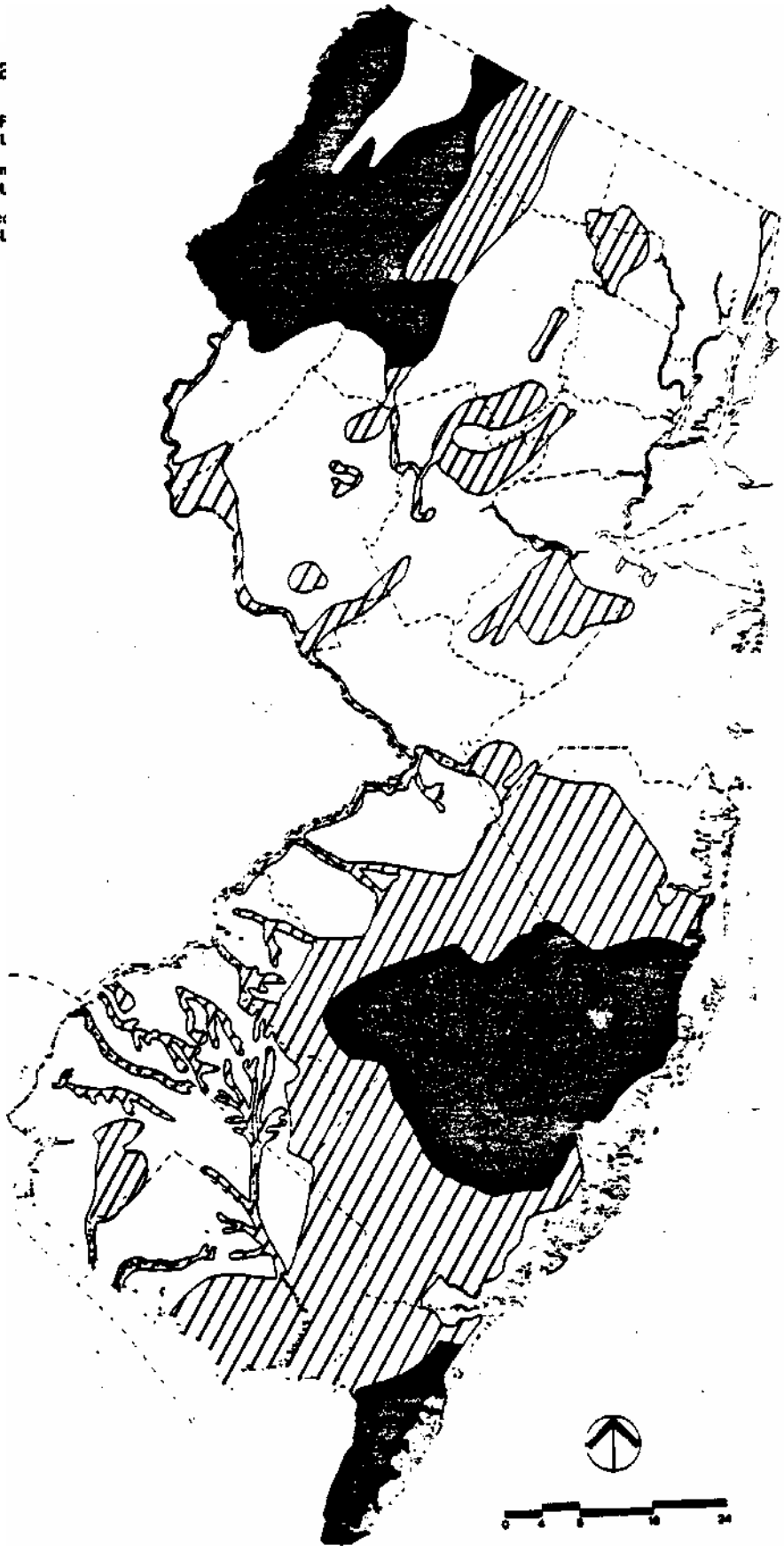
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Figure 17

factors in determining the size and extent of areas to be protected. Major concerns over not protecting large enough areas in places like state and national parks are now being recognized (Gleick, 1987).

Economic Importance

Wildlife in New Jersey is an extremely valuable natural resource. Each year over $742 million is spent in New Jersey in pursuit of wildlife-related recreational activities (fishing, boating, birdwatching, etc.) and commercial wildlife products (bluefish, clams, etc.). Economic studies indicate that roughly two to three times the money spent at the retail level on wildlife-related recreation and on commercial wildlife products Is generated in economic activity. This makes the economic value of the. state's wildlife- about $1.9 billion per year. This annual yield translates into a renewable material resource in New Jersey worth $19 billion (Cookingham, 1987).

Recreational - Aesthetic Importance

Over and above the dollars, generated for our economy by the state's wildlife resource is another value that is difficult to enumerate. That is the enjoyment experienced by tremendous numbers of citizens involved in wildlife-related recreational activities. According to a 1980 survey conducted by the U.S. Fish and Wildlife Service, over 1.2 million people spent 19.7 million days fishing in New Jersey that year and this only included those over 16 years of age. Studies conducted by Rutgers University indicated that the inclusion of the under 16 age group could triple the number of recreation days spent fishing in our state each year.

The 1980 federal survey also indicated that 175,000 hunters spent 3.6 million days hunting in New Jersey that year. Perhaps the most impressive part of the survey, though, found that some 2.2 million people had participated in "primary" nonconsumptive wildlife-related recreational

activities in 1980. These include such activities as feeding birds around the home on a regular basis and trips for the primary purpose of observing free-roaming wildlife.

The federal survey also gave an indication of the importance of wildlife in adding to the quality of life for New Jersey's citizens. It was estimated that over 4.2 million people, fully 57% of the population, had enjoyed unplanned opportunities to see or hear wildlife during the course of their daily activities. This may be the most important value of our wildlife resources in that they contribute greatly to the sense that the Garden State is a good place to live and work.

Biological Importance

Wildlife is an indicator of the quality of the habitat in which it lives—the same habitat shared by the human residents of our state. Healthy and productive wildlife populations indicate that the ecosystems we share are clean and safe. Wildlife populations usually give us the first indication that something is wrong with our environment. Dead fish can indicate polluted water, unproductive eagles can point to a build-up of chemical contaminants in the ecosystem. In this way, we are forewarned of the need for action.

Each species of wildlife possesses a pool of genetic material that is unique. This genetic material is the basis for many products useful to mankind, as well as yet to be discovered materials. This potential within the genetic complement of a species is one of the important reasons for our concern with endangered species. Once a species is eliminated, its unique genetic material is lost forever.

Because of their importance to New Jersey's quality of life, our fish and wildlife resources should be protected and conserved. These resources cannot be protected on a piecemeal basis. Large portions of the state must be dedicated to open space for more than remnants of our fish and wildlife

resources to survive. The current list of 53 species endangered or threatened with extinction in New Jersey will grow rapidly if current development trends continue. The important issue in wildlife conservation in our state is not the protection of individual sites of endangered species habitation, but the conservation of functioning ecosystems through the preservation of open space. Fish and wildlife conservation is just one of the many benefits that accrue from open space preservation*

Public land acquisition, with the goal of acquiring 373,472 additional acres, will be an important component in conserving fish and wildlife resources. Even with acquisition on this scale, 80 percent of New Jersey will continue to be in private ownership. Development controls on this remaining 80 percent will be necessary to preserve viable ecosystems and fish and wildlife populations.

-According to NJDEP-Division of Fish, Game and Wildlife an ecosystem approach is imperative.

Measures to protect wildlife habitat, particularly endangered and threatened species habitat, have been very effective in both the Pinelands Act and the Coastal Areas Facility Review Act. A weakness of the CAFRA approach is its lack of authority over construction of small numbers of housing units.

Farmlands in New Jersey are critical to many species of wildlife in New Jersey. Salem, Gloucester, Cumberland, Somerset, Hunterdon, and Warren Counties support the major concentrations of five species of endangered or threatened grassland birds. Certain general guidelines can be followed to assure the. best quality grassland habitats for these species.

Grassland, birds of concern [savannah sparrow (T), vesper sparrow (E), grasshopper sparrow (T), upland sandpiper (E), bobolink (T), and meadowlark (D)] are affected by the presence or lack of open spaces in which to feed and nest. Certain types of agricultural practices and crops are conducive to supporting populations of these endangered, threatened or declining species.

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Hay crops will support grasshopper sparrows, meadowlarks, bobolinks, savannah sparrows, and upland sandpipers, which also need shortgrass areas. Corn fields, during their 2" - 3" high stage, are excellent breeding and feeding areas for vesper sparrows, which need barren ground for these activities.

Breeding, of course, will be facilitated by scheduling crop harvest before or after the peak breeding seasons of these species. The upland sandpiper breeds from approximately early and mid-May to late June. The grasshopper sparrow breeds from approximately mid-May to early September, its peak breeding time from late May to early August. The savannah sparrow nests from early and .mid-May to late July. The vesper sparrow breeds from mid-and late April to mid-August, peaking in early to mid-May to early July. The meadowlark breeds from early and mid-May to early July. The meadowlark breeds from early and mid-May to late July, peaking late March to mid- and late May. Bobolinks perform similarly.

Interspersing habitats in monocultured crop areas can be beneficial to some species, such as grasshopper sparrows, which utilize drainage swales and uncultivated, fallow embankments in croplands. Rotation of crops, pastures, and fallow fields provide acceptable habitat for " most species.

It should be noted that while an acre, for example, of suitable habitat may support many pairs of a species, this minimum area would need to be surrounded by many 'more acres of suitable habitat to be conducive to supporting such a population. Thus in many cases, large contiguous suitable tracts would be needed to support useful populations of grassland birds.

Another group of species which depends on a dwindling habitat type are the interior forest nesting birds including goshawk (T), Cooper's hawk (E), barred owl (T), bald eagle (E), red-shouldered hawk (T), and many dozens of songbird species. Large tracts of forest are required to sustain these breeding populations and are also critical to the survival of insectivorous

neo-tropical migrants which must pass through New Jersey on their spring and fall migrations feeding in forest canopies.

Interior nesting raptors need from 600 to 1,000 acre minimum contiguous forest to feed and breed, with the bald eagle (E) and Cooper's hawk (E) needing the maximum size. Large tracts such as this may support only one pair; much larger tracts or minimum size tracts in proximity to each other to allow for exchange between breeding territories are essential if the species is to survive in the state. Smaller tracts, associated with sections of bottomland forest, are needed to support barred owls (T), and red-shouldered hawks (T), with the same requirements for adjacent similar habitats.

Interior nesting songbirds need substantially smaller forested tracts, but 100 acres is a minimum size to sustain their existence. The forested tracts must not have clearings, • including home sites, if their integrity is to be preserved. The dependent species are vulnerable to avion parasitism, predation, and competition from species associated with edge habitats. As interior species, they have not evolved successful defenses to these natural phenomena and cannot survive in their presence. Once a forest is broken by clearings, competitive species such as cowbirds, red-tailed hawks, and great horned owls thrive.

Planning consideration must be given to those grassland and deep forest habitats. Wetlands must also be considered. Most species of wildlife depend on wetlands for parts of their life cycle, and in New Jersey eighteen of thirty-seven terrestrial endangered and threatened species are permanently associated. with freshwater wetlands. All but eight of the listed species are dependent upon grasslands, large forests or freshwater wetlands*

Woodlots, farmland and wetlands interspersed provide excellent habitat for a diversity of wildlife, and the past and current land use in New Jersey has been of this sort. That use has helped New Jersey maintain an impressive diversity of wildlife. However, the other three habitats of

concern must also be preserved to continue New Jersey's natural wildlife heritage into the future (Frier-Murza, 1987).

Rapid development also impacts fish and wildlife in a more insidious manner. Point and non-point water pollution increases as regions develop, seriously impacting freshwater fish, marine fish and shellfish resources. Open space can also help reduce the magnitude of this problem (Crohingham, 1987).

The map on the following page (Figure 18) shows areas where high concentrations of threatened and endangered species occur. They are categorized first as restricted populations. These are the discrete locations which have known sitings of species and are the only currently known habitats . in the state. Other categories including grasslands,. Pinelands, Woodlands, and Coastal ecosystems reflect the general locations where high concentrations of threatened and endangered species representative of these ecosystems occur. The map was developed from inhouse data from the NJDEP/Division of Fish and Game and the Office of Natural Lands Management. This map was prepared first hand for the Office of State Planning effort.

Slope .

Slope may limit the use of land, and it is therefore an important consideration in land use planning. Slope is given in percent, and it is based on vertical change over distance. (For example, a 10-foot elevation change over 100 feet horizontal distance (10/100) is a 10% slope.) Steep slopes increase the cost of grading, the cost being a function of the amount of earth moved. Studies have shown that development costs (for single family and townhouse construction) are lower on slopes between 5 and 10% (Real Estate Research Corporation, 1974). ' In addition to grading costs, construction on steep slopes requires more sophisticated footings and pilings to support high-density dwellings. Slope, is also a prime factor in the processes of runoff and erosion. The steeper the slope, particularly

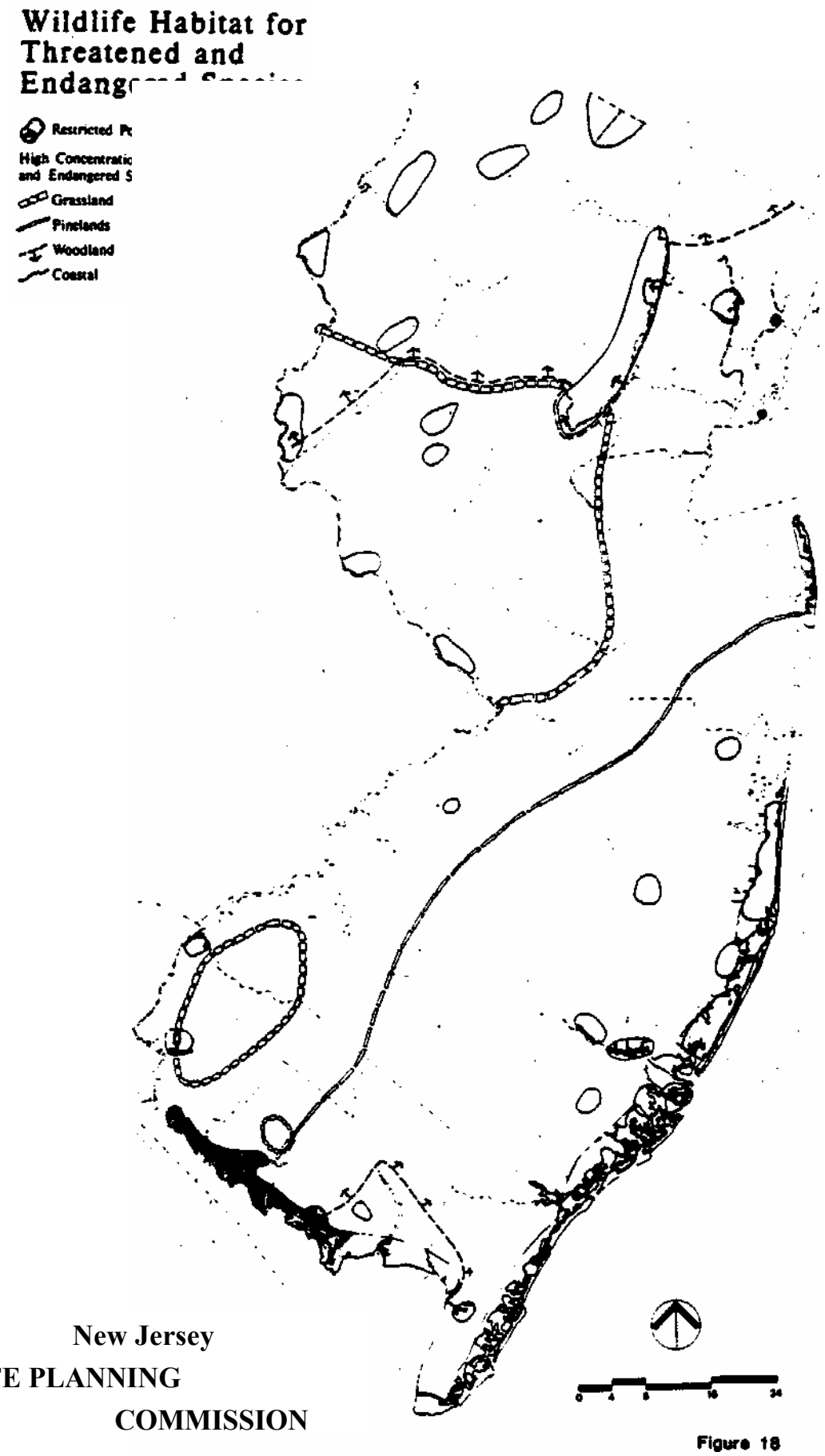
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Figure 18

over 10%, the greater the erosion hazard. Where steep slopes are denuded of vegetation, adjacent land and water bodies may be inundated with sediment during each rainstorm. Among the results are losses of wildlife, water quality, and an aesthetic landscape. A standard sediment control measure would amount to $125-$150 per single family unit (Tourbier and Westmacott, 1981). Where abatement structures are required, costs increase.

On the positive side, slopes can be used to separate different components of the landscape and can be used effectively in creative site designs for subdivision, parks and commercial or industrial areas. At the same time, slopes are good reflectors of sound and can be used effectively in noise attenuation.

Particularly ^along higher elevations, New Jersey's slopes are often wooded and add a tremendous visual element to the landscape. The Kittatinny Highlands and trap rock ridges are good examples of this type of feature.

Water drainage may be a problem on nearly level slopes (0-2%); however, erosion can still occur on relatively flat areas of 2-3% slope. Areas with slopes between 0-2% are well suited for ballfields, landfill sites, and agriculture. Where the soils are well drained, these flat lands require the least preparation for construction. Areas with gentle slopes (2-5%) are ideal for construction because of generally adequate drainage and the need for relatively little excavation. Moderate slopes (5-10%) pose a moderate limitation for septic tanks because of the possibility of seepage.

All slopes greater than 10% pose problems in designing roads and driveways. Also, when denuded of vegetation, slopes greater than 10% fail to form small surface depressions or swales, which trap sediment (Leopold, 1968). This makes these steep areas highly erodible and poses hazards to adjacent areas, which could be inundated with sediment. A 12% slope is considered by the Soil Conservation Service to be the maximum steepness for septic fields. Fairly steep slopes (10-15%) can provide creative sites for plantings and structures; however, installation of walks and utilities is costly and requires runoff and erosion management techniques. Slopes

greater than 15% are potentially critical environmental impact areas. On these slopes the soils are often thin and have low natural fertility.

Moderately steep slopes (10-25%), for most purposes, should be left in their natural condition or maintained in grass or tree cover. These areas may be useful as pastureland. An important fact to remember is that the natural processes that generated these slopes are currently taking place and will do so in the future. Man's activities generally accelerate these processes. Under construction conditions, streams whose sediment load is naturally 200 ton/square mile/year have had this load increase 100-fold (Wolman, 1964). Sites with steep slopes can be "developed with little harm only where the developer is willing to pay additional costs for managing runoff, erosion, and seepage from septic field effluent. Where the developer is willing to engage in a prudent and creative use of steep slopes and to pay the additional costs, developed steep slopes can add to the visual character of the community. Township costs such as snow-plowing can, however, pose problems.

Steep slopes (25% and over) present severe restrictions for construction in terms of excavation costs; however, they may still provide good sites for forestry, recreation, and wildlife. Steep slopes often require elaborate footings and considerable earthmoving to create building sites. They may incur erosion when denuded of vegetation.

Shore Protection

The NJDEP-Division of Coastal Resources (DCR) is currently planning to spend approximately $12 million per year over the next 5-7 years for various shore protection projects. Total spending throughout the state (expenditures by DCR and local government) is expected to amount to $15 million as local matches of approximately 25 percent will be required. The following types of projects may be funded in any given year:

- **one major beach nourishment project**
- **several dune maintenance and protection projects**

- **several small beach nourishment projects**
- **repair of existing shore protection and waterfront structures such as piers, jetties, sea walls, etc.**
- **acquisition of shorefront lands.**

The funding status for new shore protection projects is currently uncertain. All monies from the 1977 bond issue ($20 million) and the 1983 bond issue ($40 million in grants and $10 million in loans) have been either spent or committed to projects. There are at present no plans for another bond issue. There is currently a bill in the state legislature to raise real estate transfer tax and use the proceeds to fund shore protection, green acres, acquisitions, dredging, parks and recreation, land purchases, and flood control projects.

The proposed expenditure level of $15,000,000/year would provide over a 5-7 year period good progress on major shore protection problems. This level of project implementation and management could be handled by DCR's existing staff level.

The relative priorities for funding projects under existing and proposed programs generally follow the 1980 Shore Protection Erosion Master Plan. Most of the efforts and money -have gone into the four oceanfront counties. Some money has been spent in the Raritan and Delaware Bay Shores, and in urban waterfronts.

Until future funding problems are resolved, NJDEP-Division of Coastal Resources will not have a prioritized list for future shore protection projects (Weingart, 1987).

In terms of the Coastal Area Facilities Review Act (CAFRA), there is a great deal of concern over the density of the coastal area due to the number of new 24 unit developments which are occurring in coastal areas. There is also concern over the ability of the coastal barren islands to be evacuated in a reasonable time under major storm conditions.

Used wisely, natural resources provide the community with cost-free amenities and services--water purification, floodwater storage, water supply, wildlife diversity, pollution abatement, and so on. Wise use of natural resources includes preservation of open space systems, sites for outdoor education, sites for scientific study, agricultural areas, pleasing and visually diversified landscapes, and a sense of continuity to neighborhoods and new developments." Unnecessary disturbance or pollution of these natural assets destroys the balance in the environment. These assets' natural functions may be curtailed and their usefulness to residents reduced. Once lost, these cost-free amenities and services are difficult, if not impossible, to replace at reasonable expenses. Equivalent benefits could only be attained by public expenditures for water filtration or collection systems, dredging, flood control structures and programs, extensive landscaping, repeated stocking of streams with fish, and creation of artificial wildlife habitats.

Increased development places great demands on the state's resources and natural systems. People require land for housing and commerce and space for recreation, and, in their living they consume water and generate waste. More construction activity, more land covered by pavement, more cars on the roads, more air pollution, and less wildlife habitat result. Paradoxically, the amenities and resources that are eroded by development are the prime attractions for many people desiring to live in an area.

The need for environmental planning is supported by the fact that land use decisions are critical determinants of environmental quality. Historically, local planning and decisionmaking often have not had the information needed to incorporate natural resource considerations into the planning process. Consequently, land use decisions were often made in the absence of environmental goals. Another concern is that the positive endeavors of one municipality can be negated by the lack of awareness on the part of a connected municipality.

A part of environmental planning is that land has capabilities and limitations for use that are defined not only by economic and social criteria, but also by ecological criteria. The capabilities and limitations of the land should, in part, determine the way in which the land is to be used. Within this context, choice is clearly possible but is not unrestrained.

From our research and discussions during the preparation of New Jersey's State Development and Redevelopment Plan, the following major environmental objectives have emerged:

- **To decrease ozone concentrations, possibly by reducing dependence on automobile travel.**

- **To provide potable water in adequate volume and quality where needed to protect existing and potential future supplies.**

- **To enhance and ensure availability of ground water at all times.**

- **To identify and protect aquifer recharge areas for present and future water supplies.**

- **To maintain wetlands buffers and natural plant and animal habitats in order to provide sufficient life support for water-based biological entities.**

- **To maintain naturalriver and coastal flooding capacities for the preservation of life, property,and natural habitats and to avoid future public costs associated with flood damage (no filling in floodplains).**

- **To reduce the conversion of prime agricultural land to suburban uses.**

- **To protect barrier islands (including beachfronts), back bays, and tidal watercourses from overdevelopment.**

- **To protect scenic quality and prevent the unnecessary disturbance of steep slopes, and the resultant impacts associated with increased erosion, runoff, and septic tank use.**

- **To ensure that regulated discharges from publicly owned treatment works do not impair the water quality.**

- **To protect the land and natural vegetation along stream corridors, lakes, ponds, and natural habitat—to maintain stream flows and cleanliness for multiple uses: potable water supply, waste water dilution,, recreation, and industrial use.**

- **To protect scenic skylands and significant landforms such that natural vistas remain unimpaired and significant elements of the landscape remain intact.**

- **To protect historical and archeological sites, and natural/unique geologic features.**

- **To provide for the protection of existing and proposed publicly owned forests, open spaces, and recreation areas.**

- **To provide an adequate network of recreation open space 'areas within reasonable access of the states population.**

- **To provide for the protection of threatened, endangered and unique wildlife and vegetation.**

- **To enhance evacuation potential from storm and industrial hazards.**

All these objectives are affected by land use decisions. The discussions contained in this report explore interactions among them, and the maps serve to clarify areas that are affected.

The use of land involves both public and private interests. The public interest must be stated by public policy with respect to land use and development. What areas should be protected from development, what should be developed, and how should development occur in order to minimize adverse impacts? The State Development and Redevelopment Plan recognizes these concerns and calls for the identification of areas for "growth, agriculture, open space conservation, and other appropriate designations."

Public policy on use of New Jersey's land resource must affirm that certain environmental issues, such as preservation of stream water quality, cross municipal boundaries, and that protection of these resources represents the interests of a broader community. Typically, state-level agencies develop a regulatory framework for resource uses viewed to be the property of the "residents of the state. Identification of areas of concern is essential from the standpoint of environmental impacts and the unwanted consequences of strong development stimuli such as highways and major sewer lines. To protect quality of life, future development should be consistent with the capabilities of air, land, and water resources and avoid those that are sensitive, nonrenewable, or covered under statewide objectives.

Resources that require protection have very different levels of tolerance to impacts associated with development and widely varying abilities to mitigate impacts cost-free. The most sensitive or pristine resources typically occur in the least-disturbed areas. The concept of open space conservation, **however, depends entirely on the goal and the resource being managed—be it a peregrine falcon, a wetland, or a stream corridor linking the city to the suburbs. The demand for resource protection space is often greater in developed areas (see map).**

The Natural Areas Act was passed to enable the Department of Environmental Protection to acquire, maintain and preserve natural areas (NJDEP/DPF, 1984). In 1961 the New Jersey Natural Area Program was established and since then has secured 41 natural areas totaling 21,619 acres. This is only a portion of known valued areas in the state. Most of

the 41 areas are managed by the Division of Parks and Forestry. Natural Areas are defined by statute as areas of land or water that have retained their primeval (although not necessarily pristine and undisturbed) character and areas having rare or vanishing species of plant and animal life or similar features that are worthy of preservation. Natural Area designation refers only to the wilderness type management of these tracts. The acquisition of these areas has been going on since the 1930's.

The Green Acres/Recreation Program of NJDEP has recommended that open space conservation areas include the following (Figure 19):

- **All tidal and freshwater wetlands* These data are available from NJDEP/Division of Fish and Wildlife on USGS 7.5 minute quadrangle sheets. --**

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- **All subwatersheds that are designated as FW-1 Pineland Waters, FW-2 Trout Production, FW-2 Trout Maintenance, or FW-2 Category I. These waters are considered high-quality and are critical to protect. These data are all available on USGS 7.5 minute quadrangle sheets in the NJDEP Division of Water Resources.**

- **All wildlife habitats,- which are restricted to specific known areas. These data are available from NJDEP/Division of Fish and Wildlife (NJDEP-USDA, 1980).**

- **All areas designated as having high-frequency occurrence of unique (threatened and endangered) plant species. These data are available from NJDEP/National Heritage on Natural Lands Management Program on USGS 7.5 minute quadrangle sheets.**

- **Flood plain areas were also recommended. These areas are considered as part of stream corridors.**

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Figure* 19

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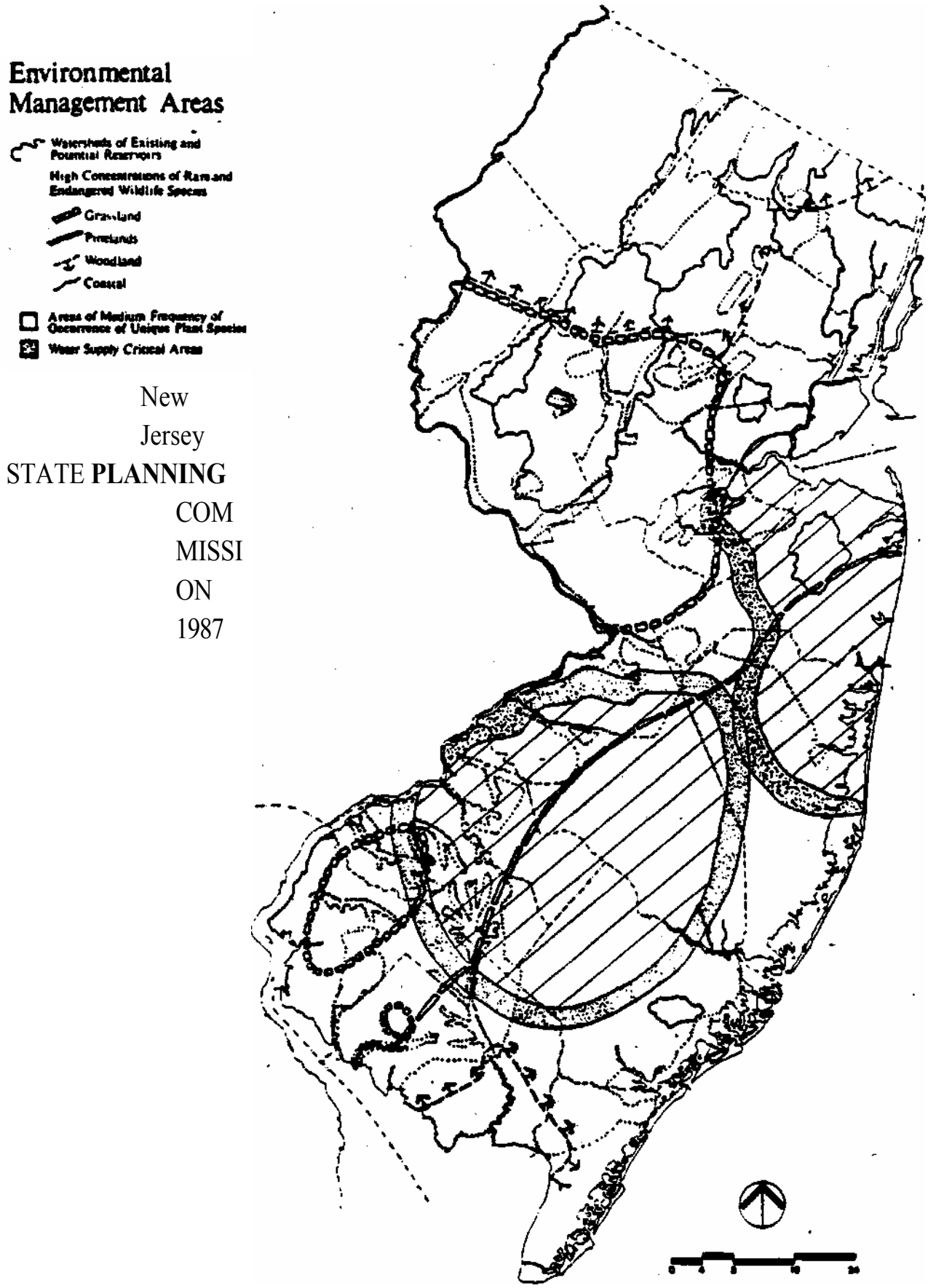
These are the most valued natural areas in the state. The designation is intended largely to protect habitat and natural features. As well as wetlands and woodlands, conservation/open space areas also include agricultural areas and limited development. Other areas in need of environmental management are mapped in Figure 20. They include the following:

- **Watersheds of Existing and Potential Reservoirs**
- **High Concentrations of Rare and Endangered Wildlife Species (grasslands, pinelands, woodlands, coastal)**
- **Areas of Medium Frequency of Occurrence of Unique Plant Species**
- **Water Supply Critical Areas,**
- **Medium and High Priority Flood Control Areas.**

Effective management of water supply reservoirs includes the protection of surface water draining into them from organic chemicals, nutrients, and fecal coliform bacteria. Vegetating buffers along streams and avoiding stream crossings by roads, pipelines, and other potential pollution sources can minimize surface runoff pollution. Concerns for the density of dwelling units with in-ground septic disposal and the area of impervious cover are also appropriate. Without good management of these types, standard water chlorination treatment may become ineffective as chlorine and organic chemicals combine to form carcinogens, and advanced, expensive filtration may be needed.

Water supply critical areas are designated where overpumping exists and aquifer withdrawals exceed natural recharge. NJDEP is working on this problem by promoting the use of alternative sources of water in these areas. These problems should not affect growth unless development of surface or other alternative sources is hampered by lack of public or private funds.


Environmental Management Areas
Watersheds of Existing and Potential Reservoirs
High Concentrations of Rare and Endangered Wildlife Species
Grassland
Pinelands
Woodland
Coastal
Areas of Medium Frequency of Occurrence of Unique Plant Species
Water Supply Critical Areas
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1987

Figure 20

Grassland bird species require agriculture, because unfarmed land eventually succeeds to shrubland and woodland. Nests must be protected in agricultural habitats, Pinelands species of plants and wildlife require a wide range of conditions, from sanctuary to disturbance. Coastal areas, especially marshland, need to be left as undisturbed as possible. Forest wildlife vary widely, with many large, carnivorous species that are at the top of the food chain. Most raptors and large mammals require large tracts of forested or mixed land for territory. If these habitats are broken up or destroyed, species populations will decline.

Agricultural lands are protected voluntarily by farmers willing to participate in preservation programs. The county-designated ADA's prefer agricultural land use, but do not prohibit other uses. For planning purposes, New Jersey's existing ADA system appears to be the most current system of preservation in use; however, the effectiveness of the program is still unknown.

To maintain the natural integrity of the northwestern part of the state, which contains a number of the most valued resources, New Jersey may need to employ the concept of island biogeography (MacArthur and Wilson, 1967). Protection obviously cannot come through acquisition, and development will clearly be taking place. This could be an excellent candidate for a Green-line Park (National Parks and Conservation Association, 1983). The major management objectives will be to minimize disturbance of woodlands and agricultural lands, maintain large contiguous wooded areas, minimize road, transmission line, and pipeline cuts, and cluster development into existing towns and villages.

To date, the major state programs (Figure 21) for controlling land use are through designation of management areas; areas that are deemed to have such special social, economic, and environmental values that the legislature has subjected development within them to certain controls. About 30 percent of the State belongs to one or more of these managed areas, including the Coastal Zone, the Pinelands, the Hackensack Meadowlands, and the state system of parks, forests and wildlife management areas. In 1987, the state

had 686,745 acres in state and federal land. This is 373,472 acres short of the statewide public open space goal. While each managed area has clearly defined roles, the State Planning Commission should work to coordinate with the appropriate authorities to further consider policies that affect development. An example of such policies is the buildout of barrier islands in 24-unit developments - which is below the threshold for review by CAFRA (Weingart, 1987). Also, the Hackensack Meadowlands District Commission will be reconsidering the Meadowlands master plan over the next two years. The New Jersey Pinelands Commission is concerned with development of areas adjacent to the Pinelands that may have an effect on them (i.e., drawdown of the Cohansey aquifer system, which is vital to the protection of the Pineland's ecology (Moore, 1987).

The final major environmental element is air quality-ozone. Other than employing new automobile exhaust system technology* the only way to significantly reduce ozone in New Jersey is to reduce the use of "the automobile. Encouraging shorter journeys to work, mass transit and vanpools are the major strategies to reduce ozone concentrations.

Existing Environmental Management

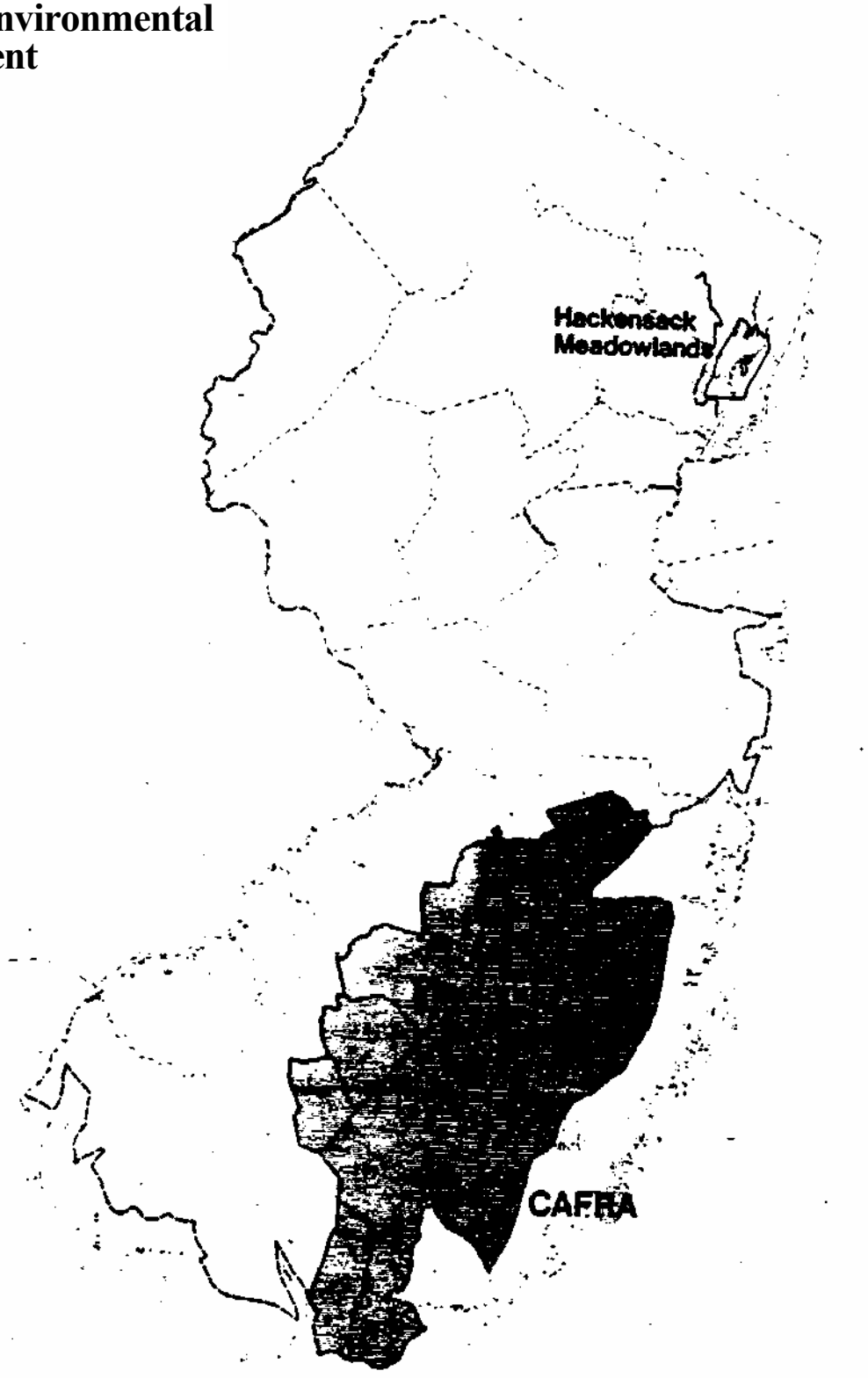

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Figure 21

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