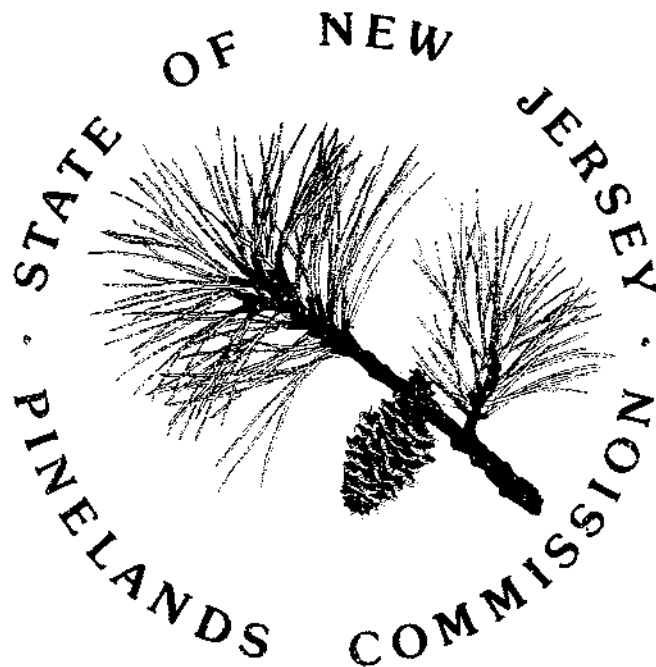


New Jersey Pinelands

Comprehensive Management Plan



**COMPREHENSIVE MANAGEMENT PLAN
for the
Pinelands National Reserve
(National Parks and Recreation Act, 1978)
and
Pinelands Area
(New Jersey Pinelands Protection Act, 1979)**

Adopted: November 21, 1980

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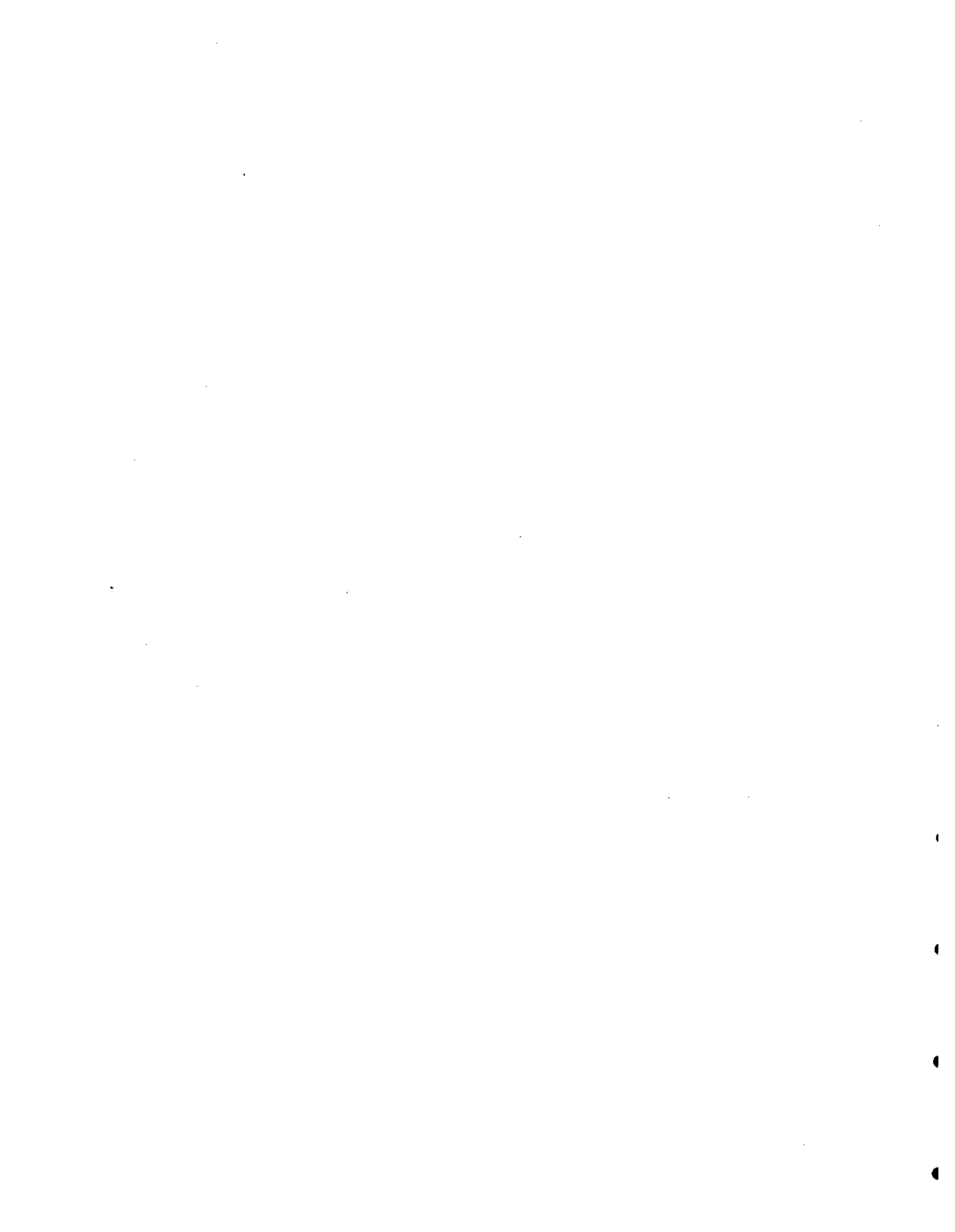
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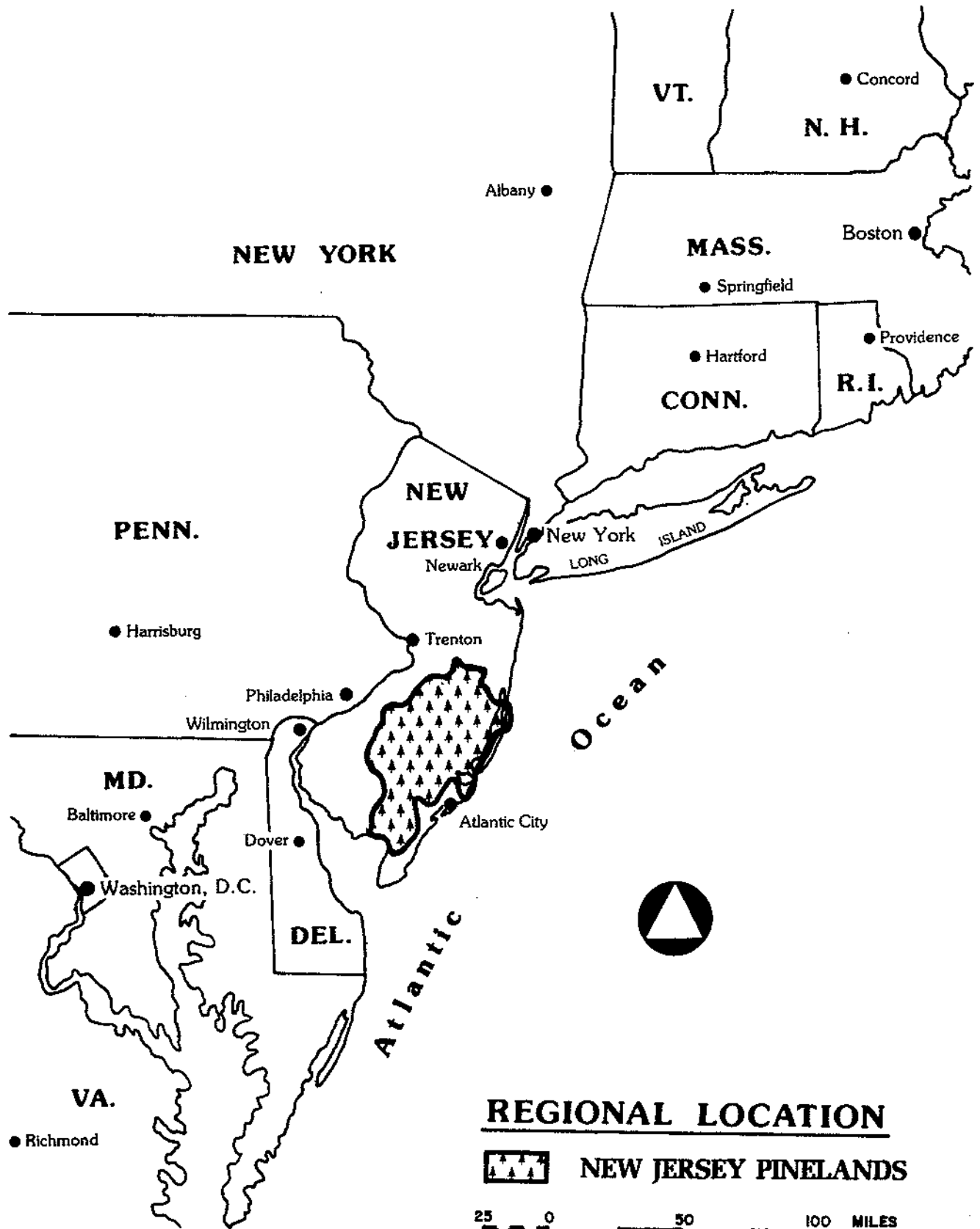
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Introduction

The New Jersey Pinelands, a million-acre forest expanse in the midst of the country's most densely populated region, have finally been recognized as one of the nation's premier environmental treasures. For more than a year, the Pinelands Commission has been developing a strategy to preserve and protect the many qualities of this unique resource. The Comprehensive Management Plan is the result of that process. It is also the culmination of long-term efforts by private groups and individuals, as well as local, state and federal governments.

While this is not the first plan prepared for the Pinelands, it is a precedent-setting one. The new plan flows from the designation by Congress in 1978 of the Pinelands as the country's first National Reserve. It also responds to specific requirements of the 1979 New Jersey Pinelands Protection Act. The Reserve concept differs from past governmental preservation and recreation efforts in that a primary goal is to manage lands by innovative means which combine the capabilities and resources of the local, state, and federal governments and the private sector. The plan designates areas where public acquisition is deemed essential for preservation. But the major thrust of the planning effort has been directed toward developing ways to safeguard the Pinelands' resources while the land remains in the care of its traditional guardians, the people who live there.

With their remarkable blend of ecological features and human uses, the Pinelands were a logical choice to test the National Reserve approach. The region is well known for its extensive water resources of very high quality. In addition, the Pinelands landscape is regarded by ecologists and others as truly special. Although patches of a few types of Pinelands features can be found in coastal New York and New England, in the Appalachian Mountains, and in other scattered small areas throughout the world, no other area has the same pattern of natural habitats, distribution of plant and animal populations, and unusual variety of plant and animal species.

The Pinelands are also special in terms of geographic location. The position of this vast, largely undeveloped area in the center of the urbanized Northeast is an outstanding characteristic which contributes to its national importance. The area is a significant natural and recreational resource in a region where open space is in short supply.

The character of the Pinelands has been shaped by both natural and man-related factors. The region has a long history of human use. For at least 300 years, it has experienced a cycle of resource exploitation including lumbering, bog iron production, and sand and gravel extraction. Settlements have appeared and disappeared as new resources were found and exhausted. Throughout this time, the ecosystem has kept its potential to maintain itself. Certain uses, particularly those related to cranberry cultivation, have actually helped preserve the existing system.

While the previous scale of resource utilization resulted in only temporary setbacks, activities in recent years have not proved as compatible. Development pressures have continued to grow throughout the Pinelands, and their nature and intensity have threatened the system's continuance. This harsh reality has resulted in numerous efforts over the last 15 years to protect the Pinelands for present and future generations.

On the local level, several municipalities within the area have attempted to control the impacts of development by improving their ordinances, although planning efforts based on natural resources are relatively recent and limited. At the same time, there has been a steadily increasing awareness that the Pinelands function as a total ecosystem, and that they require a regional approach to land use management.

The earliest of these regional efforts was carried out by the former Pinelands Regional Planning Board, which published, in 1965, four growth scenarios for the region including the famous "jetport in the Pines" proposal. A major study by Jack McCormick, originally prepared for the Philadelphia Academy of Sciences and subsequently published by the New Jersey State Museum, detailed the plant and animal species of the Pinelands and asserted that such species existed in an interdependent and easily disturbed system ("A Study of Significance of the Pine Barrens of New Jersey," 1967 and 1970). John McPhee's 1967 book, *The Pine Barrens*, promoted a wider understanding of the region's environmental, historical, and cultural significance.

The National Park Service followed up on the McCormick study by developing its own alternative plans for the area in 1968. In 1972, the Pinelands Environmental Council was established by the state legislature, and in 1975, the council produced its report, "A Plan for the Pinelands." Other groups which have studied and made recommendations regarding the future of the area include the federal Bureau of Outdoor Recreation ("Pine Barrens of New Jersey: Study Report," 1975); Rutgers University's Center for Coastal and Environmental Studies ("A Plan for a Pinelands National Preserve," 1978); and the Governor's Pinelands Review Committee ("Planning and Management of the New Jersey Pinelands," 1979). The last study is noteworthy in that its major recommendations included the establishment of a 15-member body to forge a plan for the one million-acre Pinelands region, the delineation of that region into an inner Preservation Area and an outer Protection Area, and the use of development controls during the planning period. These recommendations became keystones of the Pinelands protection strategy.

Despite their regional scope, none of the previous efforts had as great a potential for successful management of the Pinelands as exists within the current state and federal legislation. Past attempts were constrained by the facts that the region was too narrowly defined (the Pinelands Environmental Council's jurisdiction was 320,000 acres, most of which were already publicly owned), and/or that the planning body had only advisory powers. The legislation under which the Pinelands Commission's plan has been prepared has the advantage of delineating an area based on ecological boundaries. The state legislation also gives the Commission sufficient authority to ensure that the area will be managed with consideration of regional impacts.

The current legislative mandate to protect the Pinelands is set forth in the National Parks and Recreation Act of 1978, signed by President Carter on November 10. This act established the Pinelands National Reserve, encompassing parts of seven southern New Jersey counties and all or parts of 56 municipalities. It also authorized the establishment of a planning entity responsible for preparing a Comprehensive Management Plan for the Reserve. The plan is to be submitted to the Secretary of the Interior within 18 months of the receipt of federal funds appropriated pursuant to the act.

To comply with the federal statute, Governor Brendan T. Byrne issued Executive Order 71 on February 8, 1979, providing for the establishment of the Pinelands Planning Commission and making most development in the Pinelands area subject to Commission approval during the planning period. The order incorporated recommendations of the Governor's Pinelands Review Committee. The deadline for adoption of the Comprehensive Management Plan was set for August 8, 1980, or 18 months after the Executive Order went into effect.

In June, 1979, the New Jersey Legislature passed the Pinelands Protection Act, thereby endorsing the planning effort, the designation of the Pinelands Commission as the regional planning entity, and the interim restrictions on development. The Commission's composition is prescribed in both laws as follows: 15 members, including one appointed by each of the governing bodies of the seven Pinelands counties, seven appointed by the Governor of New Jersey, and one

designated by the U.S. Secretary of the Interior. For state Constitutional purposes, the Commission is attached to the New Jersey Department of Environmental Protection. The state act specifies, however, that the Commission is independent of any supervision or control by the department, and that it has the authority to exercise all the powers and duties necessary to effectuate the purposes of the state and federal legislation.

The Pinelands Protection Act delineates the Pinelands Area, consisting of the 368,000-acre, semi-wilderness Preservation Area and the 566,000-acre, somewhat more developed Protection Area. The Pinelands Area is slightly smaller than the Pinelands National Reserve, and takes in all or portions of 52 municipalities. (Plate 1; located in this document's plate section, shows the various Pinelands jurisdictional boundaries.)

The New Jersey Legislature amended the act in June, 1980, following release of the Draft Comprehensive Management Plan on June 6. The Commission was given additional time to finalize portions of the plan dealing with the Protection Area, with adoption of those portions being required to take place between November 14 and December 15, 1980. The time allotted for the Governor to review the plan was also extended, from 10 days following his receipt of the minutes of the meeting at which the plan was adopted to 30 days.

The amendments did not alter the Commission's original August 8 deadline for adopting those portions of the plan applicable to the Preservation Area. The Commission acted affirmatively on that date by approving the relevant procedures and standards which had been presented in Volume II of the draft plan. The Preservation Area Plan reflected many of the suggestions and comments generated by the plan's draft version, especially those presented during a series of six public hearings held in July. Governor Byrne held his own hearing to gather testimony on the plan before announcing his decision to let it go into effect on September 23. The Preservation Area Plan is incorporated into this document, which constitutes the Comprehensive Management Plan for both the Pinelands National Reserve and the Pinelands Area.

The plan takes its direction from the state and federal acts, which recognize that the Pinelands contain a multitude of unique natural, physical, and cultural qualities; that these qualities are being threatened by pressures for residential, commercial, and industrial development; and that it is in the interest of the people of New Jersey and the nation to protect them. The overriding goals of the acts are to preserve, protect, and enhance the significant values of the land and water resources of the Pinelands. The state act speaks of the need to maintain a contiguous tract of land in its natural state, safeguard the essential character of the Pinelands environment, protect the quality of the surface and ground water, promote compatible agricultural and recreational uses, and encourage appropriate residential, commercial, and industrial patterns of development.

The Comprehensive Management Plan sets out the strategy to achieve these goals. As required by the acts, it includes:

- a natural resource assessment;
- an assessment of scenic, aesthetic, cultural, open space, and outdoor recreational resources;
- a land use capability map and a comprehensive statement of land use and management policies;
- a financial analysis;
- a program to ensure local government and public participation in the planning process; and
- a program to put the plan into effect.

The plan consists of two major, interrelated elements. Part I describes the region's natural, cultural, and physical resources, the factors influencing those resources, and the programs which

have been developed to respond to the state and federal mandates. The first six chapters provide the basis for the land management strategy which is described in Chapter Seven. This chapter begins with a discussion of the resource goals and policies which were adopted by the Commission in the spring of 1980, and which ultimately established the direction of the program presented here. Chapter Eight sets forth the procedures for achieving coordination among various governmental entities whose actions may affect the Pinelands. Chapter Nine deals with financial issues relating to implementation of the plan, including costs, sources of revenue, and a five-year schedule for land acquisition and the attendant in-lieu-of-taxes payment program. Part I concludes with a discussion of the public participation activities which were an integral element in the plan's development, and describes how the Commission's ongoing relations with the public will be structured.

Part II contains the Comprehensive Management Plan's substantive land use programs and development standards. It also sets forth the procedures under which the Commission will certify that county and local master plans and land use ordinances are consistent with the comprehensive plan. While general descriptions of the programs and standards are provided in Part I, the second part offers specific language to put them into effect. The mechanism established by the Pinelands Protection Act to ensure local implementation of the plan requires that municipal and county governments incorporate the Comprehensive Management Plan's substantive and procedural elements into their master plans and land use ordinances. To facilitate this process, which is supposed to be completed within a year of the comprehensive plan's adoption, Part II is drafted so that it can readily provide the basis for local regulations.

Part II is divided into eight articles. The first contains general rules about the Commission's authority and other matters. Article 2 defines selected terms which are used throughout. Article 3 contains the procedures for certifying that county, municipal, and federal installation plans are in conformance with the Pinelands plan. The next article specifies the Commission's role in the development review process. It distinguishes between the procedures to be followed in localities with certified and uncertified plans and ordinances, as well as between the procedures that apply in the Preservation Area and the Protection Area. Article 5 establishes the various land use areas and specifies the regulations governing the use of land in each area, and creates the system of Pinelands Development Credits. Article 6 contains the other substantive standards and management programs which are described in Chapter Seven of Part I. Finally, Articles 7 and 8 set forth procedures for amending and enforcing the plan.

This document is the product of a concentrated effort by the Commission dating from March 30, 1979, when it met for the first time. The Executive Director, appointed by the Governor pursuant to Executive Order 71, assumed his duties in July, and a work program for the Comprehensive Management Plan was devised with the benefit of extensive public comment. The Commission adopted the work program on September 21, 1979, establishing a framework for the planning process. Shortly after, the official planning map for the Pinelands National Reserve, Pinelands Protection Area, and Pinelands Preservation Area was adopted and submitted to the Legislature.

The work program for the Comprehensive Management Plan was a series of interrelated components. These led systematically to the formulation of policies and programs. Four components—natural resources, historic and archaeological resources, sociocultural factors, and physical resources—consisted of the gathering of pertinent data, assessment and analysis, identification of issues requiring attention in the plan, and identification of subjects requiring investigation beyond the planning period. A growth factors analysis examined existing and future development pressures in the Pinelands, relying heavily on data generated by the natural, physical, and sociocultural components. The land management techniques component was designed to resolve issues arising in the preceding studies, and the intergovernmental coordination component addressed methods of implementation. A financial component dealt with cost and potential revenue sources, and evaluated various payment in lieu of taxes programs to accompany the Commission's five-year schedule for land acquisition. The delineation of policies

and programs, representing the essence of the Comprehensive Management Plan, was the final work component prior to writing the draft.

In compiling the data base and defining management issues, the Commission has supplemented staff studies by entering into contracts and interagency agreements with a range of public and private groups (see the Appendix for a list of consultants and studies). Most of these studies took place during the fall and winter of 1979-1980, while a few, such as an additional financial analysis and the recreation assessment, were completed following release of the draft. Their findings have been integrated into this document.

The methods used under the different contracts depended on the time available and the study area. For example, studies such as sociocultural factors, recreation, growth factors, and land management techniques involved significant contacts with knowledgeable local individuals and municipal and state officials, as well as interviews conducted throughout the Pinelands. The recreation and critical areas studies used special public workshops to gather information. For studies in the natural resource areas, field work was more constrained due to the restricted time frame and because much of the research was conducted during the winter. These studies were instead based on extensive literature searches, supplemented to the extent possible with interviews of persons knowledgeable in the subject areas. As the planning process continues, original research will be given a top priority. Several areas for further study are noted in Chapter Seven.

In developing this plan, the Commission was fortunate to be able to call upon many groups and individuals for their advice and assistance. The Technical Advisory Committee, a consortium of scientists possessing expertise in the dynamics of the Pinelands ecosystems, has proved to be an invaluable asset, both in responding to requests for review of technical reports and in compiling issues to be addressed within the plan. The Agricultural Advisory Committee, chaired by New Jersey Secretary of Agriculture Phillip Alampi, identified issues of concern to the agricultural community and suggested policies geared to specific goals of the state and federal acts. County planning board representatives also reviewed technical reports and performed a liaison function between their constituent municipalities and the Commission. A Federal Advisory Task Force assisted in delineating intergovernmental strategies for implementation of the plan.

The public at large, as well as specific agencies and groups, have maintained a high level of interest in the Commission's activities, and can be credited with raising a range of issues dealing with environmental, economic, and cultural topics. A series of eight public hearings on the draft plan, six in July and two in October, were heavily attended and succeeded in channeling public opinion directly to Commission members. A vast amount of written comment was also received, catalogued, and distributed for review by members and staff. Municipal and county officials were especially helpful in presenting detailed recommendations for refinements of the plan. Many of the changes incorporated into the plan's final version reflected these various suggestions from the public and from local officials.

The Pinelands planning effort will continue to provide significant opportunities for individuals and local governments to ensure the best possible future for this special region. Local implementation of the plan is, of course, the most desirable approach in the long run. The Pinelands Commission will direct its efforts toward supplying all groups, especially local governments, with the best available techniques for rational and sensitive resource management. The Commission encourages the widest possible continuing participation in its planning program.

Part I

CHAPTER ONE

Evolution of the Pinelands Ecosystem

The present Pinelands landscape and ecosystem have been shaped by natural processes which began millions of years ago and, more recently, by the influences of man. A knowledge of these events is necessary to fully appreciate the region's significance and to plan for its continuing maintenance.

Three factors contribute to the essential character of the Pinelands. First are the physical features of the landscape that distinguish the natural habitats of the region. These include relief, soils, and hydrology. Second are living organisms, the plants and animals that characterize the Pinelands. And third are ecosystem processes, the dynamic interrelationships among and between the living organisms and their particular habitat elements. Such interrelationships have evolved through thousands of years, giving us the Pinelands as they exist today. Outside influences, natural and human-cause, may interrupt or modify these interrelationships and change the essential character of the landscape.

Only general knowledge is available of the particular geologic events and climatic changes that caused the formation of the Pinelands area and of the times at which these occurred. The history of the origin and development of the present plant and animal populations cannot be fully documented, nor is there complete agreement on or understanding of man's influence on the Pinelands. Nevertheless, scientists have uncovered enough evidence to make it possible to draw reasonable assumptions about the evolutionary history of the Pinelands and the significant influences on this history.

In this chapter, the significant natural and man-made influences that are believed to have made the Pinelands landscape and ecosystems what they are today are identified. These are presented chronologically in four groups to give a sense of the evolution of the region. The four time periods are the epoch prior to the Pleistocene Ice Age, the Pleistocene Ice Age (1.8 million to 10,000 years ago), the period from 10,000 years ago to the time of European colonization, and the period from European colonization to the present.

Early Geologic Processes

The processes of deposition, sea level change, erosion, and land uplift are responsible for the present topographic and hydrologic features of the Pinelands. The present mineral soils have developed from the geologic parent material. Topography, hydrology, and soils, as well as climate, have a controlling influence on plant and animal populations. Geologic processes in the past have thus had a significant influence on today's Pinelands landscape and ecosystem.

The Pleistocene Ice Age is assumed to have started about 1.8 million years ago. Two earlier phases were particularly important. The first was a sequence of marine deposition and erosion which started about 100 million years ago. The sea covered the land, leaving sedimentary deposits composed mostly of clays, silts, sands, and gravels. When the sea withdrew, erosion proceeded, and streams and wind carried away some or all of the sediments. The deposition and erosion sequence occurred many times in southern New Jersey, resulting in deposits over the basement rock ranging from a veneer covering to layers 1,300 to 6,000 feet thick. These deposits form the Coastal Plain in which the Pinelands are located. Names have been given to distinctive and mappable units of these clays, silts, sands, and gravels.

In the area of the Atlantic Coastal Plain now designated as the Pinelands, the last marine deposit of this period has been named the Cohansey Sand. The Cohansey overlies an older deposit, called the Kirkwood Formation. Both are important in the later processes in which the surface of the Pinelands evolved.

The second important early geologic period began about 5 million years ago, when the sea withdrew from southern New Jersey and the land uplifted. The most recent sedimentary deposits were left exposed at the surface. In the Pinelands area, this was primarily the Cohansey Sand, which now undergirds almost all of the present Pinelands. The older Kirkwood Formation is exposed at the surface along the northern and western borders of the Pinelands. The Cohansey Sand is composed mostly of uncemented yellow quartz sand with variable amounts of fine to coarse, silty, and clayey sand. The Kirkwood Formation is also unconsolidated and is composed mostly of sand, silt, clay, and a little gravel.

Following the exposure of the Cohansey Sand, patches of gravels, sands, silts, and clay were deposited in localized areas on the Coastal Plain. These formations are identified as the Beacon Hill, Bridgeton, Pennsauken, and Cape May. The first three deposits are assumed to be pre-Pleistocene. The Beacon Hill Gravel is important from a landscape point of view. Today, it caps many of the highest hills in the Pinelands. The original sands surrounding the gravel were eroded away, leaving the gravel as a hill. This unusual geologic feature is known as "inversion of topography" because the younger, gravelly streambed deposits form hilltops.

The predominance of sand as the surface material had a major influence on the ultimate development of the Pinelands. The region's low relief is related to the nature of the Cohansey and underlying formations. The sandy composition of the Cohansey and the Kirkwood are responsible for the unique character of the surface and groundwater systems.

Variations in soils depend on the nature of the parent material and the influence of factors such as climate. Soils differ in their water-holding capacities, in their acidity, and in the type and amount of plant-supporting minerals they contain. Each plant species exhibits a certain range of need and tolerance for water and particular nutrients, as well as for other factors such as soil acidity. A plant species that grows and reproduces successfully on one soil type may not be able to exist under different conditions. The soils that developed over time from the Cohansey Sand and patches of subsequent deposits are low in moisture retention, low in nutrients, and high in acidity. These characteristics, interacting with other factors, have had a great influence on the types of plant and animal communities which have developed in the Pinelands.

The Pleistocene Ice Age

An epoch of glaciation known as the Pleistocene started about 1.8 million years ago and ended about 10,000 years ago. During that time, at least three of the four major ice advances reached New Jersey. The last one was known as the Wisconsin. It came the farthest south, but stopped 10 to 40 miles north of the Pinelands area. Between the successive advances, extended intervals of warmer climate occurred. During these intervals, the glacial ice melted and the glacier retreated. The climatic changes and advances and retreats of the glacier affected sea level because of the varying amount of water tied up in the ice. When glaciation was at its maximum, sea level was at its lowest, and the North American Atlantic coastline extended many miles east of its present boundary. As the climate became warmer and glacial ice melted, land areas previously covered by vegetation were inundated by sea water. These events of the Pleistocene epoch had major impacts on the Pinelands.

It is assumed that plants and animals colonized the Coastal Plain in the long periods prior to the Pleistocene, when the sea did not cover the land. The evidence of the types of species which were present then is limited. Some scientists interpret the available information as indicating that a few plants which are related to species present today in the Pinelands may have existed in these ancient times. Slightly more evidence is available on the plant and animal communities of the later Pleistocene time and on the influence that climatic and sea level changes had on them.

It is believed that in the late Pleistocene, when the Wisconsin ice was present north of the Pinelands, the climate in the region was considerably cooler, and probably wetter, than at present. Many scientists believe that at this time the Pinelands area was covered by a forest similar to that which is now present

in northern New England and Canada (a spruce-fir boreal forest). Some believe that the climate was so cold that the Arctic type of tundra vegetation existed here. In either case, the assumption is that the Pinelands plant and animal populations as we know them today developed only after the Wisconsin ice began to retreat about 10,000 years ago.

When the glacier started its final retreat from New Jersey, the sea level was still far to the east of the present North American Atlantic coastline. This increased the coastal migratory path for both southern and northern species, a factor which significantly influenced the composition of the modern Pinelands flora and fauna.

From 10,000 Years Ago to the Time of European Colonization

Although the topography, soils, and hydrological features of the Pinelands stem from the geologic processes that took place over millions of years, the plant and animal populations which exist today developed in the last 10,000 years. The two most important influences on this slowly evolving development have been climatic changes, and the interactions of natural biological succession and evolutionary adaptation processes with the physical components of the Pinelands environment.

Because every type of plant and animal has environmental tolerance limits and an optimum range for maximum growth and reproduction, climatic as well as other environmental factors have controlling influences on species distributions. While a species may flourish under the climatic and soil condition in one geographic region, or one site within a region, it may be unable to reproduce successfully or even to exist in another region or site having a single environmental condition outside its tolerance limits. As climatic conditions change, so will the geographic ranges of living organisms. Warming trends result in northward migration of southern species and cooling brings the more northern species southward.

It is believed that climatic changes in the last 10,000 years caused northward and southward dispersals of plant and animal populations, and that these are reflected in present Pinelands populations. About 5,000 years ago, the cool moist period which existed when the glacial ice started to retreat was followed by a warmer period that lasted several thousand years before the climate again turned colder. Enhanced by the enlarged coastal migratory route, plants and animals of more southern regions migrated northward. Some of these species colonized the Pinelands. It is believed that the Atlantic white cedar, a relative newcomer to the Pinelands, colonized the region during this period. To a lesser degree, migration also proceeded northward and then east to the Pinelands from the southern Appalachian area. During this same period the characteristic tree of the Pinelands, the pitch pine, may have migrated as far north as Quebec.

During the subsequent cooling period and southward migration of species, some of the southern species survived in the Pinelands. The alternating warm and cool climatic changes occurred when there were no artificial barriers to species migration and no significant human destruction of habitats.

The climatic and migration factors are reflected in the present Pinelands resources in three ways. The flora and fauna have an unusual composition of southern species that reach the northern limit of their range in the Pinelands, northern species that reach the southern limit of their range here, and species common to surrounding areas in the state. Many of the unusual Pinelands plant and animal species have geographical ranges that are discontinuous (disjunct). For example, a species may be found only in the Pinelands, the Carolinas, and Florida.

Range overlaps have resulted in hybridizations among northern and southern species. Hybridization of pitch pine with three southern tree species which overlap its range in this area, and hybridization between species of northern and southern snakes are a few examples of this process.

Overlaid on the climatic factors just described are the interactions of the natural biological processes of competition, succession, and evolutionary adaptation with the Pinelands' particular resource components. Today's flora and fauna reflect the success of specific species in invading and maintaining themselves competitively in the particular habitats that characterized the Pinelands. Terrestrial plant species are adapted to frequent fire occurrence and sandy soils of low nutrient content and water-retention capacity. Aquatic species are adapted to acid waters with low nutrient levels.

Fire has greatly influenced the development of present patterns of plant and animal distribution in the Pinelands. Some plant species, by nature of their structure, are more insulated from heat than others and are therefore less susceptible to fire damage. Also, some trees and shrubs produce stem and/or root sprouts quickly after fire damage while others have little or no resprouting capability. Seeds of some plants are destroyed by fire. The seeds of others are released when exposed to the heat of fire and germinate on relatively bare, burned-over soil rather than in a thick litter of leaves. Fire damage which produces major changes in the surface litter also affects the community composition of soil arthropods, bryophytes, and lichens. Changes in plant communities caused by fire affect the structure of the animal communities which exploit the Pinelands.

Fire can be a common natural phenomenon caused by lightning and spread by high winds. It is believed that modern plant populations in the Pinelands have evolved in the context of a fire-adapted, low-nutrient, droughty ecosystem. The native species in the Pinelands are highly flammable, yet highly resistant to killing by fire. Most native upland species other than mosses and lichens sprout from underground stems or roots if their tops have been killed back. Pitch pine, the most abundant tree species, is also the most resistant to damage and killing by fire.

In addition to fire ignited by lightning, fires were intentionally and accidentally caused by Indians and European settlers. The frequency, intensity, seasonality, and location of fire all play roles in determining its influence on species patterns. The moist lowland sites have been less affected than the uplands and often act as firebreaks. Cedars do not sprout after fire kill, but may regenerate their population on a burned site depending on several factors, such as availability of seed sources, surface litter, water level and lack of hardwood competition. Also, given appropriate conditions, burned-over hardwood swamps may be replaced by cedar.

A complex of factors such as fire, soil texture, low soil moisture, and low nutrient availability account for the present types of upland forests in the Pinelands. The role of fire is controversial. Some believe that the present patterns of oak-pine, pine-oak, and pine plains vegetation represent various stages of succession that would lead ultimately to a mixed-oak forest if fire were eliminated. Another interpretation assumes that present plant patterns reflect a long history of evolutionary adaptation to both frequent fire disturbance and sandy soils low in nutrients and moisture. Under the latter assumption, the pine plains, an extreme form of a fire-adapted pine-oak association, may not revert for a long time to a pine-oak forest.

Natural factors other than fire disturbance have changed patterns of plant and animal distribution in the Pinelands. Habitat changes occur from disturbances such as wind throw, which may create openings in forests to be filled by sequential stages of successional vegetation. Natural or animal-caused changes in drainage patterns can convert uplands to lowlands or the reverse. Indians may have altered the natural relative abundance of animal and plant populations through hunting and other types of activities, but these actions left a small imprint as compared with those that followed the European colonization of the Pinelands.

From European Colonization to the Present

Though the patterns of species composition were established in the Pinelands through natural processes, the landscape of the Pinelands has been altered over the last 300 years by a wide variety of human actions. Some of these actions have caused such great modifications in particular habitats that changes in relative species abundance and distribution have occurred. Many of the human influences have resulted in a reduction in the Pinelands' habitat and species diversity. A few have added to the existing variety of habitats and species.

Whether fire became more or less frequent and more or less severe after European settlement cannot be determined. Early settlers intentionally set fires to clear land. Others were accidentally ignited. As recreational use of the Pinelands increased through the years, so did the occurrence of accidental fire. On the other side, interest in protection of human life and man-made structures brought improvements in fire control efforts over the years.

Both upland and lowland forests of the Pinelands were subject to extensive timbering up through

the mid-nineteenth century when the demand for fuelwood and charcoal decreased. Coal replaced wood as a source of fuel, and the Pinelands' iron industry, the primary user of charcoal, faded out as Pennsylvania ore proved more economical. It is estimated that prior to this time, upland stands convenient to water transportation were clear cut every 25 years, and less accessible forests were probably lumbered every 40 years. From the time of early colonial settlement, cedar has been in great demand for lumber and posts. It has been estimated that by 1980, most cedar swamps had been clear cut five to seven times. There has been continued cutting of pine through the years for sawmills, piling, poles and pulpwood. It appears that while thinning or partial cutting may favor the development of oaks, clear-cutting favors pine. This is important in continuing the pine-dominated composition in the Pinelands. On the other hand, cedar swamps have decreased, and those that remain do not contain the large-sized trees described in journals of early visitors to the Pinelands. Clear-cutting can favor regeneration of cedars if seed sources and other factors are favorable. But because cedars are shade-intolerant, thinning or partial harvesting of the overstory has favored the replacement of cedars by hardwoods.

The use of land for housing developments, industry, and highways, obliterates specific habitats and natural communities. The result has significant implications for the Pinelands. The reduction in natural ecosystems means that the relative abundance of habitats and species patterns is altered. On the species level, the result has been the extirpation of some species with others being classified as endangered or threatened.

Recently, attention has focused on perhaps the most important effect of landscape fragmentation in the Pinelands: the creation of discontinuities in the Pinelands' natural vegetation that make dispersal barriers for flora and fauna. Larger contiguous patches of habitat can support more species with a much lower probability of extinction and facilitate the maintenance of genetic variability.

In ways other than those already described, man's actions in the last 300 years have modified the Pinelands landscape and the natural habitats and have resulted in changed species patterns. As examples, draining of lowlands has decreased directly the amount of wetland vegetation. Pollutants such as agricultural fertilizers, pesticides, herbicides, and organic and inorganic wastes, entering streams directly or seeping through the soils to groundwater and then to stream waters, have caused nutrient and pH changes that change the native floral and faunal species composition. Intensive recreation and use of off-road vehicles have compacted soils in some areas to the extent that native species cannot regenerate.

In some instances, modification of the landscape by humans has led to increased ecological diversity. Abandoned farmland will pass through a series of successional stages of vegetation types before reverting to forest. Edges of highways controlled by mowing also exhibit successional vegetation. Abandoned cranberry bogs and former bog iron, sand, and gravel mining areas have produced ponds, bogs, or swamp habitats. As in cut-over cedar swamps, unusual species of plants often are found in these modified environments.

Man has disturbed the natural predator-prey and plant-herbivore relationships that evolved in the Pinelands without human interference. As a new predator in the environment, the human hunter has eliminated certain species of the Pinelands fauna, such as the black bear, wolf, heath hen, and native turkey. The beaver was also eliminated, but efforts to repopulate it have been successful, and turkeys have been released recently. In addition, zealous plant and animal collectors including commercial dealers have reduced native populations of particular native species. Herbicides, insecticides, and other forms of artificial pest control have also changed natural ecosystem relationships.

Summary of Human Influences

Several observations can be made about the overall impact that humans have had on the Pinelands in the last 300 years. On the one hand, the degree of recovery from three centuries of cutting and burning of Pinelands forests is surprising. With a few exceptions, such as reduction in the areal extent of cedar swamps, the patterns of species distribution may be little different today than they were thousands of years ago. On the other hand, it is fortunate for the Pinelands landscape that more fertile land for agriculture existed around it in adequate supply, that the Pinelands were not located in the direct corridor of transit between New York and Philadelphia, and that mass transportation improvements still have not brought the area within easy commuting distance to either point.

The explosive population growth that occurred in New Jersey starting in 1850 and continuing to the present did not press on the Pinelands until the last two decades. In just that short time, viewed in the scale of the 10,000-year development of modern flora and fauna, a number of modifications have been made in the natural landscape. But despite past human actions, the Pinelands exist today as a unique and self-maintaining ecosystem. As such, they reflect the results of complex interlocking relationships between biological organisms and particular habitat conditions that have evolved over thousands of years.

CHAPTER TWO

Natural Resources of the Pinelands

The physical or abiotic features of the landscape—relief, soils, hydrology, and climate—distinguish the habitats in which characteristic Pinelands plants and animals live. This chapter is an assessment of these physical resources and the biological communities they support.

GEOLOGY

The Pinelands lie in the Atlantic Coastal Plain geologic formation, which has been formed over the last 170-200 million years as a result of deposition and erosion. The history and geologic characteristics of the Atlantic Coastal Plain have been described by Rhodehamel (1979). It is characterized by gently rolling terrain—sandy, droughty soils with no rock outcrops, steep slopes, or mountain peaks. In general, it is comprised of a wedged-shaped series of unconsolidated layers of sands, clays and marls on a gently southeastward dipping bedrock (80 to 100 feet per mile) which is 1,300 to 6,000 feet below the surface. These layers extend seaward into the submerged Continental Shelf.

The surficial geology of the Pinelands area is shown in Plate 2, and its geologic stratigraphy is shown in Plate 3. The lowest geologic beds originate from continental deposits (Lower Cretaceous Age). These are overlain by deposits of both continental and marine origin (Upper Cretaceous Age) dating from 136-65 million years before present (MYBP). Specific formations within this group are, oldest to youngest: the Potomac, Raritan and Magothy, Merchantville, Woodbury, Englishtown, Wenonah and Mount Laurel, and the Red Bank Sand.

During the next period, the Tertiary Age (65-1.8 MYBP), the sea covered the Atlantic Coastal Plain several times. After depositing the Cohansey Sand, the sea regressed for the last time and the present topography began to form, about 5 MYBP. The Beacon Hill Gravel was deposited over the Cohansey in the northern and central portions of the Coastal Plain. Composed of quartzose and cherty sand and gravel, the Beacon Hill Gravel appears to result from extensive stream channel development, perhaps an ancient Hudson River. The strata of the Tertiary Age are, oldest to youngest, the Hornerstown Sand, Vincentown and Manasquan Formations, Kirkwood Formation, Cohansey Sand, and Beacon Hill Gravel. The Bridgeton and Pennsauken Formations in the southwest portion of the Pinelands are also thought to be Tertiary deposits. They appear fluvial in origin.

Overlying the Tertiary deposits are those which were laid down during the Pleistocene (Wisconsin) glaciation (1.8 MYBP) and the Holocene period (0.01 MYBP). The Cape May Formation deposited during this time extends from sea level to 30 to 50 feet above sea level and is considered to be of marine origin. The Holocene deposits, alluvial and eolian in origin, appear to be a redeposition of the older deposits. Table 2.1 lists the strata of the Tertiary and the Quaternary periods which are ecologically important in the Pinelands and as sources of potable water.

The following is a discussion of all the significant strata in the Pinelands, beginning with the oldest:

Potomac Group and the Raritan-Magothy Formations

The Potomac Group and Raritan-Magothy Formations which lie on the bedrock are the oldest, thickest, and most extensive units known to occur throughout the entire Pinelands portion of the At-

Table 2.1—Upper Strata of the New Jersey Coastal Plain

Time and Age	Formation	Lithology	Thickness (ft)
Quaternary			
Holocene (0.01 MYBP*)	Undifferentiated deposits in stream channels, marshes, estuaries and bays.	Clay, silt, sand, bog iron and peat	0-10
Pleistocene (1.8 MYBP)	Quartz sand deposits (Valley Terrace phase of Cape May Formation)	Clay, silt, sand, and gravel	0-122
Tertiary			
Pliocene (5 MYBP) and Miocene	Pennsauken Formation	Gravel, sand, and silt—some sand beds are hardened with iron oxide	0-20
	Bridgeton Formation and Beacon Hill Gravel		0-69
			Sand and gravel usually 10
Miocene (22.5 MYBP)	Cohansey Sand	Sand with gravel, silt and clay	26-201
	Kirkwood Formation	Clay, silt, sand and gravel	50-452

* Million years before present.

Source: Adapted from Rhodehamel (1979).

Atlantic Coastal Plain. These interrelated units consist of alternating layers of clay, silt, sand, and gravel. They range in combined thickness from a feather edge along their outcrop adjacent to the Delaware River to over 3,000 feet in the Atlantic City area. The top of the Magothy dips uniformly to the southeast at about 45 feet per mile, and in eastern Atlantic County is found over 2,000 feet below sea level. These beds are overlain by the Merchantville Clay and the Woodbury Formation, which together form a thick and extensive confining unit throughout much of the Pinelands.

The Potomac Group and Raritan Formation are believed to be continental in origin, although marine fossils have been found in the Raritan. The Magothy is believed to be both marine and non-marine in origin.

Englishtown Formation

This formation overlies the Merchantville Clay and Woodbury Formation and is, in turn, overlain by a thin confining layer, the Marshalltown Formation. The outcrop of the Englishtown Formation ranges in thickness from 140 feet near Raritan Bay to 50 feet at Trenton. Downdip thicknesses reach more than 200 feet in the Toms River area. This formation dips uniformly to the southeast at a rate of 40 feet per mile and is 1,000 feet below sea level in southern Burlington County. The Englishtown Formation is believed to have originated from both marine and non-marine environments.

In Monmouth County, the northern half of Ocean County and the northeast corner of Burlington County, this aquifer is from 40 to 140 feet thick. In the southern third of Ocean, Burlington and Camden Counties, the sand component of the Englishtown is not found, and the unit is comprised of silt and clay. Although sufficient well data is not available to map the Englishtown Formation in the remaining portions of the Pinelands, it appears that the aquifer is absent.

Wenonah Formation and Mount Laurel Sand

The Wenonah Formation and Mount Laurel Sand function hydraulically as one, with the latter unit predominating. They overlie the Marshalltown aquitard (a layer which inhibits the free movement of water), and are overlain by the Navesink Formation, generally an aquitard.

The unit outcrops from Raritan Bay southwestward to Delaware Bay and reaches a thickness of over 200 feet in the subsurface. The upper surface of the Mount Laurel Sand dips about 40 feet per mile

to the southeast. It ranges in elevation from over 100 feet above sea level in its outcrop in the northern end of the Coastal Plain to over 1,200 feet below sea level below the barrier beach in northeast Ocean County. This unit is believed to underlie the entire Pinelands area.

Kirkwood Formation

The Kirkwood Formation overlaps several formations, including the Piney Point, Marshalltown, Hornerstown, and Navesink, depending on location. It is overlain by the Cohansey Sand. The top of the Kirkwood ranges in elevation from over 100 feet above sea level in its outcrop area to over 300 feet below sea level along the eastern edge of Cape May Peninsula. It has an irregular surface. The formation is between 50 and 100 feet thick in its outcrop and thickens to over 800 feet in the Atlantic City area.

The Kirkwood has variable lithology both along its outcrop and downdip. The outcrop, shown in Figure 2.1, consists of a lower component that is a very fine, dark, micaceous sand with a pebbly glauconitic basal layer two to four feet thick, and an upper component of silt and clay.

Under the coast in Cape May County, five distinct members have been recognized in the Kirkwood. These are, oldest to youngest: a tough, brown basal clay; the lower aquifer, a gray, medium to coarse sand (Atlantic City 800-foot sand); a blue, silty diatomaceous clay; the upper aquifer, a medium to coarse sand (Rio Grande zone); and a blue diatomaceous clay.

The lithology of the formation along the downdip appears to remain fairly consistent, with the sand component generally varying between 50 and 100 feet and showing no progressive thinning away from the outcrop. The sand attains its greatest thickness in central Camden, Gloucester, and Salem Counties, where it is more than 115 feet thick.

Cohansey Sand

The Cohansey overlies the Kirkwood Formation. It either outcrops at the surface or is overlain by a thin veneer of Pleistocene deposits, except in Cape May County and along the eastern coast, where these deposits may have a thickness of 200 feet. The areal extent of the Cohansey outcrop is 2,350 square miles, southeast of the Kirkwood outcrop. The occurrence of outliers within the Kirkwood outcrop indicates that the Cohansey was more extensive at one time. The combined thickness of the Cohansey and overlying Pleistocene deposits range from less than 20 feet to more than 300 feet, as shown in Figure 2.2.

The Cohansey Sand typically consists of fine to coarse grained quartzose sand with lenses of gravel that are usually one foot thick or less. In most areas, overall clay content is less than 20 percent. Lenses of white, yellow, red, and light gray clay occur generally in the upper part of the formation and may be as much as 25 feet thick. The sand is predominantly yellow (limonite staining), but shades of white, red, brown, and gray also occur. Parallel bedding and cross-stratification are present in the sand.

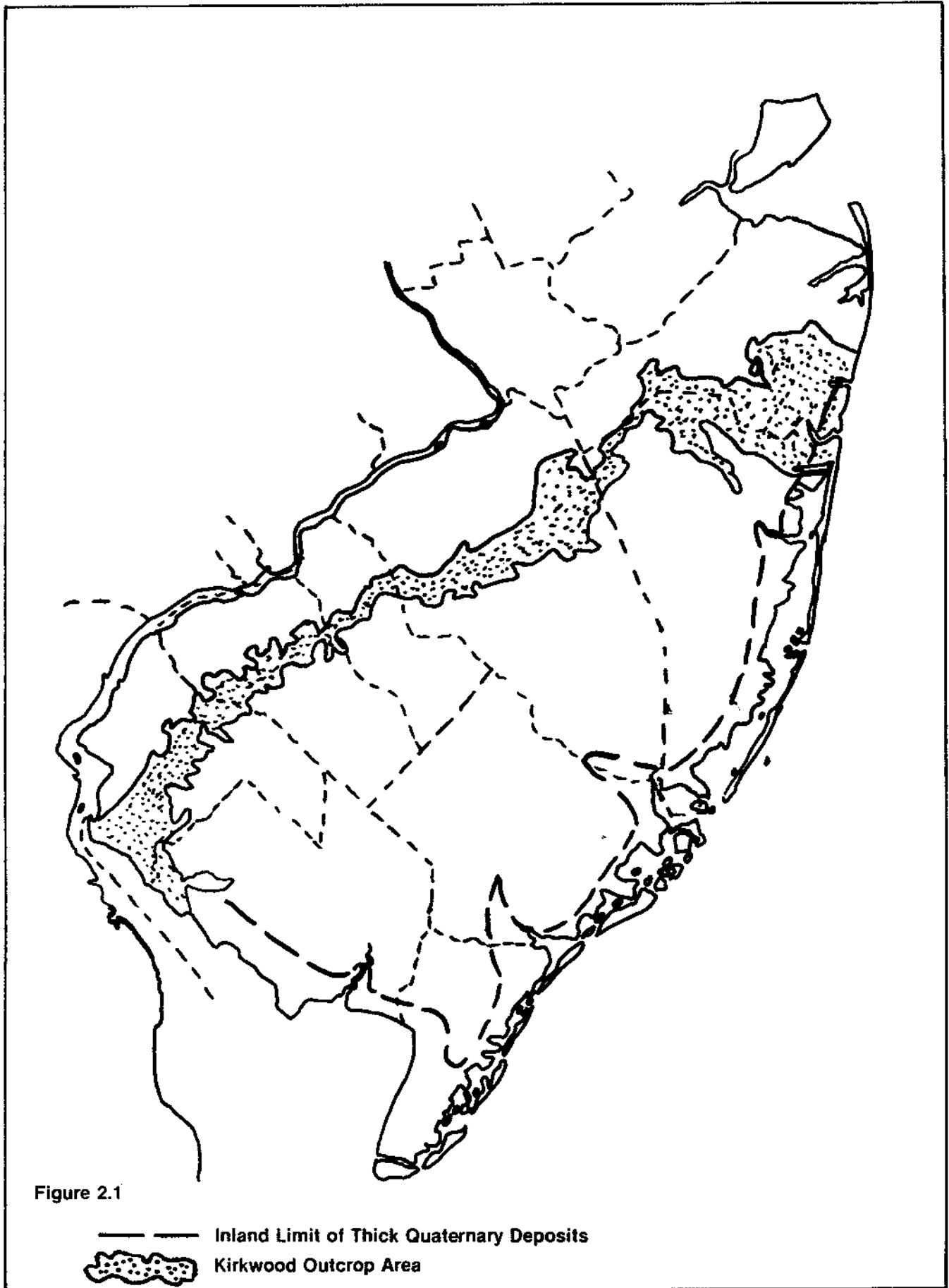
The Cohansey is interpreted to be a mixed or transitional environment deposit that, in overall aspect, is a partly dissected ancient subdelta plain. This is because the Cohansey has deposits which have been identified as stream, fluvial plain, deltaic, estuarine, lagoonal, beach, and nearshore marine in origin.

The Beacon Hill Gravel overlies the Cohansey. Chert, quartzose gravel, and ilmenite are present in both the Cohansey and Beacon Hill. The coarseness of the gravel, however, suggest a shorter mode of deposition, dominated by stream transport to a fluvial environment.

In Monmouth County, the Beacon Hill can be 20 feet thick, but prolonged erosion during and since the Pliocene time has thinned and removed the formation from wide areas. Deposits identifiable as Beacon Hill Gravel are now restricted to small scattered remnants at the highest altitudes in the Atlantic Coastal Plain. It forms the summit of Apple Pie Hill and the summits of two lines of prominent hills along the boundary of the Mullica River Basin east and southeast of Woodmansie in Burlington County.

Quaternary Deposits

These deposits form a discontinuous veneer lying above the Cohansey throughout much of the Pinelands. They are, from oldest to youngest, the Bridgeton, Pennsauken and Cape May Formations.



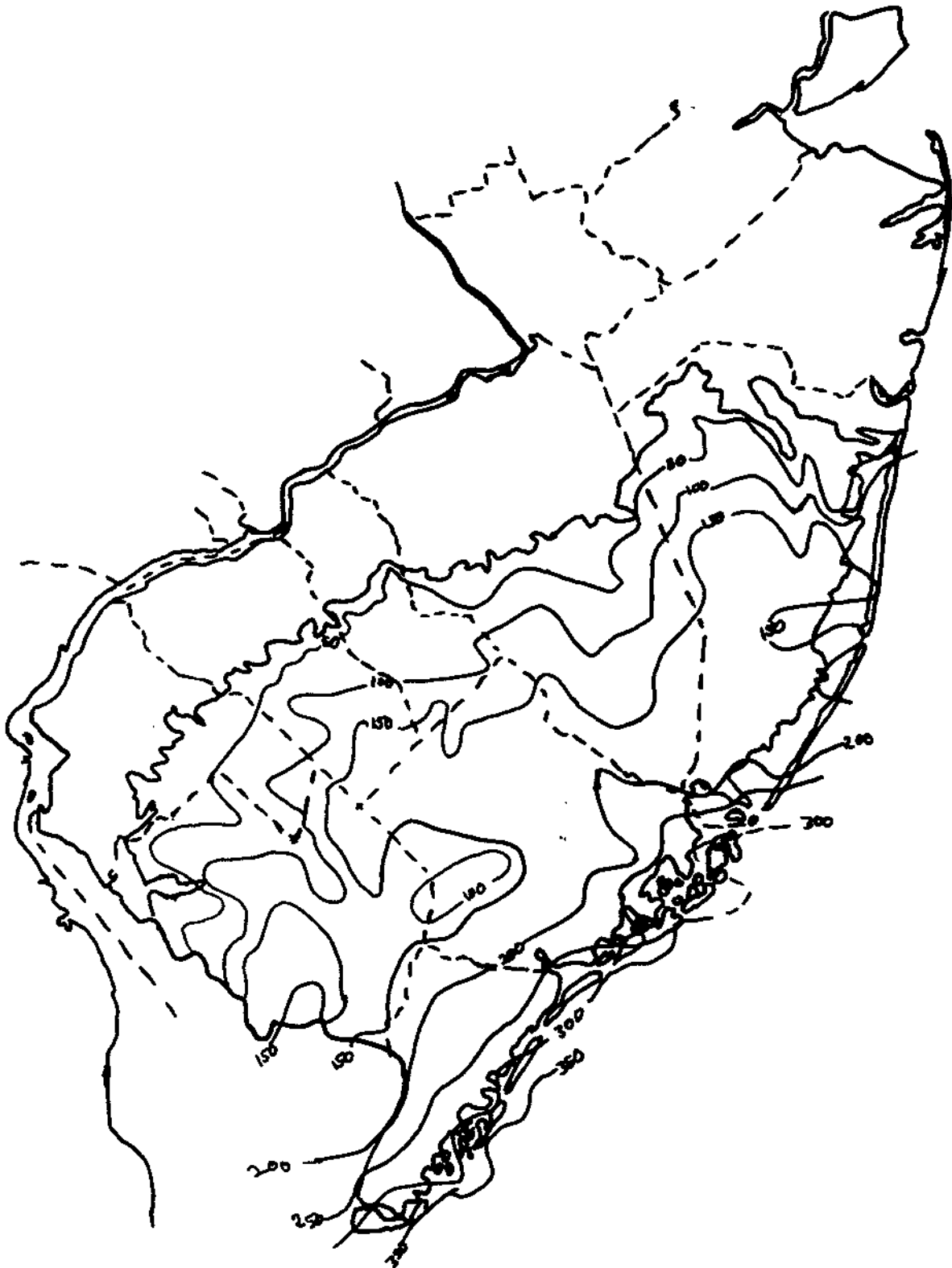


Figure 2.2—Thickness of Cohansey Sand and Overlying Quaternary Deposits

The Bridgeton and Pennsauken deposits are generally derived from erosion and redeposition of the Cohansey Sand and Beacon Hill Gravel. They cap the tops and mantle the upper slopes of most of the pronounced hills and narrow ridges, and can be as much as 20 feet thick.

The Cape May Formation in Cape May County contains four lithologic components deposited in three environments—estuarine, marine and deltaic. Elsewhere, the thickness of this formation is 85 feet near Batsto, 112 feet at Sweetwater, and 229 feet at Atlantic City.

The most important hydrologic function of the Cape May deposits is their ability to absorb precipitation and transmit water to underlying aquifers. Because hydraulic continuity with the underlying Cohansey is excellent, they can be considered a part of the Cohansey Sand—upper Kirkwood aquifer system, although this has been debated.

The particular characteristics of the Pinelands geology—low relief with sandy, droughty soil, underlain with a number of water-bearing sand layers alternating with confining clay layers—give rise to a unique and fragile surface and groundwater system. In essence, precipitation is rapidly absorbed by the droughty sand, percolates through the soil to the relatively shallow water table, and in turn supports the region's stream flow as groundwater seepage. The following section discusses the hydrogeologic characteristics of the strata underlying the Pinelands, the existing groundwater quality, and sources of degradation.

HYDROGEOLOGY

The most important abiotic element of the Pinelands ecosystem is water, considering its availability and characteristic chemistry. Water is stored in the extensive sand aquifers below the surface. This ground water supports 89 percent of the flow in the Pinelands streams, discharging primarily through the swamps and marshes. It is replenished solely by precipitation, of which about 44 percent of the annual total percolates through the sandy soil surface.

Although highly permeable, the uppermost soil tends to be chemically inert with a low adsorptive capacity. It is therefore incapable of filtering out wastes. In addition, the waters are susceptible to various forms of pollution because they are weakly buffered against chemical change. Groundwater contamination in the Pinelands is a significant threat.

Numerous aquifer systems, aquifers, and sub-aquifers occur throughout the New Jersey Coastal Plain (See Plate 3). Only five, however, can be considered regional in nature and capable of producing substantial quantities of water. They are described here from oldest to youngest.

Potomac-Raritan-Magothy Aquifer System

The sand strata within these formations are believed to be hydraulically connected, making them function as an aquifer system. At present, the system is not important for water supply in the Pinelands area. But development in Camden, Burlington, and Gloucester Counties makes it an important aquifer in southern New Jersey.

The recharge area is located adjacent to the Delaware River and is heavily developed and industrialized. Contaminants can enter the system here and move down and across to affect wells throughout the aquifer. This system is isolated from overlying aquifers by clay lenses, which inhibit the vertical transport of contaminants between aquifers under the normal hydraulic gradients. Reversing the gradients by pumping in the outcrop could encourage recharge by vertical leakage. Also, wells drilled through the confining units without proper sealing can provide direct hydrologic links between aquifers without benefit of the filtering capacity of the confining units.

Tests of this aquifer system indicate permeabilities on the order of 1,000 to 1,500 gpd/ft² (gallons per day per square foot). Transmissivity, a measure of the aquifer's ability to transmit water, is the product of the permeability and aquifer thickness. Expressed in gallons per day per foot (gpd/ft), the transmissivity of this system ranged from 17,000 to 50,000 gpd/ft in Camden County, 46,600 to 513,000 gpd/ft in Burlington County, and 30,000 to 68,000 gpd/ft in Gloucester County. An average specific capacity of 29.3 gpm/ft (gallons per minute per foot of drawdown) was observed in 96 wells in Camden County.

Under the Pinelands, the Raritan-Magothy material may be finer grained with lower permeabilities than in the outcrop. However, similar values of transmissivity should be expected because the aquifer thickens along its downward slope. Data from pumping and drilling wells indicate the presence of three water-bearing aquifers in this system, with the upper two connected and hydraulically separate from the lower one.

In 1976, pumpage from the system was estimated at 240 mgd (million gallons per day). Withdrawals were primarily located either in the outcrop or a short distance down-dip. Other discharges from this system include: base flow to streams in the outcrop area, vertical leakage to lower aquifers, and submarine underflow which maintains the offshore fresh/salt water interface.

Recharge occurs from precipitation on the outcrop area (estimated at 320 mgd), induced infiltration from surface water (the Delaware River with an average flow of 7,500 mgd at Trenton), vertical leakage from overlying aquifers, and water released from storage in the confining strata.

The aquifer system is capable of supporting additional large volume withdrawals. However, to maximize these supplies, withdrawal points should be spread out in relatively undeveloped portions of the aquifer rather than concentrated as they presently are. In the long run, quality, not quantity, may be the factor limiting use of this system because of the highly developed and industrial nature of land use in the recharge area.

Englishtown Formation

In most of the Pinelands region, the Englishtown Formation is considered a confining bed rather than an aquifer. Elsewhere, in Monmouth, northern Ocean, northeast Burlington, Camden, and extreme southeast Middlesex Counties, the Englishtown functions as an aquifer, exhibiting moderate to low permeability. The average specific capacity for 119 wells in the northern Coastal Plain was 2.9 gpm/ft of drawdown. This formation cannot be expected to produce additional water supplies in the Pinelands area as its lithology changes to a confining unit.

Wenonah Formation and Mount Laurel Sand

This system is a minor one in the Pinelands area, with withdrawals in 1976 averaging about 3 mgd. Recharge in the outcrop area is about 130 mgd. The aquifer has generally low values of transmissivity. The average specific capacity is 4.2 gpm/ft of drawdown for 33 wells in the northern portion of the Coastal Plain. The average permeability value of 97 gpd/ft² is also low for the Pinelands aquifers. Water supply in the Pinelands area should not be developed from this aquifer. Development which does occur should be in the outcrop area or a short distance away in order to fully utilize available recharge.

Kirkwood Formation

The Kirkwood Formation is the most highly developed aquifer along the shore and barrier beaches of Atlantic, Cape May, and Ocean Counties. In 1976, withdrawals approached 25 mgd. Development of the Kirkwood occurs along the coast because the shallower Cohansey is more vulnerable to salt water intrusion.

In the central Pinelands, the Kirkwood contains fewer and less permeable water-bearing sands. Away from Atlantic City, the formation thins, and the water-bearing sands change from clean medium to coarse-grained to clayey and silty fine-grained. Permeabilities near Atlantic City have been estimated at 810 to 1,140 gpd/ft², whereas permeabilities in central Cape May County are around 300 gpd/ft², and in Seaside Park around 200 gpd/ft².

The Kirkwood Formation aquifers are recharged from precipitation (150 to 200 mgd within the 165 square-mile outcrop area), vertical leakage from the overlying Cohansey, and release of water stored in the clay layers above, beneath, and within the formation. The quantity of available water and the permeability of the formation makes it an important aquifer in the coastal area. One significant observation regards the cone of depression (a water table profile resulting from withdrawals) in Atlantic and Cape May Counties. The 1934 and 1970 profiles were similar, although public water supply pumpage had increased 300 percent. Apparently, they have remained unchanged since 1970 (Geraghty & Miller, Inc., 1980). The spreading and shifting pattern of increased pumpage during this time is the primary reason. This indicates a potential greater than 25 mgd (the 1976 pumpage level), provided that the additional wells are spread out. Wide distribution of the wells would reduce drawdown interferences, and

their location towards the outcrop would enable use of a significant portion of the 150 to 200 mgd available recharge. To maintain adequate stream flows, only 85 to 115 mgd of this recharge could be developed. Ultimately, the extent of pumpage may be controlled by the movement of the fresh/salt water interface which lies some distance off-shore rather than by the available supply of freshwater. Observation wells would be necessary to monitor chloride concentrations as water supply development proceeded and the interface moved inland.

Cohansey Sand

Based upon its extensive storage capacity (estimated by Rhodehamel in 1973 to be as much as 17 trillion gallons), a high permeability (660 to 1885 gpd/ft²), and availability of direct recharge (2,350 square mile outcrop area); the Cohansey Sand is the most important fresh water aquifer in the New Jersey Coastal Plain. Throughout the area, the Cohansey is partially covered by a thin veneer of Pleistocene materials which are generally quite permeable and hydraulically connected. Areas in Cape May are an exception, where the thick overlying deposits may be separated from the aquifer by a thin confining unit. In some areas, especially Cumberland County, the uppermost part of the Kirkwood Formation is connected hydraulically to the Cohansey and forms part of the aquifer.

The volume of water in the Cohansey usually controls the water table level. However, well logs and stratigraphy tests have indicated the existence of two clay beds at relatively shallow depths which may have local influence on the water table. These are found in the southern portion of the Pinelands (see Plate 4). The shallower, a white, tan, or yellow clay, lies 10 to 40 feet below the land surface and ranges in thickness from 10 to 50 feet. The deeper clay unit is blue or gray clay which lies 50 to 115 feet below land surface and is 10 to 75 feet thick. The two units are found adjacent to each other and overlap only in a few small areas. They are important in that they restrict deep aquifer contamination by interrupting vertical movement.

The water table in the Cohansey is typically shallow, generally less than 10 feet below the surface over much of the area (Plate 4). Its fluctuations in response to discharge and recharge rarely exceed 7 feet. Between 1959 and 1967 a Lebanon State Forest well showed an annual water table fluctuation of 2.5 to 3 feet with a maximum of 5 feet.

Although the Cohansey stores a large volume of water, developing it for water supply without recharge would lower the water table. Since most of the Pinelands' unique flora are adapted to a wetlands environment, lowering the water table could disrupt this entire ecosystem. In addition, the cranberry industry, which relies on large volumes of water, would be placed in jeopardy, and the frequency of fire would be greatly increased.

Hydraulic Regime

The fresh groundwater in the unconsolidated formations of the Pinelands is derived solely from precipitation over the outcrop areas. Rainfall lost to evapotranspiration has been estimated at 50 percent. An additional 11 percent is lost as overland flow, leaving 39 percent for recharge (Betz, Converse & Murdoch, Inc., 1980). Since rainfall averages 45 inches per year in the Pinelands, about 20 inches per year (0.95 mgd per square mile) is available to recharge the groundwater reservoir. This amounts to 1,580 mgd over the Pinelands' 1,660 square mile area and 2,230 mgd over the entire Cohansey outcrop.

Excess groundwater discharges through the swamps and bogs to support 89 percent of the stream flow in the Pinelands. Typically, the average annual Pinelands stream discharges (volume per unit area) are low. Flow rates throughout the year tend to be uniform and peak discharges from storms are low. Rainfall is absorbed by the porous soil, held in storage in the large groundwater reservoirs, and gradually released throughout the year. Precipitation elsewhere in New Jersey is typically discharged directly as stream flows, with peak flows and seasonal changes closely reflecting.

The hydraulic flows of the Cohansey-Kirkwood aquifer system are conceptually diagrammed in Figure 2.3. Only the shallow and intermediate circulation patterns are depicted. The shallow, local flow paths are short, since no point in the Pinelands is more than 1.5 miles from a surface water body. Under average conditions and hydraulic gradients, the water flow rate is about 4 feet per day. Water detention time, then, in the shallow flow system would be five years at most. Approximately 85 percent of the infiltrated precipitation follows this shallow flow route.

The intermediate flow system, which receives 10 percent of the infiltrating precipitation, occurs at depths of about 50 to 300 feet below sea level. This flow path is towards the Batsto River and Atlantic Ocean. Travel time from the central Pinelands to the Atlantic is about 2,000 years.

There is also a deep groundwater flow system that is not depicted in Figure 2.3. This system involves vertical leakage between aquifers into the Raritan-Magothy. Although data from deep wells is extremely limited, a first approximation of the hydraulic gradients and the deep flow system can be suggested. A regional cone of depression has developed in the Raritan-Magothy along the Delaware River due to extensive pumping in the outcrop. This cone extends below the Pinelands area. As a result, hydraulic gradients in the Raritan-Magothy along the Delaware, relative to sea level, are lower (-80 feet), than in the central Pinelands (-27 feet) and at Island Beach (-2 feet). These values indicate that deep groundwater movement in the Raritan-Magothy Formation beneath the central Pinelands is northwestward towards the center of the cone of depression. In addition, greater hydraulic heads in the aquifers overlying the Raritan-Magothy encourage vertical leakage, thereby influencing groundwater movement in the entire saturated zone from the water table down to the bedrock.

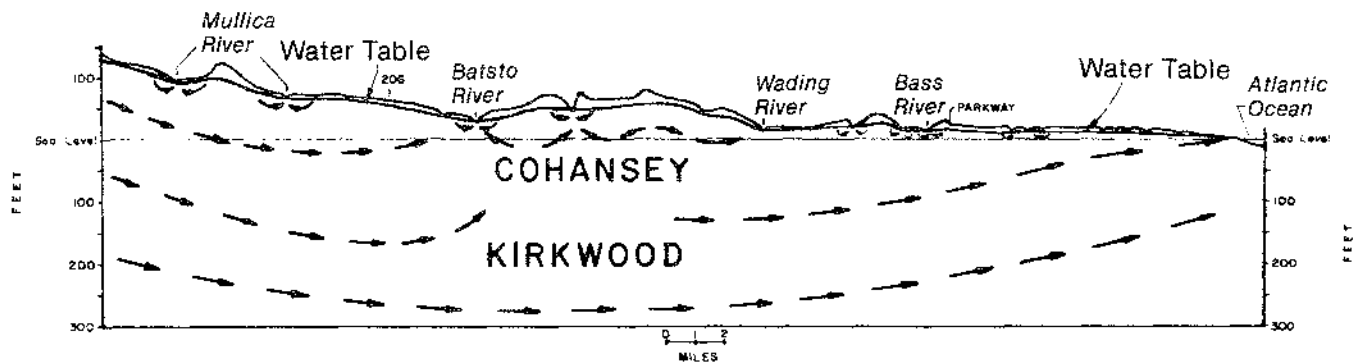


Figure 2.3—Hydraulic Flows of the Cohansey-Kirkwood Aquifer System

Withdrawals from the aquifers underlying the Pinelands can affect the characteristic ecosystem by lowering the water table. As seen in the discussion of flow patterns, all the aquifers are interrelated. Withdrawal from the Cohansey is most critical because the surface aquatic systems would be directly and immediately affected. In a study of the Mullica River basin, a joint group of biologists and engineers (Granstrom, Nieswand, and Ahmed, 1973, and Durand, Granstrom, and Rudolph, 1974) suggested 118 mgd as the maximum amount of water that could be withdrawn through conjunctive use of surface and gound waters without altering salinity regimes in the Mullica estuary. Extrapolation of these results to the Pinelands Area indicate that 400 to 900 mgd could be developed from the Cohansey without affecting the estuarine communities. The qualitative aspects of the water supply, however, may well be the limiting factor for future development. Since the soil surface provides little or no filtration or renovation of wastes moving through it, groundwater chemistry is easily changed.

Groundwater Quality

Precipitation that recharges the Pinelands' groundwater supply percolates through the forest litter and enters a porous groundwater reservoir that is chemically inert. The underground water is generally low in dissolved solids (25 to 50 milligrams per liter, mg/l). Due to this low concentration, it is weakly buffered against chemical change. Hardness is also low, less than 40 mg/l. Nitrate concentrations are low in the central area with values less than 0.1 mg/l.

Dissolved iron content, however, is often higher than the Environmental Protection Agency drinking water standard of 0.3 mg/l. As the rainwater percolates through the forest litter, dissolved carbon dioxide (CO₂) is picked up from biological decomposition. Reacting with the water, the CO₂ is converted to carbonic acid which gives the groundwater its typical acidic character; 4.5 to 5.0 are common pH values. Being acidic and having low dissolved solids, the groundwater is corrosive, and readily dissolves iron from decaying vegetation as well as from soil and sediment minerals. Bog iron, common in the Pinelands, is a result of the oxidation and precipitation of the dissolved iron when the water is exposed to the air through seepage.

Water quality has been determined for samples from a limited number of wells in the Mullica River basin. A summary of four selected parameters follows:

Parameter	Cohansey 65 Wells		Kirkwood 38 Wells	
	Range	Median	Range	Median
pH	3.8 — 7.9	4.8	4.2 — 9.3	6.2
Total Iron (mg/l)	0 — 10.5	0.05	0 — 23	0.7
Total Dissolved Solids (mg/l)	6 — 155	25.0	14 — 175	77.0
Nitrate (mg/l)	0 — 37	0.3	0 — 13	0.2

The pH values appear higher in the Kirkwood Formation. This may be attributed to a loss of carbon dioxide and oxygen as the ground water passes into the deeper aquifer. The longer residence time allows for chemical reactions which alter the carbon dioxide-bicarbonate buffering system and shift the pH to slightly alkaline.

Iron and dissolved solids are very low under the central Pinelands. Iron tends to rise above the drinking water standard towards the south and southeast. Dissolved solids also have a tendency to increase to the south and southeast as the fresh water/salt water interface is approached. Groundwater nitrate levels are likewise very low in undisturbed areas. Anomalous values of 10, 20, and 30 mg/l have been observed in Winslow Township, Camden County, probably reflecting either agricultural or waste disposal activities.

Groundwater Contamination

The surface, unconsolidated sands of the Pinelands hold a vast quantity of clean water. However, based on the experiences of other areas with similar hydrogeologic characteristics, such as Long Island and Delaware, it can be assumed that the Cohansey and Kirkwood aquifers are highly susceptible to pollution. Significant pollution sources, actual or potential, include septic tanks, landfills, chemical spills and dumping, chemical storage leaks, industrial waste lagoons, highway de-icing, and agricultural chemicals. These sources may have immediate local impacts, and also pose a long-term, cumulative threat.

It is estimated that 180,000 people reside in unsewered areas of the Pinelands, producing 13.5 mgd of sewage and 19.8 million gallons per year of septage (septic tank pumpage). A complete discussion of the problems associated with septic effluent is presented later in this chapter in the section on soils.

Leachate from landfills is a highly mineralized liquid which typically contains chloride, iron, lead, copper, sodium, nitrate, and organic chemicals. The chemical composition depends on the material in the landfill. Some landfills are used to dispose of industrial wastes, which may contain toxic and/or carcinogenic chemicals such as cyanide, arsenic, phenols, chlorinated hydrocarbons, vinyl chloride, chromium, and lead. Leachate from landfills receiving sludge or septage may also contain pathogenic viruses and bacteria.

Spills and discharges of hazardous chemicals or other materials are caused by poor housekeeping practices at gasoline stations, commercial establishments, industrial facilities, and airports; by the illicit dumping of waste materials; and by storage failures or transportation-related accidents. Most small petroleum product spills have local water quality impacts only, although they have cumulative effects. Large chemical spills, especially of hazardous, toxic, or carcinogenic materials, have serious regional water quality impacts.

Pipelines and tanks which carry and store petroleum products and other chemicals are subject to accidental rupture, external corrosion, and structural failure from a wide variety of causes. In the Pinelands, there are 14 storage tanks which are required to have federal and/or state permits because of their size. Approximately 13.9 million gallons are stored in these facilities, and additional amounts transferred through them. If 0.5 percent of the total volume stored in these large tanks leaked annually, then some 70,000 gallons would be lost. Most of the gasoline tanks at service stations are tar-coated steel, and are

prone to corrosion. Fiberglass tanks, introduced in the early 1960's, do not corrode, but may crack under cold temperatures or excessive surface loads.

Industrial waste lagoons are constructed for the primary purpose of providing temporary storage of waste materials. If not constructed properly, considering the permeable sands of the Pinelands area, they tend to lose wastewater by infiltration into the surface aquifer, thereby creating "renewable storage." Seven industrial lagoons have been identified in the Pinelands, and three of these have been linked to contaminated wells. Wastewater impoundments which are not associated with surface water discharge or groundwater recharge as disposal techniques do not require National Pollution Discharge Elimination System permits. The New Jersey Clean Water Act of 1976 does provide for the issuing of permits for lagoons using "soak-away" disposal. However, those lagoons existing prior to the law's enactment have not come under the permit program.

The direct recharge of stormwater runoff from pollution sources like roads and parking lots have an impact on groundwater quality. Such runoff can contain high amounts of chloride, zinc, lead, asbestos, and gasoline, as well as bacteria. Preliminary results of studies of stormwater recharge on Long Island and in California have indicated elevated concentrations of contaminants in groundwater beneath unvegetated recharge basins. Utilizing stormwater runoff management as a technique to maintain groundwater levels increases the risk that these impacts may be experienced in the Pinelands.

Highway de-icing using sodium and calcium chloride is popular because it is easy, efficient, and relatively inexpensive. Sodium, calcium and chloride ions from the salt are carried into the water table by snow melt and rainfall. Uncovered stockpiles and water used to wash the spreading trucks are other sources of salt contamination.

There is increasing evidence to support an association between fertilizer use and nitrate in groundwater. Lawn fertilizers appear to be as significant a source of nitrogen as septic tank discharges. As mentioned above, instance of high groundwater nitrate levels possibly stemming from agricultural fertilization has been noted in Winslow Township. Other agricultural chemicals such as herbicides and pesticides used both by homeowners and farmers have been found in surface and groundwaters.

Further discussion of the impact of fertilizers on groundwater quality is found in the soils section. The problems of landfills, hazardous waste disposal, and industrial waste lagoons are covered in detail in Chapter Four.

SURFACE HYDROLOGY

A distinctive characteristic of the Pinelands are the surface waterways. Most of the region is drained by rather closely spaced and somewhat parallel streams flowing to barrier bays along the Atlantic Ocean or south to the Delaware Bay. The Rancocas Creek is one of the major exceptions. It flows westward from its source in the Pinelands to drain into the Delaware River.

The streams in the Pinelands are typically slow moving and shallow because of the very low topographic gradient. The unusual brown or so-called tea-colored appearance of the stream waters results from the abundance of an organic iron complex, which is derived from the oxidation of iron ions dissolved in groundwater and mixed with decomposing plant byproducts at the surface. Bog iron accumulates on stream bottoms. The waters of both streams and lakes in the Pinelands are low in hardness, alkalinity, and pH values, and most are generally high in humic complex, especially during the growing season.

The characteristic stream water quality in the Pinelands can be expressed in terms of values that describe the least disturbed waters in the area. These are as follows (Robichaud, et al., 1980):

- pH — value of less than 5.0
- Nitrate-nitrogen concentration — value of about 0.17 parts per million (seasonally higher in winter)
- Ammonia-nitrogen — value of about 0.036 parts per million
- Total phosphate — value of about 0.019 parts per million
- Saturation with dissolved oxygen — 85 percent

The fact that the groundwater aquifers and most streams in the Pinelands are still low in nutrients (or unpolluted) makes the region unusual. However, particular land use activities in localized areas are beginning to change this. The streams are extremely sensitive to pollutants from sewage or agricultural runoff and reflect the presence of these by changes in biological communities, such as the growth of algal blooms. The levels of nutrients in the streams of the Pinelands, and the water levels themselves, strongly affect the ecosystems and biological communities of the coastal estuaries.

Basins

The surface hydrology analysis provided by Betz, Converse & Murdoch, Inc. for the Pinelands planning effort was conducted by drainage basin. The basins and sub-basins are listed in Table 2.2 and are shown in Plate 5.

Table 2.2—Pinelands Drainage Basins

Basin	Sub-Basin
1. Toms River ¹	1.1 Toms River
2. Rancocas Creek ²	2.1 Rancocas North Branch
	2.2 Rancocas South Branch
3. Cedar Creek ²	3.1 Cedar Creek
4. Forked River ³	4.1 Forked River
	4.2 Oyster Creek
	4.3 Mill Creek
	4.4 Westecunk Creek
5. Mullica River ²	5.1 Bass River
	5.2 Wading River
	5.3 Batsto River
	5.4 Atsion-Mechesactauxin Creek (Atsion-Sleeper)
	5.5 Nescochague Creek
	5.6 Hammonton Creek
	5.7 Mullica River
6. Great Egg Harbor River ^{1,2}	6.1 Great Egg Harbor (Upper)
	6.2 Great Egg Harbor (Lower)
7. Maurice River ¹	7.1 Manumuskin River
	7.2 Lower Maurice River
8. Absecon Creek ⁴	8.1 Absecon Creek
9. Tuckahoe River ³	9.1 Tuckahoe River
10. Dennis Creek ³	10.1 Dennis Creek
11. Patcong Creek ⁴	11.1 Patcong Creek

Footnotes

1. Headwaters or portion thereof not included in Pinelands National Reserve.
2. Outlet or portion thereof not included in Pinelands National Reserve.
3. Entire basin within Pinelands National Reserve.
4. Basin outside National Reserve but within Pinelands Protection Area.

Hydrologic Budget

The term “hydrologic cycle” denotes the general circulation of water in its various states (liquid, solid, or gaseous) from ocean to atmosphere, from the atmosphere over and through the ground, and back to the ocean again. Quantification of the components of the hydrologic cycle is carried out by developing a drainage basin hydrologic budget. The parameters of the hydrologic cycle — precipitation, evaporation, transpiration, infiltration, and runoff — are balanced until all of the water entering and

leaving the watershed is accounted for. The budget of any drainage basin may be represented by the equation:

$$P = R + ET \pm \Delta \text{ SMS} \pm \Delta \text{ GWS} \pm \Delta \text{ DS} \pm \text{GWF}$$

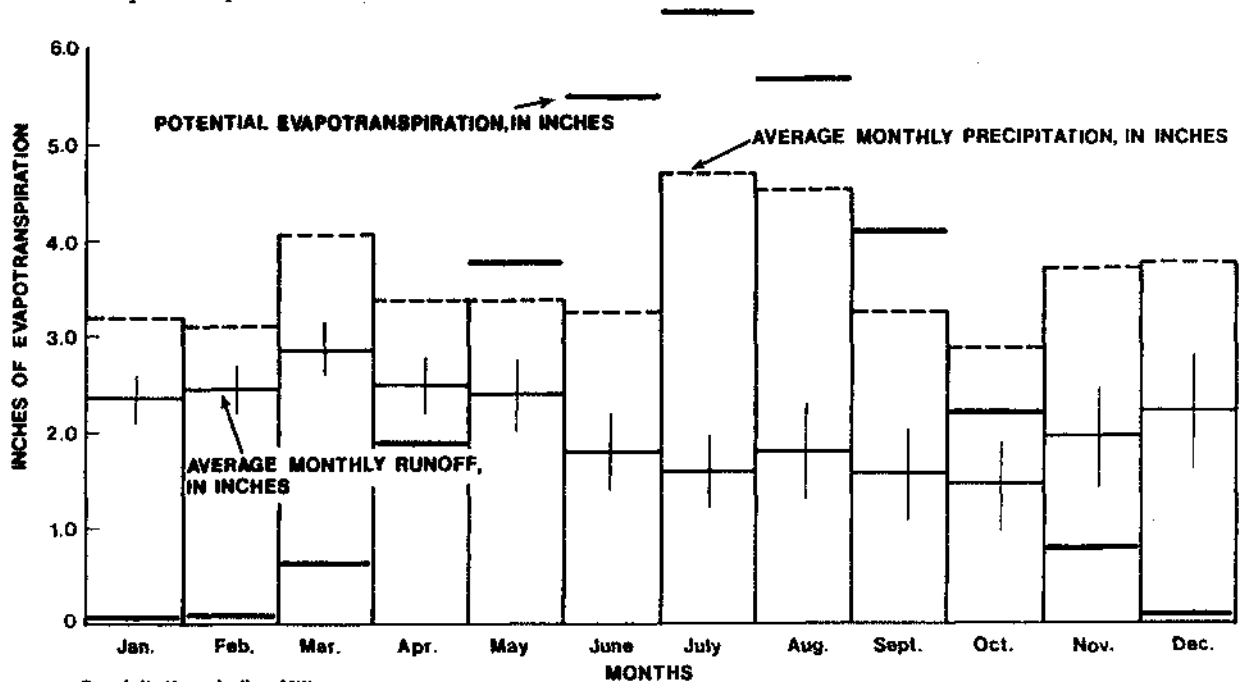
where

- P = Total precipitation input
- R = Total stream flow
- ET = Total evapotranspiration loss
- Δ SMS = Change in soil moisture storage
- Δ GMS = Change in groundwater storage
- Δ DS = Change in depression storage
- GWF = groundwater flux (groundwater flow into or out of the drainage basin).

Normally, when the period of record is long enough, variations in soil moisture, groundwater storage and depression storage may become negligible. This is so in the Pinelands, and the remaining parameters have been analyzed. Emphasis has been placed on the various components and characteristics of stream flow. This is because the sources, quantity, and distribution of stream flow and any changes which may result from future development have direct impacts on the water quality and aquatic and terrestrial ecology of the Pinelands and downstream areas.

Precipitation in its various forms is the source of all water coming into the Pinelands area. Although precipitation is distributed relatively evenly on a geographic, annual, and monthly basis when compared to other areas of the country, it is still quite variable. Mean annual precipitation increases slowly from the west through the central portion of the Pinelands and then decreases rapidly towards the bays and ocean; 44 inches to 46 inches to 38 inches. An overall annual range for the whole Pinelands is 25 to 68 inches. Using past data from Atlantic City Airport as an indication, future rainfall can be predicted. On an annual basis, there is an 80 percent chance that precipitation will equal or exceed 35 inches and a 90 percent chance for 33 inches.

Mean monthly precipitation in the Pinelands ranges between 3 and 5 inches. July and August tend to be the wettest months, and January, February, June, and October the driest. Monthly precipitation trends at Indian Mills are shown in Figure 2.4, along with monthly stream flow of the Batsto and monthly potential evapotranspiration:



Precipitation—Indian Mills
 Streamflow—Batsto River at Batsto
 Potential Evapotranspiration—Seabrook, N.J.

Figure 2.4—Mean Monthly Precipitation, Streamflow, and Potential Evapotranspiration

Evapotranspiration losses can be grouped into three categories: interception losses, evaporation from undrained depressions, and evapotranspiration from soil and groundwater. Evapotranspiration includes evaporation from all water, soil, ice, vegetative, and other surfaces and transpiration from plants.

Interception is the portion of the rainfall which does not reach the ground because it is "intercepted" on the vegetal cover. Studies of the Pinelands have estimated that about 13 percent of the average annual precipitation is intercepted.

Evaporation from undrained depressions has been estimated at 2 percent. This should be a minor factor because impermeable depressions in which rainfall would be stored are rare in the Pinelands.

Plant transpiration is probably the largest single contribution to water vapor loss in the Pinelands area. Together with evaporation losses, the total loss is estimated at 35 percent of the annual precipitation.

Total evapotranspiration, the sum of the above three factors, has been estimated at 50 to 55 percent of the annual precipitation. It varies in the different regions of the Pinelands. Analysis of the values for average annual precipitation and evapotranspiration indicate that evapotranspiration decreases from 23 inches per year in the western portion of the Pinelands to 20 inches along the coast.

Stream flow in the Pinelands streams has been analyzed for mean annual flow, seasonal and daily distribution, low and high flow frequency, and character of direct and groundwater discharges. Stream flow recording gages are or have been in operation in 12 of the 23 Pinelands basins. The length of record ranges from 4 to 58 years.

Average annual discharge for each of the stream flow measuring stations has been calculated and is shown in Table 2.3. Flow values in this table which are from gages with less than 25 years of record were examined with respect to data from other gages with longer records and adjusted where necessary.

Table 2.3—Average Annual Flow Rates at U.S. Geological Survey Gaging Stations

Gaging Station Identification Number	Stream Name and Location	Drainage Basin	Period of Record (Water Years)	Average Drainage Area (mi ²)	Average Discharge Per Sq. Mi. (cfs/mi ²)	Average Discharge (inches/yr)
01408500	Toms River near Toms River	Toms River	1929-78	124.0	1.73	23.5
01409000	Cedar Creek at Lanoka Harbor	Cedar Creek	1933-58, 1971	56.0	1.91	25.9
01409095	Oyster Creek near Brookville	Forked River	1966-78	7.43	3.80	51.4
01409280	Westecunk Creek at Stafford Forge	Forked River	1974-78	16.0	1.96	26.7
01409400	Mullica River near Batsto	Atsion-Mechesactauxin	1958-78	64.4	1.74	23.6
01495000	Batsto River at Batsto	Batsto	1927-78	70.5	1.79	24.3
01409810	West Branch Wading River near Jenkins	Wading River	1975-78	81.4	1.78	24.1
01410000	Oswego River at Harrisville	Wading River	1931-78	64.0	1.38	18.7
01410500	Absecon Creek at Absecon	Absecon Creek	1924-28, 33-38, 47-48	16.6	1.62	22.0
01410787	Great Egg Harbor River Tributary at Sicklerville	Upper Great Egg Harbor River (GEHR)	1973-78	1.64	1.06	14.4
01410810	Fourmile Branch at New Brooklyn	Upper GEHR	1973-78	7.74	1.48	20.1
01410820	Great Egg Harbor River near Blue Anchor	Upper GEHR	1973-78	37.3	1.52	20.6
01411000	Great Egg Harbor River at Folsom	Upper GEHR	1925-78	56.3	1.54	20.93
01411300	Tuckahoe River at Head of River	Tuckahoe River	1971-78	30.8	1.33	18.1
01465850	South Branch Rancocas Creek at Vincentown	South Branch Rancocas Creek	1962-75	64.5	1.46	19.7
01466000	Mt. Misery Brook in Lebanon State Forest	North Branch Rancocas Creek	1952-65	2.71	0.71	9.64
01466500	McDonald's Branch in Lebanon State Forest	North Branch Rancocas Creek	1954-78	2.37	1.00	13.6
01467000	North Branch Rancocas Creek at Pemberton	North Branch Rancocas Creek	1921-78	111.0	1.54	20.9
01411500	Maurice River at Norma	Maurice River	1932-78	113.0	1.49	20.2
01411200	Manantico Creek near Millville	Maurice River	1932-57, 1978	22.3	1.69	22.9

The average mean annual discharge and average total discharge at each gage are presented in terms of cubic feet per second per square mile of drainage area (cfs/mi²) and inches per year (in/yr). The average flows range from 1.0 cfs/mi² (13.6 in/yr) for McDonald's Branch to 3.8 cfs/mi² (51.7 in/yr) for Oyster Creek. The weighted average discharge for the entire Pinelands is 1.7 cfs/mi² or 23 in/yr. In general, unit stream flows are highest in the Cedar Creek, Oyster Creek, and Westecunk Creek watersheds. Average stream flows in the Mullica River basin with the exception of Oswego River are slightly above the mean Pinelands flow. Flows in Oswego River, Rancocas Creek, and the Great Egg Harbor River basin are less than the Pinelands mean.

The most notable feature of the average mean flows are streams which appear to have anomalous flows:

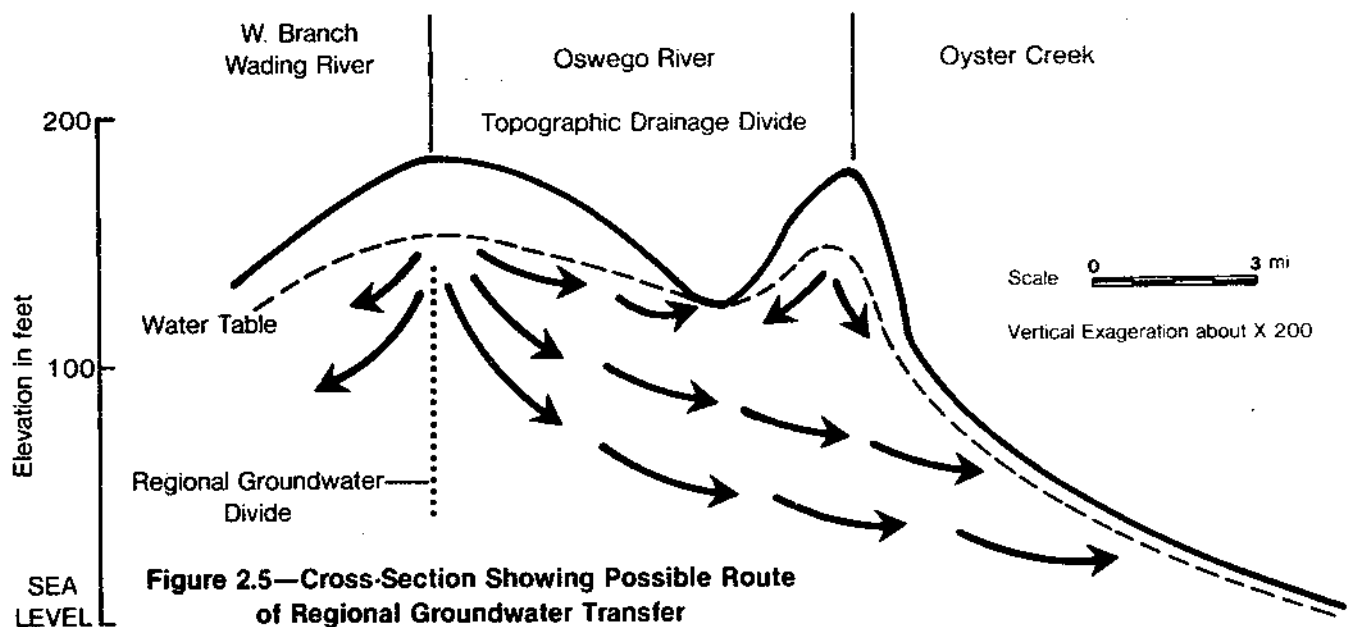
<u>Stream</u>	<u>Flow (in/yr)</u>
Oyster Creek	51.4
Oswego River	18.7
McDonald's Branch	13.6
North Branch Rancocas	20.9

These differences illustrate two major components of Pinelands hydrology and geology: intra-basin and inter-basin transfer of groundwater.

Intra-basin transfer of water can be illustrated by focusing on McDonald's Branch, which is located in the headwaters of the North Branch Rancocas Creek drainage basin. The McDonald's Branch drainage area upstream from the gage is 2.3 square miles, and 90 percent of the soils upstream feature high-depth water tables and high to excessive infiltration rates. The explanation for the low average flow at the McDonald's Branch gage is that a relatively high portion of the rainfall which reaches the groundwater reservoir penetrates to the regional groundwater flow system rather than the shallow local flow pattern discharging to the nearest stream, and thus bypasses the gage.

The topographic and soils characteristics of McDonald's Branch appear to be representative of much of the upland headwaters area in the vicinity of the topographic drainage divides. It is likely, although corroborative data is unavailable, that other headwater areas experience the same intra-basin transfer.

Inter-basin transfer of groundwater is a similar phenomenon except that water moves into the adjacent basin rather than just moving down stream. Inter-basin transfer accounts for variation of annual flows between adjacent Oswego River (18.7 in/yr), Oyster Creek (51.4 in/yr) and Westecunk Creek (26.7 in/yr). Figure 2.5 illustrates this phenomenon.



The significance of inter-basin transfer is seen in the fact that Oyster Creek's discharge of 51.4 inches per year exceeds annual precipitation. Inter-basin transfer occurs in most cases because groundwater drainage divides do not always coincide with topographic drainage divides.

The concepts of intra- and inter-basin flow of groundwater have two implications regarding the water resources of an area. First, the techniques used to estimate water availability in a basin must be reviewed. And secondly, the transfer of groundwater could also be a transport mechanism for soluble pollutants, causing them to affect the adjacent basin rather than the point of discharge.

Although the average annual discharge for the Pinelands' streams can be calculated, this value does not represent an even distribution flow throughout the year. Stream flow varies daily in response to precipitation and evapotranspiration rates. It is greatest in March and lowest in September and October. These low flows occur because the majority of precipitation is transpired back to the atmosphere. The groundwater reservoir gradually decreases throughout the summer until the growing season ends.

Low flow is important because the characteristic Pinelands ecosystem is water dependent. Also, low flows relate to waste assimilation, water supply, cranberry flooding, and waterbased recreation. Conversely, high flows are also important. The highs could indicate the size that a stream channel would have to be to accommodate frequently occurring flows as well as the potential for flooding.

There are several methods for presenting the distribution of stream flows, including flow duration curves, low flow frequency curves, and peak flood flow rates. In each case, these are prepared from a statistical analysis of historical data and are presented in terms of probability or recurrence interval.

Sample flow duration curves for the Mullica gages are illustrated in Figure 2.6. The curves were prepared for average daily flows in a unit (cubic feet per second per square mile — cfs/mi²) that allows comparison of different sized watersheds. The shapes and slopes of the curves are useful as indicators

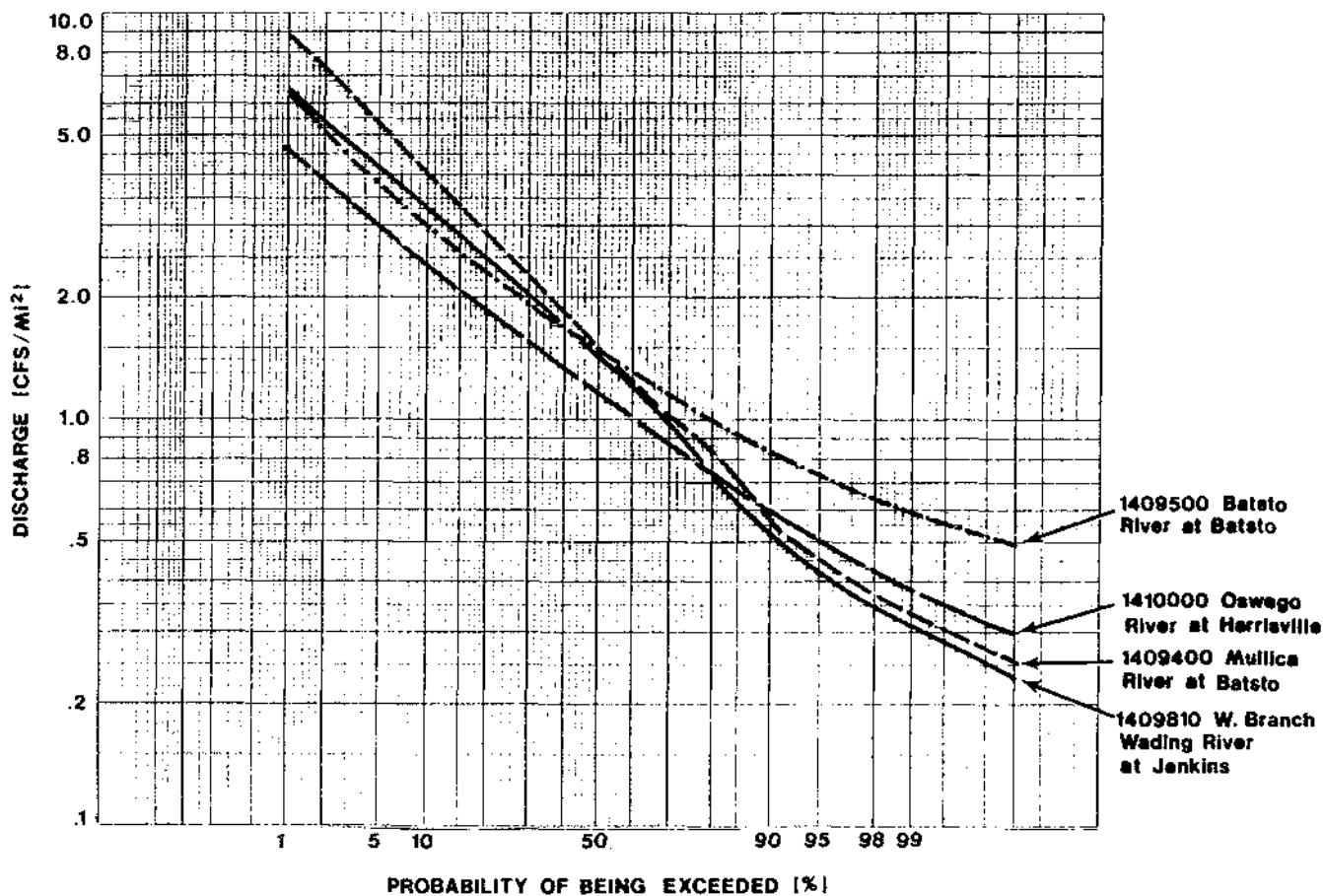


Figure 2.6—Flow Duration Curves — Mullica River Basin

of unusual natural or man-made conditions including soil conditions, inter- or intra-basin transfer, channel modification, or reservoirs. Typical Pinelands streams have a fairly uniform flow; therefore, the curves should be fairly flat.

Examination of the Mullica basin curves show a uniformity between the Batsto and Oswego except that flows in the Batsto are higher. This represents a net groundwater transfer out of the Oswego and into the Batsto. The other two curves for the West Branch Wading and Mullica gages show similar perturbations in the curves at the 70th percentile point. The discontinuity in the Mullica could be from past efforts to channelize and realign the Sleeper Branch, whereas the West Branch Wading discontinuity is probably caused by intermittent flooding and draining of the cranberry bogs.

The ratio between 10 and 90 percentile flows is presented in Table 2.4. The lower the ratio, the greater the uniformity of flow. The factors accounting for higher ratios are high percentage of soils with high infiltration rates, lack of urban or agricultural development, and inter-basin transfer of groundwater into these basins. Variability of flow was caused by high runoff-producing soils, pumpage for water supply, cranberry water regulation, and loss of water by inter-basin transfer.

Table 2.4—Comparison of Streamflow Duration Variability

Stream Name and Location	Period of Record (Water Years)	Drainage Area (mi ²)	Discharge (cfs) likely to be 10% of the Year	90% of the Year	Exceeded Ratio of 10% to 90% Discharge
Toms River near Toms River	1929-78	124.0	2.95	.81	3.6
Cedar Creek at Lanoka Harbor	1933-58, 1971	56.0	3.05	1.02	3.0
Oyster Creek near Brookville	1966-78	7.43	5.5	2.6	2.1
Westecunk Creek at Stafford Forge	1974-78	16.0	3.05	1.28	2.4
Mullica River near Batsto	1958-78	64.4	3.3	.52	6.3
Batsto River at Batsto	1927-78	79.5	2.95	.83	3.6
West Branch Wading River near Jenkins	1975-78	84.1	4.0	.57	7.0
Oswego River at Harrisville	1931-78	64.0	2.4	.6	4.0
Absecon Creek at Absecon	1924-28 33-38, 47-78	16.6	2.3	.16	14.4
Great Egg Harbor River Tributary at Sicklerville	1973-78	1.64	2.15	.17	12.6
Fourmile Branch at New Brooklyn	1973-78	7.74	2.6	.69	3.7
Great Egg Harbor River near Blue Anchor	1973-78	37.3	2.7	.64	4.2
Great Egg Harbor River at Folsom	1925-78	56.3	2.6	.66	3.9
Tuckahoe River at Head of River	1971-78	30.8	2.45	.49	5.0
South Branch Rancocas Creek at Vincentown	1962-75	64.5	3.1	.33	9.4
McDonalds Branch in Lebanon State Forest	1954-78	2.37	1.73	.53	3.3
North Branch Rancocas Creek at Pemberton	1921-78	111.0	2.9	.59	4.9

Low flow frequencies are presented in Table 2.5. The concept used is recurrence interval, or the average number of years during which an item of given magnitude is expected to occur once. Essentially, the table shows the lowest flow rates which have occurred over 7, 30, and 90 day periods during the years of record for each station. This information can be used to help determine appropriate land use and water-consuming activity for the basin. For example, a basin with frequent low flows should not have a point source discharge of wastewater placed in it.

Peak flow rates, although relatively low in the Pinelands, are presented in Table 2.6. During and after storm events, flow rates gradually increase until they reach a peak after a day or more, then they gradually recede. Relative steepness and small area account for the highest peak flows, which occur in Oyster Creek.

Table 2.5—Summaries of Low Flow Frequency Analysis

Location	Recurrence Interval (Years)	Day Flow (cfs)		
		7	30	90
Toms River	50	53.4	60.3	74.9
	10	65.0	71.9	90.0
	5	71.3	79.8	100.1
Cedar Creek at Lanoka Harbor	50	29.2	40.2	45.3
	10	34.8	47.4	55.1
	5	38.4	51.8	60.9
Westecunk Creek at Stafford Forge	50	7.5	12.3	15.4
	10	9.8	14.6	17.4
	5	11.3	16.1	18.8
Oswego River at Harrisville	50	17.0	22.0	26.8
	10	21.5	26.6	33.8
	5	24.6	29.8	38.5
Absecon Creek at Absecon	50	.04	.16	.63
	10	.24	.67	2.01
	5	.59	1.38	3.50
Great Egg Harbor River Tributary at Sicklerville	50	.03	.03	.11
	10	.07	.11	.23
	5	.11	.19	.35
Fourmile Branch at New Brooklyn	50	2.7	2.8	3.8
	10	3.6	3.8	4.7
	5	4.2	4.4	5.3
Great Egg Harbor River at Blue Anchor	50	10.2	11.1	14.1
	10	13.3	15.2	18.6
	5	15.5	18.1	22.1
Great Egg Harbor River at Folsom	50	17.6	19.2	23.5
	10	22.0	24.4	30.1
	5	24.9	27.9	34.7
Tuckahoe River at Head of River	50	8.2	10.2	11.2
	10	9.5	11.7	14.2
	5	10.3	12.6	15.7
Maurice River	50	27.2	31.8	39.8
	10	36.7	42.9	54.4
	5	43.3	50.8	64.6
Manantico Creek near Milville	50	4.8	10.1	12.4
	10	7.3	12.8	16.0
	5	9.0	14.5	18.3
South Branch Rancocas Creek at Vincentown	50	6.0	8.2	12.0
	10	8.3	11.6	16.9
	5	9.9	14.1	20.7
Mt. Misery Brook in Lebanon State Forest	50	.002	.006	.092
	10	.006	.016	.150
	5	.012	.030	.207
McDonald's Branch in Lebanon State Forest	50	.88	.89	.93
	10	.95	.98	1.07
	5	1.00	1.05	1.17
North Branch Rancocas Creek at Pemberton	50	27.8	36.2	45.2
	10	34.9	44.1	56.9
	5	39.9	49.9	65.1
Oyster Creek near Brookville	50	13.3	14.8	16.3
	10	15.3	16.8	18.7
	5	16.5	18.0	20.0
Mullica River near Batsto	50	10.0	14.3	18.5
	10	15.6	19.8	25.7
	5	19.7	24.0	31.2
Batsto River at Batsto	50	36.6	38.8	42.1
	10	41.1	44.5	51.0
	5	44.3	48.5	56.9
West Branch Wading River near Jenkins	50	19.9	20.1	26.6
	10	23.4	24.8	33.7
	5	26.3	28.6	40.3

Table 2.6—Peak Flood Flow Rates

Station	2 Year Storm cfs	Storm cfs/mi ²	10 Year Storm cfs	Storm cfs/mi ²	50 Year Storm cfs	Storm cfs/mi ²	100 Year Storm cfs	Storm cfs/mi ²
Toms River near Toms River	744.0	6.0	1320.0	10.6	1990.0	16.0	2330.0	18.8
Cedar Creek at Lanoka Harbor	413.0	7.4	686.0	12.4	990.0	17.8	1160.0	20.7
Oyster Creek near Brookville	108.0	14.5	195.0	26.2	302.0	40.6	357.0	48.0
Mullica River near Batsto	515.0	8.0	1120.0	17.4	2010.0	31.2	2510.0	39.0
Batsto River at Batsto	512.0	7.3	1040.0	14.8	1710.0	24.3	2060.0	29.2
Oswego River at Harrisville	345.0	5.4	695.0	10.9	1170.0	18.3	1430.0	22.3
Great Egg Harbor River at Folsom	283.0	5.0	591.0	10.5	1010.0	17.9	1250.0	22.2
Manantico Creek near Millville	198.0	8.9	510.0	22.9	1030.0	46.2	1350.0	60.5
South Branch Rancocas Creek at Vincentown	781.0	11.9	1120.0	17.1	1470.0	22.4	1630.0	24.9
Mt. Misery Brook in Lebanon State Forest	12.5	4.6	30.9	11.3	60.3	22.1	78.3	28.7
McDonalds Branch in Lebanon State Forest	10.0	4.3	22.4	9.7	40.9	17.7	51.6	22.3
North Branch Rancocas Creek at Pemberton	743.0	6.7	1350.0	12.2	2070.0	18.6	2440.0	22.0

Hydrologic budgets for the Pinelands basins and sub-basins are presented in Table 2.7. The last two columns show the difference represented by the budget equation $P = R + ET$, which can be attributable to basin transfer. The only difference which cannot be reasonably explained by the transfer theory is in the Tuckahoe Basin. The difference should be attributed to either insufficient stream flow data, intra-basin transfer, or stream flow or precipitation measurement error. The first is most probable.

The four major aspects of the Pinelands' surface water hydrology are:

- *Major flow characteristics are a function of the runoff and infiltration characteristics of the basins' soils.* Direct runoff from individual storms varies as a function of the percentage of the basin underlain by "effective" runoff source areas (U.S. Soil Conservation Service Hydrologic Soil Groups "C" and "D"). Conversely, Hydrologic Soil Groups "A" and "B" are those which rapidly infiltrate precipitation and contribute to recharge of groundwater. Significant recharge areas can be defined as those areas with soil classed either as group "A" or group "B" where completely encompassed by Group "A". Where the water table under these areas is deeper than 10 feet, the infiltrating rainwater will enter the deeper aquifer flow system.
- *Intra-basin and inter-basin transfers of groundwater are related to areas of high infiltration, deep water table and steep ground slope.*
- *Poorly managed urban development will upset existing stream flow characteristics.*
- *Large areas of the Pinelands are subject to periodic flooding.* Areas of flooding are best identified by mapping alluvial and muck soils.

Surface Water Quality

Pinelands streams have a characteristic and typical composition which is equally important to the maintenance of the Pinelands ecosystem as are the water flows and groundwater levels. The typical, high-quality Pinelands stream is slow-moving, brown but clear, has a sandy substrate, and is overhung by dense vegetation. The water is soft and the pH is low. It generally has a high level of dissolved humic matter, especially in the summer months, and may have fluctuating oxygen levels due to bog and swamp drainage and organic demands. There are low levels of nutrients and suspended and total dissolved solids. It can be classified as dystrophic.

The Pinelands' drainage basins and sub-basins contain 80 sampling stations which furnish data for five parameters: biochemical oxygen demand (BOD), total nitrogen, fecal coliform, suspended solids, and total dissolved solids. Analysis was limited to stations which had a minimum of five samples for each of the above parameters. The water quality at each of the 80 sampling stations was indexed as either pristine, good, slightly disturbed, more disturbed, or most disturbed.

Table 2.7—Hydrologic Budget Analysis Data

Basins	Precipitation (inches)	Evapotrans- piration (inches)	Calculated Runoff (inches)	Runoff (inches)*			Difference† (inches)	Difference (Volume— in/mi ²)
				Measured	Adjusted	Estimated		
Toms River	45.6	22.3	23.5	23.5	—	—	0.0	—
Rancocas Creek Basin	44.7	22.6	22.1	—	—	—	—	—
North Branch Rancocas	45.0	22.6	22.4	20.9	—	—	- 1.5	- 166.5
South Branch Rancocas	44.1	22.5	21.6	19.7	—	—	- 1.9	- 122.6
Cedar Creek	44.4	21.4	23.0	25.9	—	—	+ 2.9	+ 162.4
Forked River Basin	43.8	20.5	23.3	—	—	—	—	—
Forked River	43.9	20.8	23.1	—	—	25.9	+ 2.8	+ 43.1
Oyster Creek	43.6	20.6	23.0	51.4‡	41.0	—	+ 18.0	+ 207.0
Mill Creek	42.7	20.4	22.3	—	—	27.2	+ 4.9	+ 100.0
Westecunk Creek	43.9	20.5	23.4	26.7	—	—	+ 3.3	+ 52.8
Mullica River Basin	44.7	21.6	23.1	—	—	—	—	—
Bass River	43.5	20.6	22.9	—	—	22.9	0.0	—
Wading River	45.7	21.6	24.1	21.8	—	—	- 2.3	—
West Branch Wading River	45.7	21.6	24.1	24.1	—	—	0.0	—
Oswego River	44.8	21.4	24.4	18.7	—	—	- 5.7	- 364.8
Batsio River	44.6	21.6	22.9	24.3	—	—	+ 1.4	+ 98.7
Atsion-Mechesactauxin Creek	44.2	21.9	22.3	23.6	—	—	+ 1.3	+ 115.4
Nescochague Creek	44.4	22.1	22.3	—	—	22.3	0.0	—
Hammonton Creek	44.8	21.8	23.0	—	—	23.0	0.0	—
Mullica River	44.1	21.0	23.1	—	—	23.1	0.0	—
Great Egg Harbor Basin	44.4	22.0	22.4	—	—	—	—	—
Upper Great Egg Harbor	44.6	22.4	22.2	20.9	—	—	- 1.3	- 221
Lower Great Egg Harbor	44.7	21.4	23.3	—	—	23.3	0.0	—
Maurice River Basin	42.8	22.8	20.0	—	—	—	—	—
Manumuskin River	43.0	22.8	20.2	—	—	20.2	0.0	—
Maurice River	42.5	23.0	19.5	20.2‡	19.5	—	—	—
Absecon River	43.0	20.7	22.3	22.0‡	22.3	—	0.0	—
Tuckahoe River	44.3	21.9	22.4	18.1	—	—	- 4.3	—
Dennis Creek	42.4	22.5	19.9	—	—	19.9	0.0	—
Patcong Creek	41.3	20.8	20.5	—	—	20.5	0.0	—

* Use the runoff value farthest to the right for budget computation.

† Attributable to basin transfer except at Tuckahoe River.

‡ Gage significantly upstream of basin outlet—flow adjusted to represent entire basin.

Of the 80 stations, 2 were judged to be pristine, 15 good, 46 slightly disturbed, 10 more disturbed, and 7 most disturbed. These ratings are illustrated in Figure 2.7. Also, the pH was separately analyzed at each station. These results are depicted in Figure 2.8. Although an important parameter in Pinelands waters, pH was purposely excluded from the water quality index methodology so that its relationship with the index could be examined.

The water quality index was based on an additive ranking system as follows:

- If the concentration limit for a particular parameter was better or equal to the "base concentration limits" 90 percent of the time (90th percentile), it was given a "1". The following "base concentration limits" were established for use in the water quality index (Betz, Converse & Murdoch, Inc., 1980):

Biochemical oxygen demand (BOD)	5 mg/l
Total nitrogen (TN)	3 mg/l
Suspended solids (SS)	12.5 mg/l
Total dissolved solids (TDS)	100 mg/l
Fecal coliform (FL)	200 MPN/100 ml
- If the concentration limit for a particular parameter fell in the 50th to 90th percentile bracket, it was given a "2".
- If the concentration limit for a particular parameter fell below the 50 percentile level, it was given a "3".

The factors were combined into the following groups:

- *Good quality*—the added values for the five parameters equaled 5.
- *Slightly disturbed*—the added values for the five parameters equaled 6 or 7.
- *More disturbed*—the added values for the five parameters equaled 8 or 9.
- *Most disturbed*—the added values for the five parameters were greater than 9.

Stream stretches rated as good quality in the above analysis were subjected to a more stringent test. The following concentration limits were used:

Biological oxygen demand	3 mg/l
Total nitrogen	1 mg/l
Suspended solids	10 mg/l
Total dissolved solids	50 mg/l
Fecal coliform	100 MPN/100 ml

Any stream stretch that met these criteria at least 90 percent of the time was considered pristine. These concentration limits were based on a review of the frequency distribution in the twelve "good quality" streams, water quality data from a known pristine stream (McDonald's Branch), and the general literature.

Drainage Basin Water Quality

This section summarizes the water quality index and pollution source data for each basin. The tables show the following:

- Monitoring station location.
- Drainage area (square miles).
- Water quality index.
- Quantity of sewage treatment plant discharge. (For evaluation of relative impact, the quantity of domestic discharges is given in a concentration rating of gallons per day per square mile of drainage area upstream from sampling station.)
- Number of domestic sewage treatment plant and industrial discharges (upstream from sampling station except where noted).
- Number of landfills.
- Number of sewage effluent spray irrigation sites.
- Percent of land developed.
- Percent agricultural.

The following summaries do not include direct relationships between land uses, pollution sources, and water quality because station locations, large basin sizes and mixes of upstream land uses prevent their determination.

Toms River Drainage Basin (Table 2.8)

Although many upstream areas in the **Toms River** basin are relatively undisturbed and have good water quality as shown by the Davenport Branch station (OCN037), many of the downstream areas have been affected by development pressure, and non-point and point sources. The station on Manapqua Branch (OCN042), which is rated as most disturbed, is immediately downstream from a domestic point discharge and a landfill. The watershed at the station is only 5.9 square miles. The good water quality station on Davenport Branch (OCN037) drains 4.7 miles; there are no point or site-specific non-point pollution sources. The change from good to disturbed water quality from upper to lower Davenport Branch is not explainable by the land use data or pollution source data.

The New Jersey Department of Environmental Protection states that major problems in the Toms River basin can be attributed to extremely rapid population growth and development. Inadequate septic systems, overloaded and antiquated waste treatment plants, and substantial stormwater runoff contributions in downstream areas have combined with the natural slow flow of the river to degrade water quality

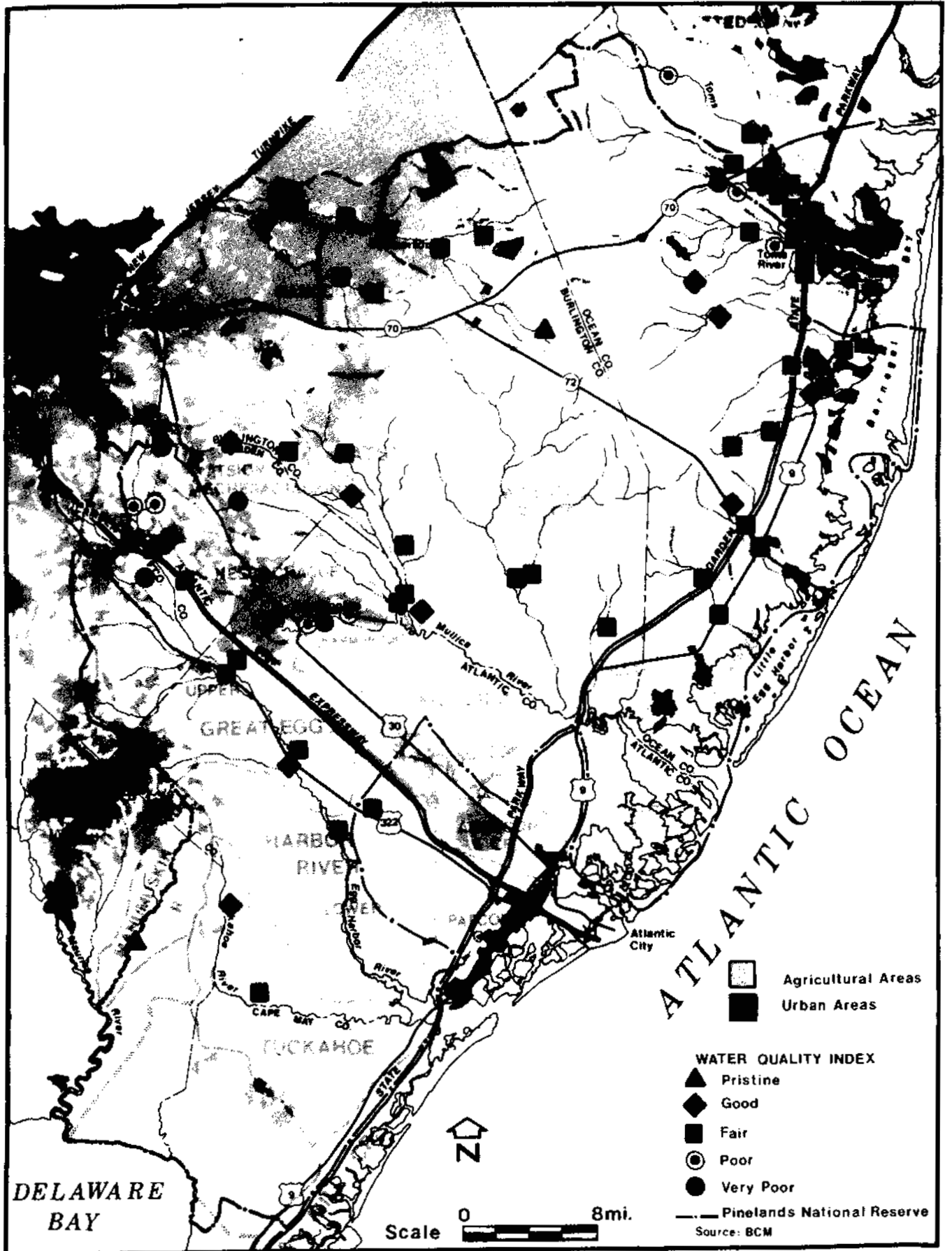


Figure 2.7—Water Quality Index

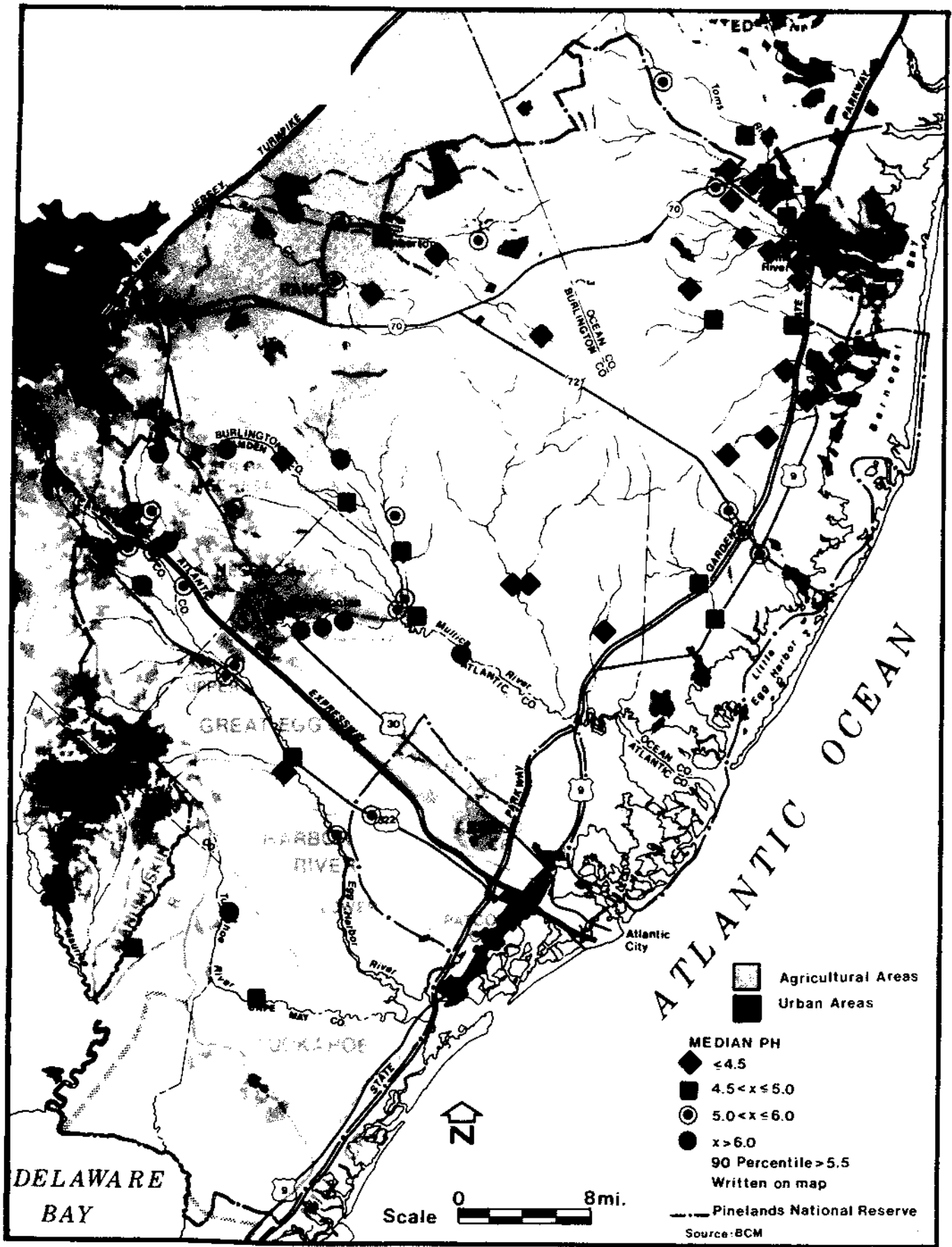


Figure 2.8—pH

with excessive solids, nutrient loadings, fecal coliform and BOD. Heavy power boat utilization of downstream portions has also degraded water quality. Major concerns within the basin include protection of headwater areas and stream stretches above the cranberry bogs, lakes, and impoundments. The headwaters of Davenport Branch and Wrangle Brook which lie outside state landholdings are most critical.

Table 2.8—Toms River Drainage Basin Assessment

Water Quality Station					Point Source			Nonpoint Source		Land Use	
		River Mile	Drainage Area (sq. mi)	Water Quality Index *	Quantity of Sewage Plant Discharge (1000 gal./day/sq. mi.)	Number of Sewage Treatment Plants	Number of Industrial Dischargers	Number of Landfills	Number of Effluent Spray Irrigation Sites	Percent Developed	Percent Agricultural
Number	Location										
OCN031	Toms River off Trenton-Cassville Rd.	30.33	7.8	6	0	0	0	0	0	11	0
OCN030 (01408260)	Toms River near Van Hiseville	27.69	17.2	8	2.60	1	0	0	0	21	0
OCN029	Toms River off Lakehurst-Whitesville Rd.	18.52	45.6	6	1.67	2	1	0	1	8	1
OCN028 (01408310)	Toms River near Lakehurst	14.60	52.0	6	1.46	2	1	1	3	7	0
OCN041	Ridgeway Branch off Lakehurst-Whitesville Rd.	3.65	28.7	6	11.49	1	0	1	0	3	2
OCN040 (01408492)	Ridgeway Branch off Rt. 70 near Lakehurst	—	—	7	—	1	0	1	0	7	3
OCN027	Toms River off Rt. 571 (Manchester-Dover Border)	11.75	56.1	7	1.194	2	1	1	3	20	3
OCN042	Manapaqua Branch off Lakehurst-Ridgeway Rd. (Tributary to Union Branch)	0.85	5.9	10	25.40	1	0	1	0	4	1
OCN039	Union Branch off Colonial Drive	4.38	27.2	8	5.50	1	0	1	1	8	1
OCN038	Union Branch off Brookville Rd.	0.35	—	6	—	2	0	2	2	6	2
OCN026	Toms River below confluences of Union and Ridgeway	10.73	124.0	6	4.41	4	1	3	5	9	1
OCN025 (01408500)	Toms River near Toms River	9.98	124.0	6	4.41	4	1	3	5	54	0
OCN024	Toms River off Lakehurst Rd.	6.65	—	7	—	4	1	3	5	60	0
OCN035	Wrangle Brook off Fort de France Ave.	4.0	—	6	0	0	1	0	2	9	1.4
OCN034	Wrangle Brook off S. Barbados Dr.	2.02	18.7	7	0	0	1	1	2	2	0
OCN037	Davenport Branch off Whiting-Lacey Rd.	8.05	4.7	5	0	0	0	0	0	4	0
OCN036	Davenport Branch between Holiday City and Dover Rd.	1.26	8.09	8	0	0	0	0	0	—	—
OCN033	Wrangle Brook at end of Gem Ave.	0.67	—	7	0	0	1	1	2	2	0
OCN032	Jakes Brook off Double Trouble Rd.	1.42	8.63	6	0	0	0	0	0	6	0
TOTAL — Toms River Basin			191		2.86	4	2	4	7	19	4

* Index values = 5 (pristine) to 15 (most disturbed)

Rancocas Creek Drainage Basin (Table 2.9)

It can be assumed that the upper areas of the **North Branch Rancocas** sub-basin have good water quality because of the large amount of state-owned property there. Below Browns Mills, however, water quality is degraded by the increase in point discharges and development.

The **South Branch Rancocas** sub-basin has a higher percentage of agricultural land and developed land than the North Branch. High phosphorus and suspended solids loads were observed at the water quality station at Retreat; however, the information is not sufficient to determine the exact cause of these violations. The Department of Environmental Protection states that high fecal coliform loads occur on the Southwest Branch just downstream of the Evesham Township, Medford Lakes Borough and the Medford Township municipal sewage treatment plants.

Excessive phosphorus and bacterial levels in the mid-stretches of the North Branch can be attributed to agricultural runoff, malfunctioning septic systems, and sewage treatment plants. The two Mount Holly sewage treatment plants and the Pemberton Township Municipal Utility Authority treatment plant, which have a combined flow of approximately 3.1 million gallons a day, are presently being upgraded. In the South Branch sub-basin, excessive algal growth caused by high phosphorus loads discharged from the Medford Lakes Borough sewage treatment plant should be alleviated with treatment plant upgrading.

Table 2.9—Rancocas Creek Drainage Basin Assessment

Water Quality Station					Point Source			Nonpoint Source		Land Use	
		River Mile	Drainage Area (sq. mi)	Water Quality Index*	Quantity of Sewage Plant Discharge (1000 gal./day/sq. mi.)	Number of Sewage Treatment Plants	Number of Industrial Dischargers	Number of Landfills	Number of Effluent Spray Irrigation Sites	Percent Developed	Percent Agricultural
Number	Location										
North Branch Rancocas											
01465970	North Branch at Browns Mills	—	19.5	7	3.58	2	0	1	0	40	0
01466500	McDonald's Branch in Lebanon State Forest	—	2.3	5	0	0	0	0	0	0	0
				(pristine)							
01466900	Greenwood Branch at New Lisbon	—	13.7	7	0	0	0	2	0	—	—
01467000	North Branch at Pemberton	—	111.0	7	4.41	8	0	3	0	—	—
01467003	North Branch at Ewansville	—	126.0	8	24.40	13	1	3	0	17	0
01467006	North Branch on Pine St. in Mt. Holly	—	134.0	7	22.60	14	1	3	0	—	—
Below station	01467006	—	—	—	—	15	1	3	0	—	—
South Branch Rancocas											
01465835	South Branch at Retreat	—	44.4	7	6.46	2	0	2	0	—	—
01465850	South Branch at Vincentown	—	53.3	7	5.57	3	0	2	0	—	—
01465900	South Branch at Eayrestown	—	76.0	no data	3.91	3	0	2	1	—	—
01465915	South Branch at Hainesport	—	156.0	10	17.94	9	1	5	1	—	—
Below station	01465915	—	—	—	—	9	2	5	1	—	—
TOTAL Rancocas Creek Basin		—	341	—	—	—	—	—	—	28	10

* Index values = 5 (pristine) to 15 (most disturbed)

Cedar Creek Drainage Basin (Table 2.10)

The Cedar Creek basin contains a large percentage of undisturbed land, a condition responsible for the basin's good water quality. The existing point and non-point sources do not have major effects on the stream quality, at least the sampling station locations. Localized impacts may exist.

Based on the stream quality problems evident in the Toms River and Great Egg Harbor River basins, headwater areas (small streams in the upper watershed) are the most critical here. The drainage basins of Factory Branch, Newbolds Branch, Daniels Branch and the unnamed tributary above Camp Columbus are not presently within federal and/or state landholdings. Cedar Creek drains directly into Barnegat Bay, which has a minimal flushing rate and low tolerance for excess nutrient loadings.

Forked River Drainage Basin (Table 2.11)

The Forked River, which also drains directly into Barnegat Bay, has three branches. The Middle Branch is almost 100 percent forested and undisturbed. This condition is reflected in the good water quality monitored at Route 9. Quality in the South Branch is also probably good. The North Branch water quality is rated slightly disturbed because of elevated fecal coliform levels. Due to the station locations, it was not possible to assess the relative impact of the upstream landfills, agricultural areas, or developed areas.

Table 2.10—Cedar Creek Drainage Basin Assessment

Water Quality Station					Point Source			Nonpoint Source		Land Use	
		Drainage Area (sq. mi)	Water Quality Index *	Quantity of Sewage Plant Discharge (1000 gal./day/sq. mi.)	Number of Sewage Treatment Plants	Number of Industrial Dischargers	Number of Landfills	Number of Effluent Spray Irrigation Sites	Percent Developed	Percent Agricultural	
Number	Location										
OCM045 (01408830)	Cedar Creek off Whiting-Lacey Road	20.1	5	0	0	0	0	1	0.4	1.5	
OCN044 (01408870)	Cedar Creek off Double Trouble Road	46.4	5	0	0	0	1	0	1.6	0.2	
OCN043 (01409000)	Cedar Creek at Lanoka Harbor	56.0	6	0.5	2	0	2	1	11	0	

* Index values = 5 (pristine) to 15 (most disturbed)

Table 2.11—Forked River Drainage Basin Assessment

Water Quality Station					Point Source			Nonpoint Source		Land Use	
		Drainage Area (sq. mi)	Water Quality Index *	Quantity of Sewage Plant Discharge (1000 gal./day/sq. mi.)	Number of Sewage Treatment Plants	Number of Industrial Dischargers	Number of Landfills	Number of Effluent Spray Irrigation Sites	Percent Developed	Percent Agricultural	
Number	Location										
Forked River											
OCN047	North Branch Forked River; dirt road along JCP&L ROW		6	0	0	0	1	0	—	—	
OCN046	North Branch Forked River at Forked River	15.4	7	0.39	1	0	1	0	—	—	
OCN048	Middle Branch Forked River at Rt. 9	—	5	0	0	0	0	0	—	—	
OCN049	South Branch Forked River at Rt. 9	—	—	0	0	0	0	0	—	—	
TOTAL Forked River Basin		20	—	—	1	0	1	0	11	7	
Oyster Creek											
OCN052	Oyster Creek outflow of Brookville Bog	2.3	6	0	0	0	0	0	—	—	
OCN051 (01409095)	Oyster Creek at Rt. 532	7.4	6	0	0	0	0	0	—	—	
TOTAL Oyster Creek Basin		11	—	0	0	2	0	0	6	8	
Mill Creek											
OCN056 OCN054 (01409150)	Eight Mile Branch at Rt. 72	—	—	0	0	0	0	0	—	—	
OCN055	Mill Creek at Rt. 72	10.0	6	0	0	0	1	0	—	—	
OCN055	Fourmile Branch at Oxycocus-Littleville Mill Rd.	8.0	5	0	0	0	0	0	—	—	
OCN053	Mill Creek at Rt. 180	19.8	7	0	0	0	1	0	—	—	
01409210	Mill Creek at Manahawkin Discharge Below Station 01409210	20.4	—	0	0	0	1	0	—	—	
TOTAL Mill Creek Basin		21	—	0	2	0	2	0	21.4	3.5	
Westecunk Creek											
OCN059	Westecunk Creek at Martha Rd.	15.6	6	0	0	0	0	0	0.1	1.0	
OCN058 (01409282)	Westecunk Creek off Rt. 9 near West Creek	20.6	6	0	0	0	2	0	1.5	3.2	
TOTAL Westecunk Creek Basin		21	—	—	—	—	—	—	1.5	3.2	

* Index values = 5 (pristine) to 15 (most disturbed)

There are three lakes below the Garden State Parkway (the Protection Area boundary) on the North Branch. The basin is also distinguished by the relatively steep slopes of the Forked River mountains.

The **Oyster Creek** basin has slightly disturbed water quality. High BOD levels are probably due to livestock, malfunctioning septic systems, or natural conditions. High fecal coliform levels may be due to livestock or septic system failures.

The major route from Philadelphia to Long Beach Island (Route 72) cuts through the **Mill Creek** basin. There is high development pressure along this road and in the area surrounding Manahawkin. Due to the lack of data for the area below Manahawkin, it was not possible to assess the impact of the two existing domestic dischargers. The basin contains Manahawkin Lake and cranberry bogs upstream. The wetlands area in the lower part of the basin is currently protected by state laws.

The elevated fecal coliform levels in the **Westecunk Creek** basin could be due to livestock areas or to septic system failures. The water quality index does not indicate degradation from the two landfill sites; however, localized impacts are probable.

Mullica River Drainage Basin (Table 2.12)

The **Bass River** sub-basin is relatively undeveloped and contains large state land holdings. The water quality index value of slightly disturbed at the East Branch station is probably conservative. The suspended solids 90th-percentile concentration was only 0.5 mg/l higher than the 12.5 mg/l cutoff point. The slightly elevated solids load could be attributable to activities at the state recreation area immediately upstream from the sampling station. The headwaters of the East Branch, West Branch, and Bartlett's Branch of Bass River are not within current public land holdings.

The **Wading River** sub-basin has minimal developed land. However, it is used extensively for cranberry and blueberry production. Water quality levels on the West Branch of the Wading River and the East Branch (Oswego River) are slightly disturbed. The elevated suspended solids and fecal coliform levels are probably due to localized problems.

It is most important that the water quality of the Wading River and its tributaries be maintained as high as possible. Tributaries in the upper watershed which lie outside of state-owned lands are most critical. These headwater streams include Yellow Dam Branch, Plains Branch, Beaver Branch, Ives Branch, Pole Branch, Probst Branch, Goose Pond, and sections of the West Branch around Chatsworth.

Water quality within the **Batsto River** sub-basin is good to slightly disturbed. An analysis of the fecal coliform/fecal streptococcus ratio shows that the bacterial contamination could be caused by human waste and/or livestock and poultry waste. The latter category includes wild game. High total dissolved solids levels in Springers Brook could be due to the surrounding agricultural practices. High pH and alkalinity concentrations indicate the use of lime or septic systems contamination.

The Batsto River increases in quality downstream. Good quality is found at the station at Batsto due to cleansing action as the river passes through bogs and swamps. The headwater areas of Springers Brook, Indian Mills Brook, and the Batsto River are not currently protected. These areas are particularly vulnerable to development pressure from the Medford Lakes region. The Batsto River is a major tributary of the Mullica River.

Water quality in the **Atsion-Mechesactauxin** sub-basin is quite variable. The most disturbed water quality on the Wildcat Branch is probably due to the industrial point source, urban development, and surrounding agricultural land. This station provides a good illustration of the fragile character of headwater areas. The normal low flows of the small streams are not adequate to assimilate the waste. Water quality at all other stations is rated either good or slightly disturbed due to elevated suspended solids loads. These loads could be due to natural conditions.

This sub-basin probably has the greatest potential within the Mullica River system for being impacted by development. The small, upper streams which are not within the Wharton Tract are very close to the developing centers of Berlin and Atco.

Because there is only one water quality station at the very base of the **Nescochague Creek** sub-basin, it is impossible to evaluate any local upstream water quality impact. Water quality at that station in Pleasant Mills is slightly disturbed due to suspended solids concentrations; probably caused by natural conditions.

Table 2.12—Mullica River Drainage Basin Assessment

Water Quality Station				Point Source			Nonpoint Source		Land Use	
		Drainage Area (sq. mi)	Water Quality Index *	Quantity of Sewage Plant Discharge (1000 gal./day/sq. mi.)	Number of Sewage Treatment Plants	Number of Industrial Dischargers	Number of Landfills	Number of Effluent Spray Irrigation Sites	Percent Developed	Percent Agricultural
Number	Location									
Bass River										
01401050	East Branch Bass River near New Gretna	8.1	6	0	0	0	0	0	—	—
01410200	West Branch Bass River near New Gretna	6.5	no data	0	0	0	0	0	—	—
	Below Station 01410200	—	—	—	0	0	1	0	—	—
TOTAL Bass River Sub-Basin		20.0	—	0	0	0	1	0	3.7	0.1
Wading River										
01409810	West Branch Wading River near Jenkins	84.0	no data	0	0	0	0	0	—	—
01409815	West Branch Wading River near Maxwell	85.9	6	0	0	0	0	0	—	—
01410000	Oswego River (East Branch Wading River) at Harrisville	64.0	6	0	0	0	0	0	—	—
01410070	Wading River at Wading River	176.0	no data	0	0	0	0	0	—	—
TOTAL Wading River Sub-Basin		176.0	—	0	0	0	0	0	2.0	6.1
Batsto River										
01409450	Springers Brook near Indian Mills	12.6	7	0	0	0	1	0	5.5	44.1
01409470	Batsto River at Quaker Bridge	55.7	6	0	0	0	2	0	—	—
01409500	Batsto River at Batsto	70.5	5	0	0	0	2	0	—	—
TOTAL Batsto River Sub-Basin		74.0	—	0	0	0	0	0	1.0	18.0
Atsion-Mechesactauxin Creek										
01409375	Mullica River near Atco	3.2	5	0	0	0	0	0	22.0	26.0
01409383	Mullica River at Jackson Rd. near Indian Mills	16.8	6	0	0	0	0	0	—	—
01409387	Mullica River at outlet of Atsion Lake	26.7	5	0	0	0	1	0	—	—
01409400	Mullica River near Batsto	64.4	no data	0	0	0	2	0	—	—
01409403	Wild Cat Branch at Chesilhurst	1.0	10	0	0	1	1	1	22.0	23.0
39382507-4393500	Mullica River at Pleasant Mills	127.0	6	0	0	1	3	1	4.0	15.0
TOTAL Atsion-Mechesactauxin Creek Sub-Basin		89	—	0	0	1	3	0	4.0	5.0
Nescochague Creek										
01409411	Nescochague at Pleasant Mills	43.8	6	5.25	1	3	1	1	9.0	36.0
TOTAL Nescochague Creek Sub-Basin		51	—	—	1	3	1	1	9.0	36.0
Hammonton Creek										
01409412	Hammonton Creek off Rt. 30 at Hammonton	2.5	8	0	0	1	0	0	—	—
01409414	Hammonton Creek at Hammonton	2.7	11	270.37	1	1	0	0	—	—
01409416	Hammonton Creek at Westcoatville	9.6	9	76.04	1	1	0	0	13.0	48.0
	Below Station 01409416	—	—	—	1	1	1	0	—	—
TOTAL Hammonton Creek Sub-Basin		17.0	—	—	1	1	1	0	10.0	24.0
Lower Mullica River										
01409535	Mullica River at Green Bank (tidal)	243.0	tidal	5.66	3	7	10	0	—	—
	Below station 01409535	—	—	—	4	8	14	1	—	—
TOTAL Mullica River Basin		517.0	—	—	4	8	14	1	3.0	13.0

* Index values = 5 (pristine) to 15 (most disturbed)

Slightly elevated pH levels at the Pleasant Mills station are probably related to the percentage of land in agricultural use. The headwaters of Pump Branch, Blue Anchor Branch, and Great Swamp Branch are in agricultural areas.

The Nescochague sub-basin is divided by Route 30 running from Philadelphia through Hammon-
ton. Development pressure is high. Management of the headwater areas is critical to water quality in
the Mullica River.

The **Hammonton Creek** sub-basin has poor to very poor water quality because of point sources,
urban runoff, and agricultural practices. Based on the water quality index and pH values, Hammonton
Creek has the worst water quality in the whole Pinelands area. The high nutrient loads can adversely
impact Nescochague Lake, the Mullica River, and finally Great Bay. The high pH values will alter the
acid water-dependent Pinelands aquatic communities. Improvement of water quality would require
controls on all sources of contamination.

The **Mullica River** drains a significant portion of the Pinelands National Reserve. The sub-basin en-
compassing its lower main stem is affected by drainage from the upper tributaries and by the tidal
influence of Great Bay. Due to lack of data, the impact of direct drainage to this section of the Mullica
could not be determined.

The Atlantic County portion of the sub-basin is more threatened than the Burlington County por-
tion because it has more land area, more development and more agricultural land. Within the total
Mullica River Basin, the Lower Mullica is not as vulnerable as the upper watersheds because its capa-
city to assimilate pollutants is greater. If the upper reaches are altered by development and agricultural
practices, the entire river and estuarine system will feel the impacts.

Great Egg Harbor River Drainage Basin (Table 2.13)

Water quality in the **Upper Great Egg Harbor River** sub-basin is affected by point sources, mal-
functioning septic systems, and agricultural runoff from both within and outside the Pinelands boundary.
pH values are generally higher than in other areas of the Pinelands due to agricultural liming practices
and pollution sources. The water quality level improves and the pH level drops farther downstream.
This is due to dilution effects, reduction of point sources, and less developed agricultural land in the
area between Penny Pot and Mays Landing.

Table 2.13—Great Egg Harbor River Drainage Basin Assessment

Water Quality Station					Point Source			Nonpoint Source		Land Use	
		Drainage Area (sq. mi)	Water Quality Index *	Quantity of Sewage Plant Discharge (1000 gal./day/sq. mi.)	Number of Sewage Treatment Plants	Number of Industrial Dischargers	Number of Landfills	Number of Effluent Spray Irrigation Sites	Percent Developed	Percent Agricultural	
Number	Location										
Upper Great Egg Harbor River											
01410775	GEHR at Berlin	1.98	12	0	0	0	0	0	—	—	
01410784	GEHR near Sicklerville	15.1	8	53.0	1	0	1	0	—	—	
01410787	GEHR at Sicklerville	1.6	9	0	0	0	0	0	0	45.0	
39420307-4562901	GEHR at New Brooklyn Lake, west outlet	22.8	7	35.1	1	1	1	1	—	—	
01410803	Fourmile Branch at Winslow Crossing	6.2	6	0	0	0	0	0	—	—	
01410810	Fourmile Branch at New Brooklyn	7.4	7	0	0	0	0	0	—	—	
01410820	GEHR near Broad Lane (near Blue Anchor)	37.3	6	21.4	1	1	1	0	—	—	
01410865	Squankum Br. at Malaga Rd.	3.0	12	0	0	0	0	0	29.0	42.0	
01411000	GEHR at Folsom	56.3	7	14.2	1	1	2	1	3.0	9.6	
01411503	Hospitality Branch at Berryland	20.0	6	0	0	0	0	0	16.0	20.3	
01411110	GEHR at Weymouth	154.0	7	5.4	2	1	5	2	6.3	22.0	
01411140	Deep Run Branch at Weymouth	20.0	5	14.0	1	0	1	1	3.2	11.6	
Lower Great Egg Harbor River											
01411196	Babcock Creek at Rt. 322 near Mays Landing	16.3	7	1.2	1	1	0	0	—	—	
01411170	GEHR at Mays Landing	205.0	tidal	5.5	24	2	6	2	—	—	
	Below Station 01411170	—	—	—	7	3	9	2	—	—	
TOTAL Great Egg Harbor River Basin		304.0	—	—	7	3	9	2	6.0	17.0	

* Index values = 5 (pristine) to 15 (most disturbed)

It is difficult to assess water quality in the **Lower Great Egg Harbor River** because the river becomes tidal and the two water quality stations are located in the upper non-tidal section of the sub-basin. Water quality levels are only slightly disturbed at Mays Landing. Therefore, it is assumed that the lower stretches of the river are also minimally disturbed.

Maurice River Drainage Basin (Table 2.14)

There is little data on the water quality of the Maurice River basin. The one station on the **Manumuskin River** has a water quality index rating of pristine. However, it also has elevated levels of arsenic, probably due to industrial waste discharges.

Table 2.14—Maurice River Drainage Basin Assessment

Water Quality Station		Point Source					Nonpoint Source		Land Use	
		Drainage Area (sq. mi)	Water Quality Index*	Quantity of Sewage Plant Discharge (1000 gal./day/sq. mi.)	Number of Sewage Treatment Plants	Number of Industrial Dischargers	Number of Landfills	Number of Effluent Spray Irrigation Sites	Percent Developed	Percent Agricultural
Number	Location									
Manumuskin River 01412100	Manumuskin River near Manumuskin	32.1	5	0	0	1	0	0	2.4	6.8
	Maurice River Below Station 01412100	—	—	—	0	0	0	3	0	—

* Index values = 5 (pristine) to 15 (most disturbed)

Absecon Creek Drainage Basin (Table 2.15)

The **Absecon Creek** basin currently has a high percentage of developed land and will be under increasing development pressure due to growth in and around Atlantic City. Water quality data was unavailable. The creek feeds the Atlantic City Reservoir, a public drinking water source, and empties into Absecon Bay.

Table 2.15—Absecon Creek Drainage Basin Assessment

Water Quality Station		Point Source					Nonpoint Source		Land Use	
		Drainage Area (sq. mi)	Water Quality Index	Quantity of Sewage Plant Discharge (1000 gal./day/sq. mi.)	Number of Sewage Treatment Plants	Number of Industrial Dischargers	Number of Landfills	Number of Effluent Spray Irrigation Sites	Percent Developed	Percent Agricultural
Number	Location									
TOTAL Absecon Creek Basin		19	—	0	0	0	2	0	61	2

Tuckahoe River Drainage Basin (Table 2.16)

The upper reaches of the **Tuckahoe River** basin have good quality because of the large amount of natural vegetation remaining there. The slightly degraded water quality at Head of River could be due to the nearby industrial discharge or to malfunctioning septic systems. Below Head of River, the Tuckahoe is tidal and little is known of existing water quality levels. Due to the lack of development or agricultural land, it is assumed that water quality is good to slightly disturbed.

Dennis Creek Drainage Basin (Table 2.17)

Little is known of the water quality conditions within the **Dennis Creek** basin. It is assumed that with the state landholdings and low percentage of development, water quality is fairly good. Because the creeks drain directly into the Delaware Bay instead of to smaller, more enclosed bays, water quality conditions are less critical to the estuary.

Table 2.16—Tuckahoe River Drainage Basin Assessment

Water Quality Station		Drainage Area (sq. mi)	Water Quality Index *	Point Source			Nonpoint Source		Land Use	
Number	Location			Quantity of Sewage Plant Discharge (1000 gal./day/sq. mi.)	Number of Sewage Treatment Plants	Number of Industrial Dischargers	Number of Landfills	Number of Effluent Spray Irrigation Sites	Percent Developed	Percent Agricultural
11411290	Tuckahoe River near Estell Manor	8.8	5	0	0	0	0	0	8.2	9.6
11411300	Tuckahoe River at Head of River, State Route 49	30.8	7	0	0	1	1	0	—	—
	Below Station 11411300	—	—	0	0	2	3	0	—	—
TOTAL Tuckahoe River Basin		70.	—	—	—	—	—	—	3	5

* Index values = 5 (pristine) to 15 (most disturbed)

Table 2.17—Dennis Creek Drainage Basin Assessment

Water Quality Station		Drainage Area (sq. mi)	Water Quality Index	Point Source			Nonpoint Source		Land Use	
Number	Location			Quantity of Sewage Plant Discharge (1000 gal./day/sq. mi.)	Number of Sewage Treatment Plants	Number of Industrial Dischargers	Number of Landfills	Number of Effluent Spray Irrigation Sites	Percent Developed	Percent Agricultural
TOTAL Dennis Creek Basin		72	—	0	1	0	3	0	3	13

Patcong Creek Drainage Basin (Table 2.18)

Information on water quality conditions in the **Patcong Creek** basin is also scant. Due to the high percentage of development in the basin, it is expected that the water is relatively disturbed. Development pressure in the area will increase due to its proximity to Atlantic City and the major road intersections.

Table 2.18—Patcong Creek Drainage Basin Assessment

Water Quality Station		Drainage Area (sq. mi)	Water Quality Index	Point Source			Nonpoint Source		Land Use	
Number	Location			Quantity of Sewage Plant Discharge (1000 gal./day/sq. mi.)	Number of Sewage Treatment Plants	Number of Industrial Dischargers	Number of Landfills	Number of Effluent Spray Irrigation Sites	Percent Developed	Percent Agricultural
TOTAL Patcong Creek Basin		26	—	—	1	0	0	0	43	3

Summary

Some generalized observations can be made from an examination of the data used for the sub-basin analyses. They are:

A relatively consistent relationship exists between pH and water quality. Frequency distributions of pH values are given in Table 2.19. Areas exhibiting higher pH's generally have lower water quality. In many cases, high pH waters were found downstream from point sources or agricultural areas.

Streams with low average flows are sensitive to pollution. Streams with small catchment areas, usually less than 20 square miles, have low average flows and do not have the capacity to assimilate

Table 2.19—pH Values

Station	Location	Number of Samples	Frequency Distribution		Maximum	Minimum
			90th percentile	Median		
Toms River						
OCN030		91	6.30	5.40	7.1	—
OCN029		85	6.03	4.80	6.8	5.1
OCN028		90	5.81	4.69	6.7	—
OCN041	Ridgeway Branch	81	4.89	4.21	5.5	—
OCN040	Ridgeway Branch	93	5.20	4.25	6.2	—
(01408492)						
OCN027		82	5.90	4.92	—	—
OCN042	Manapaqua Branch	86	6.50	5.75	6.8	—
OCN039	Union Branch	91	5.41	4.33	6.8	—
OCN038	Union Branch	81	4.85	4.36	6.0	—
OCN026		75	5.75	4.47	6.5	—
OCN025		203	5.70	4.70	7.2	3.5
(01408500)						
OCN024		83	5.75	4.60	6.6	—
OCN035	Wrangle Brook	79	4.70	4.20	5.7	—
OCN034	Wrangle Brook	85	5.00	4.40	—	—
OCN037	Davenport Branch	84	4.80	4.37	6.1	—
OCN036	Davenport Branch	82	4.94	4.49	6.6	—
OCN033	Wrangle Brook	76	4.90	4.40	5.7	—
OCN032	Jakes Brook	84	4.65	4.19	6.2	—
North Rancocas						
01465970		29	6.00	5.20	6.4	4.0
01466500	McDonalds Branch	75	4.60	4.10	6.0	3.2
01466900	Greenwood Branch	25	4.80	4.30	6.4	3.7
01467000		33	5.20	4.60	6.4	3.9
01467003		24	6.60	5.80	6.7	4.2
01467006		27	6.60	6.20	7.0	5.1
South Rancocas						
01465835		29	4.60	4.20	5.8	3.8
01465850		29	6.50	5.50	6.7	4.4
01465915		27	6.70	6.40	—	—
Cedar Creek						
OCN045		88	5.41	4.60	6.7	4.4
(0148830)						
OCN044						
(01408870)		87	5.30	4.52	5.2	4.2
OCN043		91	4.90	4.31	5.40	4.2
Forked River						
OCN047	North Branch Forked River	82	4.55	4.15	7.6	—
OCN046	North Branch Forked River	91	4.89	4.28	8.1	4.2
OCN048	Middle Branch Forked River	79	4.42	4.16	4.7	—
Oyster Creek						
OCN052		73	4.80	4.36	5.7	—
OCN051		157	4.70	4.40	5.8	3.9
Mill Creek						
OCN054		102	5.80	5.23	6.4	5.0
(01409150)						
OCN055	Fourmile Branch	85	5.90	5.09	7.6	—
OCN053		89	6.25	5.34	6.5	4.6
(01409210)						
Westecunk Creek						
OCN059		85	5.35	4.03	—	—
OCN058		94	5.65	4.74	6.5	4.9

Table 2.19—pH Values Continued

Station	Location	Number of Samples	Frequency Distribution		Maximum	Minimum
			90th percentile	Median		
Bass River						
01410150	East Branch Bass River	16	5.10	4.50	5.3	3.3
Wading River						
01409815	West Branch Wading River	29	4.80	4.20	5.7	3.0
01410000	Oswego River	20	5.20	4.40	3.4	3.2
Batsto River						
01409450	Springers Creek	20	6.60	6.40	6.6	4.7
01409470		11	6.40	5.00	6.4	4.3
01409500		22	5.60	4.70	6.2	3.5
Atsion/ Mechesactauxin Creek						
01409375	Mullica River	9	7.40	6.40	7.4	—
01409383	Mullica River	7	7.20	4.20	7.2	4.1
01409387	Mullica River	15	6.30	4.65	6.4	3.4
01409400	Mullica River	23	5.40	4.90	5.6	—
01409403	Wildcat Branch	6	6.50	5.90	6.5	5.2
0393825074393500		17	5.90	5.00	6.3	—
Nescochague Creek						
01409411		5	6.6	5.90	6.6	4.4
Hammonton Creek						
01409412		8	6.90	6.20	6.9	4.4
01409414		6	7.40	7.10	7.3	4.3
01409416		20	6.50	6.10	7.2	4.3
Lower Mullica River						
01409535		7	6.50	6.10	8.1	3.4
Upper Great Egg Harbor River						
01410775		29	7.20	6.30	7.5	5.7
01410784		60	6.60	5.90	6.9	4.3
01410787		63	7.70	6.70	8.5	3.7
01410789		110	7.50	6.90	8.7	5.2
01410803	Fourmile Branch	103	5.90	5.40	—	—
01410810	Fourmile Branch	116	6.50	5.70	8.0	3.0
01410820	Fourmile Branch	81	6.60	5.70	7.7	4.3
01410865	Squankum Branch	30	7.00	6.50	7.3	5.7
01411000		98	6.50	5.10	7.1	4.5
01411053	Hospitality Brook	25	6.00	5.70	6.3	4.5
01411110		31	5.90	4.90	6.4	3.8
01411140	Deep Run	28	6.20	4.40	7.0	3.9
394203074562901	West Outlet, New Brooklyn Lake	34	7.30	6.20	—	—
Lower Great Egg Harbor River						
01411170		28	6.40	5.20	6.8	4.1
01411196	Babcock Creek	24	5.30	5.00	6.4	3.9
Tuckahoe River						
01411290		26	5.80	5.10	—	—
01411300		42	6.10	4.80	—	—
Manumuskin River						
01412100		26	4.90	4.40	6.0	3.9

large waste loads. The small tributary streams have either very good or very disturbed quality, depending on upstream land use. Streams with higher average flows can better assimilate organic wastes.

Land uses impact surface water quality. Stream stretches with pristine or good water quality gen-

erally drain areas of natural vegetation which have few point sources or site-specific, non-point sources. Stream stretches draining areas in row-crop agriculture generally have higher pH levels, higher nitrogen levels, and higher total dissolved solids levels due to fertilization and liming activities.

Streams draining areas of suburban and urban development generally contain elevated pH, suspended solids, dissolved oxygen demand and nitrogen. The high levels are due to malfunctioning septic systems, stormwater runoff, point source discharges, and leachate from site-specific non-point pollution.

Water quality is affected by both point and non-point sources of pollution. However, because point sources are continuous and non-point sources result from storm events, the ecological effects may differ significantly.

Hammonton Creek is an example of point source degradation. By contrast, Squankum Branch in the Great Egg Harbor River has one small agricultural area, no known point discharge, and poor quality. Non-point sources are more pervasive. Every stream draining a developed or agricultural area will be affected. Although point sources affect only stream segments downstream of the discharge, they very often can discharge greater amounts of pollutants than non-point sources.

The Pinelands, being relatively undeveloped, have fewer and smaller point sources than the rest of the state. Therefore, non-point sources play a more significant role. Also, as treatment plants become upgraded and industrial discharges pretreated, the relative effect of each point source may diminish.

The Pinelands system is sensitive to water quality changes. Major water quality parameters associated with development which may alter stream ecosystems and vegetation are pH, suspended solids, total dissolved solids, and nutrients.

The Pinelands ecosystem has adjusted to a low pH. If the characteristic pH is altered, the species pool will change. Suspended solids are normally very low. Increased loads can smother bog vegetation and fish eggs, clog gills of filter feeders, and transport toxins and nutrients. Total dissolved solids are low and Pinelands species have adjusted to that condition. Alteration of solids levels can also cause the species pool to change. The waters have low nutrient levels which provide for the endemic plants and animals. Raising the nutrient levels will increase competition from invader species which cannot adapt to the low nutrient environment.

In addition, the water of characteristic Pinelands streams is very susceptible to chemical change. This situation is compounded by the fact that the typical Pinelands sandy soil is inert, achieving very little renovation of polluted water.

Estuaries may be impacted by water quality changes in Pinelands streams. Many of the Pinelands rivers drain to small, semi-enclosed estuaries whose water exchange with the ocean is minimal, such as Barnegat Bay. Because of their minimal flushing, they may be affected by increased nutrient loadings. Secondly, reduced stream flows from increased groundwater withdrawals would alter the salinity gradients in the estuary. Freshwater marshes would shift, aquatic nursery and spawning areas would be altered, and circulation patterns would be disrupted.

SOILS

The soils of the Pinelands, which have developed from the sandy geologic deposits, are unusually porous and acid. The parent soil material has a greater proportion of coarse sandy particles than finer silt and clay particles. The greater the proportion of coarse particles in a soil, the less its capacity to retain both water and nutrients. Thus, even though the Pinelands get the same amount of rainfall as the surrounding areas, the water drains so rapidly through the soil that little moisture or nutrients are left. This concept of leaching has significant implications when examining the relationship between land use and water quality. It is particularly relevant when evaluating the use of chemicals on both agriculture and residential areas, and the suitability of on-site disposal of wastewater with the standard septic tank.

Soils are classified in two ways, by series and phase. Soils with similar subsurface and morphological characteristics are classified into series. These are further refined into phases as determined by

characteristics including slope, degree of erosion, stoniness, and surface texture. The Pinelands have thirteen major soils series. In order of decreasing natural drainage, they are: Lakewood (excessively drained), Evesboro, Woodmansie, Downer, Sassafra, Aura, Lakehurst, Klej, Hammonton, Atsion, Berryland, Pocomoke, and Muck (very poorly drained). Additional soils which have limited distribution in the Pinelands include: Adelpia, Bayboro, Colemantown, Collington, Colts Neck, Donlonton, Elkton, Fallsington, Fort Mott, Freehold, Fripp, Galestown, Holmdel, Howell, Keyport, Kresson, Lakeland, Lenoir, Marlton, Matawan, Mullica, Nixonton, Pasquotank, Pemberton, Phalanx, Shrewsbury, Tinton, Weeksville, Westphalia, and Woodstown. Leon and St. Johns are other older soil mapping units. These soils have been incorporated into the Atsion and Berryland soils series.

Characteristically, the surface ("A" horizon) of an unlimed Pinelands soil is extremely acid (pH 3.6—4.0). The subsoil and substratum ("B" and "C" horizons) tend to be either extremely acid or very strongly acid (pH 4.2—5.0), with an average pH of about 4.6.

Figure 2.9 shows the regional locations of the 13 major soils. Some general characteristics of these soils are given in Table 2.20.

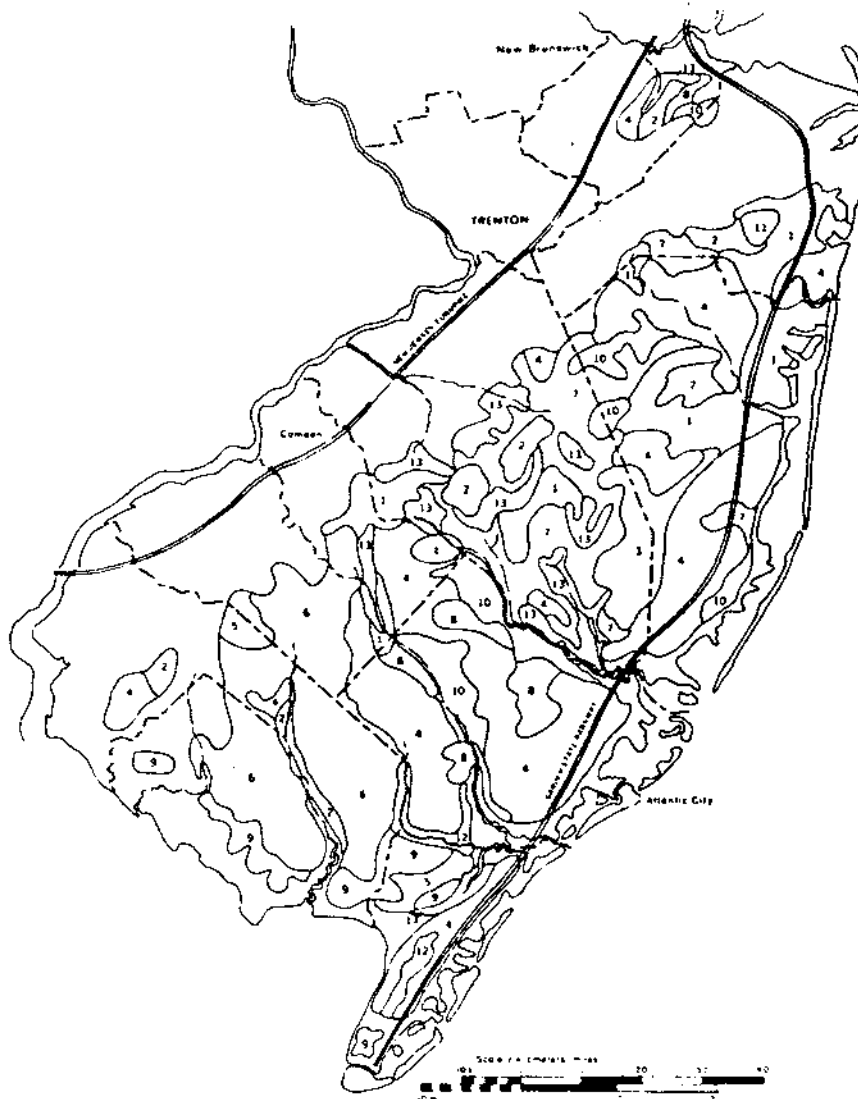


Figure 2.9—General Soil Map of the New Jersey Pine Barrens.

The two long double lines are the New Jersey Turnpike and the Garden State Parkway. Soils: (1) Lakewood, (2) Evesboro, (3) Woodmansie, (4) Downer, (5) Sassafra, (6) Aura, (7) Lakehurst, (8) Klej, (9) Hammonton, (1) Atsion, (11) Berryland, (12) Pocomoke, and (13) Muck. From Soil Surveys of U.S. Department of Agriculture (1951-1978).

Source: Markley, 1979

Table 2.20—General Distribution and Extent of Soils in the Pine Barrens

Soil series	General distribution in Pine Barrens	Position in landscape	Most common trees (in order of abundance)
Lakewood	Rare in southern part	High	Pitch and shortleaf pines, and few chestnut oaks; <i>dwarf form where fires have been severe</i>
Evesboro	Entire region	High	Pitch and shortleaf pines and few chestnut oaks
Woodmansie Fort Mott	Burlington and Ocean counties Mostly in southern part	High High	Dwarf pitch pine Black, white, and chestnut oaks, hickories, and few pitch and shortleaf pines
Downer	Entire region	High	Black, white, scarlet, red, and chestnut oaks, hickories, and few pitch and shortleaf pines
Sassafras	Mostly in southern part	High	Black, red, white, and scarlet oaks, hickories, and few beeches
Aura	Mostly in southern part	High	Black, white, red, and scarlet oaks, hickories, and few pitch and shortleaf pines
Lakehurst	Mostly in northern part	Intermediate	Pitch pine and few black, white and chestnut oaks
Kiej	Entire region	Intermediate	Black and white oaks, blackgum, and few red maples, sweetgums, pitch and shortleaf pines
Hammonton	Entire area	Intermediate	Black, white, red, southern red, and scarlet oaks and few pitch and shortleaf pines
Woodstown	Mostly in southern part	Intermediate	Red, white, black, southern red oaks, hickories, and few beeches
Atsion Fallsington	Entire area except Cape May County Southern part	Low Low	Pitch pine, red maple, and blackgum Swamp white oak, red maple, blackgum, sweetgum, sweet birch, beech, and few pitch pines
Berryland	Entire area	Low	Pitch pine, red maple, blackgum, and few Atlantic white cedars
Pocomoke	Entire area	Low	Swamp white oak, red maple, blackgum, sweetgum, willow oak, and few pitch pines
Muck	Entire area	Low	Atlantic white cedar and bay magnolia

Source: Adapted from Markley, 1979

Soil Development and Mineralogy

A typical "Pine Barrens" soil is usually thought of as a highly leached gray sand, such as the Lakewood. However, the Lakewood series is only one of several upland soils and is not representative of the large areas of lowland soils with high water tables in the Pinelands. The Lakewood soil is classified as a podzol, which normally develops in a moist cool climate under evergreen forests. There is a small accumulation of humus, and the surface mineral layer becomes gray as it is strongly leached of both organic matter and plant nutrients. Some of the clay, iron, and other relatively insoluble but mobile material which is leached from the surface accumulates in the "B" horizon. The Pines' average summer temperature is normally too high for podzolic soil formation. This is compensated by the unusually permeable, sandy quartzose parent material which podzolizes easily. Other soil series, such as Sassafras, podzolize more slowly because the larger proportion of finer particles in the surface soil inhibits the leaching process.

Soils are dynamic, changing over time in response to their environment until a stable state (equilibrium) is reached. A podzol soil, such as the Lakewood, is considered to have reached equilibrium, whereas the Sassafras has not yet stabilized. Those factors which help form soils—time, topography, parent material, climate and biological activity—also influence the formation of minerals in the soil.

The Pinelands soils are chemically inert because they are dominated by quartz sand, which is resistant to weathering and non-reactive. The silt fractions are also dominated by quartz, and are also

inert. The clay particle parent materials, more reactive and easily weathered feldspar and mica, rarely exceed 1 percent of the mineral content. The clay composition is dependent upon the parent material present and time of formation. Mica is mineralized to muscovite, vermiculite and smectite clays and feldspar to kaolinite and gibbsite clays. Since Pinelands soils contain small amounts of these fine particles, they have a low cation exchange capacity, resulting in low fertility and low pH.

Soil Characteristics and Interpretations

Soil characteristics have a direct influence on the land use patterns in a region. They also indicate the impact which various land uses can have on the natural environment. Therefore, mapping of soil characteristics provides a general guide to appropriate land use activities.

Some characteristics and interpretations are related to soil phases, while others are related to the series. For example, phases are used to classify prime agricultural soils, whereas the series are used to predict depth to seasonal high water table.

Agricultural Soils

Agriculture is an important economic activity in the Pinelands. As a land use, it is most dependent on soil characteristics. However, the best agricultural soils are also the easiest to develop. Plate 6 identifies those soil phases classified as prime agricultural soils, unique soils, and soils of statewide importance. These classifications are defined by the U.S. Soil Conservation Service.

Prime farmland is land best suited for producing food, feed, forage, fiber, and oilseed crops, and also available for these uses. The land could be cropland, pastureland, rangeland, forest land, or other land, but not built-up urban land or water. It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to modern farming methods. Prime farmland meets the following criteria:

- The soils have an adequate moisture supply. A dependable water supply is one in which enough water is available for irrigation in 8 out of 10 years for the crops commonly grown.
- At a depth of 20 inches, the soils have a mean annual temperature higher than 32°F. In addition, the mean summer temperature at this depth in soils with an O horizon (an organic layer at the surface of the mineral soil) is higher than 47°F; in soils that have no O horizon the mean summer temperature is higher than 59°F.
- The soils have a pH between 4.5 and 8.4 in all horizons within a depth of 40 inches, or in the root zone if the root zone is less than 40 inches deep. This range of pH is favorable for growing a wide variety of crops without adding large amounts of amendments.
- The soils have no water table, or a water table that is maintained at a sufficient depth during the cropping season to allow food, feed, fiber, forage, and oilseed crops common to the area to be grown.
- The soils can be managed so that, in all horizons within a depth of 40 inches, or in the root zone if the root zone is less than 40 inches deep, during part of each year the conductivity of saturation extract is less than 4 mmhos/cm and the exchangeable sodium percentage (ESP) is less than 15.
- The soils are not flooded frequently during the growing season (less often than once in 2 years).
- The soils have a product of K (erodibility factor) x percent slope of less than 2.0 and a product of I (soil erodibility) x C (climatic factor) not exceeding 60. That is, prime farmland does not include soils having a serious erosion hazard.
- The soils have a permeability rate of at least 0.06 inches per hour in the upper 20 inches, and the mean annual soil temperature at a depth of 20 inches is less than 57°F. (Permeability rate is not a limiting factor if the mean annual soil temperature is 57°F or higher.)
- Less than 10 percent of the surface layer in these soils consists of rock fragments coarser than 3 inches. These soils present no particular difficulty in cultivating with large equipment.

Unique farmland is land other than prime farmland that is used for the production of specific high-value food and fiber crops. It has the special combination of soil quality, location, growing season,

and moisture supply needed to produce sustained high quality and/or high yields of a specific crop when treated and managed according to modern farming methods. Examples of such crops are citrus, olives, cranberries, fruit and vegetables.

Farmland of statewide importance is land, in addition to prime and unique farmlands, that is of statewide importance for the production of food, feed, fiber, forage, and oilseed crops. Criteria for defining and delineating this land are determined by state authorities. Generally, additional farmlands of statewide importance include those that are nearly prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods. Some may produce as high a yield as prime farmlands if conditions are favorable.

Depth of Water Table

Depth to seasonal high water table is one of the most restrictive soil characteristics in the Pinelands. It represents the level to which the water table rises during the wet season, which in the Pinelands is spring. Plate 7 depicts the ranges of seasonal high water tables in the Pinelands. These values are listed in Table 2.21, along with other characteristics of the Pinelands' soils by series.

**Table 2.21—Characteristics of New Jersey Pinelands Soils
As Described by the U.S. Soil Conservation Service**

Series	Drainage Class	Hydrologic Soil Group	Depth to Seasonal Water Table (ft)	Horizon Depths (in)	Texture	pH	Permeability (in/hr)	Cation Exchange Capacity (millequivalents/100g)
Adelphia	moderately well drained	C	1.5-4	0-14	SL,FCL,SIL	2.6-5.0	0.2-6.0	—
				14-37	SCL,L	3.6-5.0	0.2-2.0	
				37-60	SR-LS-SL	3.6-5.0	0.6-6.0	
Alluvial Land	very poorly drained	D		0-10	L,SIL,SL	<4.5	0.6-2.0	—
				10-30	SIL	4.5-5.0	0.6-2.0	
				30-60	SR-SL-SIL	4.5-5.0	0.6-6.0	
Atsion	poorly drained	D	0-1.0	0-18	S,FS	3.6-5.0	6.0-20	<8
				18-24	LS,S,SL	3.6-5.0	2.0-6.0	
				24-40	S,LS	4.5-5.0	6.0-20	
				40-60	SR-S-SIL	4.5-5.0	6.0-20	
Aura	well drained	B	>6.0	0-22	SL,LS,L	3.6-5.0	0.2-6.0	3-7
				0-22	GR-SL	3.6-5.0	0.2-6.0	
				22-59	GR-SL,SCL,GR,SCL	3.6-5.0	0.2-2.0	
				59-72	S,GR-S,SCL	3.6-5.0	0.2-6.0	
Bayboro	very poorly drained	D	0-0.5	0-14	FSL	4.5-5.5	2.0-6.0	—
				0-14	L,CL	4.5-5.5	0.6-2.0	
				14-64	CL,SC,C	4.5-5.5	0.06-0.2	
Berryland	very poorly drained	D	0-0.5	0-12	S,LS	3.6-4.4	6.0-20	<10
				12-20	S,LS	1.5-5.0	2.0-6.0	
				20-30	S	4.5-5.0	2.0-6.0	
				30-40	S,LS	4.5-5.0	2.0-20	
				40-72	SR-S-SL	4.5-5.0	2.0-20	
Colemantown	poorly drained	D	0-1.0	0-10	FSL,L,SCL	3.6-5.5	0.2-2.0	—
				10-30	SC,C,CL	4.5-5.5	0.06-0.2	
				30-60	L,CL,SL	4.5-5.5	0.2-0.6	

**Table 2.21—Characteristics of New Jersey Pinelands Soils
As Described by the U.S. Soil Conservation Service
Continued**

Series	Drainage Class	Hydrologic Soil Group	Depth to Seasonal Water Table (ft)	Horizon Depths (in)	Texture	pH	Permeability (in/hr)	Cation Exchange Capacity (milliequivalents/100g)
Collington	well drained	B	>6.0	0-13	SIL,FSL,SL	3.5-5.5	0.6-2.0	—
				0-13	LS	3.6-5.5	6.0-20	
				13-32	SL,SCL,CL	3.6-5.5	0.2-20	
				32-60	SR-S-SIL	3.6-5.5	0.2-6.0	
Colts Neck	well drained	B	>6.0	0-10	SL,LS,L	4.5-6.0	0.6-2.0	—
				10-35	SL,SCL,L	4.5-6.0	0.6-2.0	
				35-60	LS,S,SL	4.5-6.0	2.0-20	
Dontlonton	moderately well drained	C	1.5-2.0	0-12	FSL,L,LFS	4.5-5.5	0.2-20	—
				12-50	SC,SCL	4.5-5.5	0.06-0.2	
				50-60	FSL,SCL,CL	4.5-5.5	0.2-2.0	
Downer	well drained	B	>6.0	0-18	LS,SL	3.6-5.0	0.6-6.0	4-7
				18-30	SL,GR-SL	4.5-5.0	0.6-6.0	
				30-40	SR-S-G-LS	4.5-5.0	>2.0	
				40-60	SR-GR-S-SCL	4.5-5.0	>2.0	
Elkton	poorly drained	D	0-1.0	0-10	SIL,SL,SICL	3.6-5.5	0.6-2.0	—
				10-36	SIC,CL,C	3.6-5.5	>0.2	
				36-60	SICL,FSL,C	3.6-5.5	0.2-6.0	
Evesboro	excessively drained	A	>6.0	0-40	S,LS	3.6-5.0	6.0-20	<1
Fallsington	poorly drained	D	0-1.0	0-11	SL,FSL,L	3.6-5.5	0.6-6.0	5-12
				11-27	SL,L,SCL	3.6-5.5	0.6-2.0	
				27-60	LS,S,SL	3.6-5.5	2.0-6.0	
Fill Land	variable	A			S,GS	4.0-5.0	6.0+	—
Fort Mott	well drained	A	>6.0	0-30	LS,S	3.6-5.5	6.0-20	—
				30-49	SL,SCL	3.6-5.5	0.6-6.0	
				49-60	SR-S-LS	3.6-5.5	6.0-20	
Freehold	well drained	B	>6.0	0-12	L,SL,FSL	3.6-4.4	0.2-6.0	—
				0-12	LS,LFS	3.6-4.4	6.0-20	
				12-35	SL,SCL,L	4.5-5.0	0.6-2.0	
				35-60	SR-LS-SL	4.5-5.0	0.6-6.0	
Fripp	excessively drained	A	>6.0	0-5	FS,S	5.1-7.8	6.0-20	—
				5-80	FS,S	5.6-7.8	6.0-20	
Galestown	somewhat excessively drained	A	>6.0	0-40	LS,S	3.6-5.5	>6.0	—
				40-60	S,LS,GR-S	3.6-5.5	>6.0	
Hammonton	moderately well drained	B	1.5-4.0	0-18	LS,SL	3.6-4.4	2.0-6.0	>5
				18-36	SL,GR-SL	4.5-5.0	0.6-6.0	
				36-60	SR-GR-S-SL	4.5-5.0	>2.0	

**Table 2.21—Characteristics of New Jersey Pinelands Soils
As Described by the U.S. Soil Conservation Service
Continued**

Series	Drainage Class	Hydrologic Soil Group	Depth to Seasonal Water Table (ft)	Horizon Depths (in)	Texture	pH	Permeability (in/hr)	Cation Exchange Capacity (millequivalents/100g)
Holmdel	moderately well drained	C	0.5-4.0	0-10	L,SL,FSL	3.6-4.4	0.6-2.0	—
				0-10	LS,LFS	3.6-4.4	2.0-20	
				10-34	SL,SCL,L	4.5-5.0	0.6-2.0	
				34-60	SF-FSL-S	4.5-5.0	0.6-2.0	
Howell	well drained	C	>3.0	0-8	FSL,L,SIL	3.6-5.0	0.2-2.0	—
				8-14	SCL	3.6-5.0	0.2-2.0	
				14-46	C,SICL,SIC	3.6-5.0	0.2-0.6	
				46-60	C,SCL,SIL,GR	3.6-5.0	0.2-0.6	
Keansbury	very poorly drained	D	0-0.5	0-10	FSL,SL,L	>4.5-5.5	0.6-2.0	—
				10-30	SL,SCL,FSL	4.5-5.5	0.2-2.0	
				30-60	SR-LS-SL	4.5-5.5	2.0-6.0	
Keyport	moderately well drained	C	1.5-4.0	0-10	SIL,L	3.6-4.4	0.2-0.6	—
				0-10	SL,FSL	3.6-4.4	0.6-2.0	
				10-60	SICL,CL,C	4.5-5.0	>0.2	
Klej	moderately well drained	B	1.5-2.0	0-39	LS,FS,LFS	3.6-5.0	>6.0	>5
				39-47	S,FS	3.6-5.0	>6.0	
				47-60	SL,SCL,SC	3.6-5.0	>2.0	
Kresson	somewhat poorly drained	C	1.0-1.5	0-14	FSL,SL,L	3.6-5.5	0.2-6.0	—
				0-14	LS	3.6-5.5	2.0-6.0	
				14-30	C,CL,SC	3.6-5.5	0.06-0.2	
				30-60	SR-SL-C	3.6-5.5	0.06-0.2	
Lakehurst	moderately well drained	A	1.5-3.5	0-15	S,FS	3.6-5.0	6.0-20	—
				15-30	S,FS,LS	3.6-5.0	6.0-20	
				36-60	S,GR-S,SL	4.5-5.0	6.0-20	
Lakeland	excessively drained	A	>6.0	0-43	S,FS	4.5-6.0	>20	—
				43-90	S,FS	4.5-6.0	>20	
Lakewood	excessively drained	A	>6.0	0-10	S,FS	3.6-5.0	6.0-20	<1
				10-36	S,FS,LS	3.6-5.0	6.0-20	
				36-60	S,GR-S,SL	3.6-5.0	0.6-20	
Lenoir-Keyport	somewhat poorly drained	D	1.0-2.5	0-8	L,SIL,VFSL	4.5-5.5	0.6-2.0	—
				8-75	C,SIC,CL	4.5-5.5	0.06-0.2	
Manahawkin Muck	very poorly drained	D	+ 1.0-0	0-39	SP	3.6-5.5	0.2-6.0	—
				39-60	S,GR-S	4.5-5.0	2.0-6.0	
Marlton	well drained	C	2.0-5.0	0-10	FSL,SL,L	<4.0-5.0	0.2-2.0	—
				10-40	SC,SCL,C	4.5-5.5	0.06-0.2	
				40-60	SR-SL-C	4.5-5.5	0.06-0.2	
Matawan	moderately well drained	C	2.0-3.0	0-20	LS	4.5-5.5	0.6-6.0	—
				0-20	SL,FSL	4.5-5.5	0.6-6.0	
				20-38	SCL,SL,CL	3.6-5.5	0.06-0.6	
				38-60	SR-S-CL	3.6-5.5	0.06-20	

**Table 2.21—Characteristics of New Jersey Pinelands Soils
As Described by the U.S. Soil Conservation Service
Continued**

Series	Drainage Class	Hydrologic Soil Group	Depth to Seasonal Water Table (ft)	Horizon Depths (in)	Texture	pH	Permeability (in/hr)	Cation Exchange Capacity (millequivalents/100g)
Mullica	very poorly drained	C	0-0.5	0-10	SL,L	3.6-5.0	0.6-2.0	—
				0-10	GR-SL,GR-L	3.6-5.0	0.6-6.0	
				10-28	SL,SCL,GR-SL	3.6-5.0	0.6-2.0	
				28-60	SR-GR-S-SCL	3.6-5.0	0.2-20	
Nixonton	moderately well drained	B	3-5	0-34	VFSL,L,SIL	5.1-6.5	0.6-2.0	—
				34-80	LFS,LS,FS	5.1-6.5	2.0-6.0	
Pasquotank	poorly drained	B/D		0-14	FSL	<4.5-5.0	0.6-2.0	—
				14-30	VFSL,FSL	4.5-5.0	0.2-2.0	
				30-60	SR-LS-S-FSL	4.5-5.0	0.6-2.0	
Pemberton	moderately well drained	A	1.0-4.0	0-24	S,LS	3.6-5.0	2.0-60	—
				24-34	SL,FSL,SCL	3.6-5.0	2.0-6.0	
				34-60	SR-S-C	3.6-5.0	0.6-6.0	
Phalanx	well drained	B	>6.0	0-6	LS,S	3.6-5.0	2.0-6.0	—
				6-22	SL,LS,CN-SL	4.5-5.5	0.6-6.0	
				22-46	CN-SL,FL-LS,SCL	4.5-5.5	0.6-2.0	
				46-72	S,LS,FL-S	4.5-5.5	2.0-6.0	
Pocomoke	very poorly drained	D	0-0.5	0-28	SL,FSL,LS	3.6-5.5	0.6-2.0	<10
				28-40	LS,S	3.6-5.5	2.0-6.0	
				40-60	SCL,SL,S	3.6-5.5	0.6-6.0	
Sassafras	well drained	B	>6.0	0-9	SL,L,FSL	3.6-5.5	0.6-6.0	4-12
				0-9	LFS	3.6-5.5	0.6-6.0	
				9-40	L,SCL,SL	3.6-5.5	0.6-2.0	
				40-70	GR-SL,FSL,S	3.6-5.5	0.6-20	
Shrewsbury	poorly drained	D	0-1.0	0-14	FSL,SL,L	3.6-5.0	0.6-2.0	—
				14-32	SL,SCL,CL	3.6-5.0	0.2-2.0	
				32-60	SR-LS-SL	3.6-5.0	2.0-20	
St. John	very poorly drained	B/D	0-22		S	4.5-5.5	>20	>10
				22-42	S	4.5-5.5	0.6-2.0	
				42-72 +	S	4.5-5.5	>20	
Tidal Marsh	—	D		0-96		6.6-7.3	6.0+	—
				0-36		6.6-7.3	6.0+	
				36-96 +				
Tinton	well drained	A	>6.0	0-26	S,FS,LS	3.6-5.0	0.6-6.0	—
				26-40	FSL,SL,SCL	3.6-5.0	2.0-6.0	
				40-60	SR-S-SL	3.6-5.0	0.6-6.0	
Weeksville	very poorly drained	B/D	0-1.0	0-42	SIL,VFSL,L	4.5-5.5	0.6-2.0	—
				42-56	FSL,SL	4.5-5.5	0.6-2.0	
				56-72	S,LS,LFS	4.5-5.5	2.0-6.0	

**Table 2.21—Characteristics of New Jersey Pinelands Soils
As Described by the U.S. Soil Conservation Service
Continued**

Series	Drainage Class	Hydrologic Soil Group	Depth to Seasonal Water Table (ft)	Horizon Depths (m)	Texture	pH	Permeability (in/hr)	Cation Exchange Capacity (millequivalents/100g)
Westphalia	well drained	B	>6.0	0-10	FSL,VFSL	3.6-5.5	0.6-2.0	—
				10-28	FSL,VFSL,LFS	3.6-5.5	0.6-2.0	
				28-72	FS,LFS	3.6-5.5	0.6-6.0	
Woodmansie	well drained	B	>6.0	0-17	S,LS	3.6-4.4	6.0-20	>4
				17-30	SL,GR-SL,SCL	3.6-5.5	0.6-6.0	
				30-60	SR-GR-S-SCL	3.6-5.5	0.6-20	
Woodstown	moderately well drained	C	1.5-2.5	0-11	SL,FSL,L	3.6-5.5	0.6-6.0	5-14
				11-29	SCL,L,SL	3.6-5.5	0.6-2.0	
				29-60	SL,LS,GR-S	3.6-5.5	0.6-6.0	

Texture Symbols

S—Sand
 LS—Loamy Sand
 SL—Sandy Loam
 SCL—Sandy Clay Loam
 SIL—Silt

L—Loam
 FLS—Fine Loamy Sand
 VFSL—Very Fine Sandy Loam
 C—Clay

Modifier Symbols (precede texture symbols)

GR—Gravelly
 SR—Stratified
 CN—Channery

Hydrologic Soil Groups

All soils have been classified into four hydrologic groups according to their infiltration and transmission rates. They are:

- **Group A** — Soils having high infiltration rates even when thoroughly wetted. These consist chiefly of deep, well to excessively drained sands or gravels. These soils have a high rate of water transmission in that water readily passes through them and low runoff potential.
- **Group B** — Soils having moderate infiltration rates when thoroughly wetted. These consist chiefly of moderately deep to deep, and moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.
- **Group C** — Soils having slow infiltration rates when thoroughly wetted. These consist chiefly of soils with a layer that impedes downward movement of water or soils with moderately fine to fine texture. These soils have a slow rate of water transmission.
- **Group D** — Soils having very slow infiltration rates when thoroughly wetted. These consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low slow rate of water transmission, and high runoff potential.

The distribution of these groups in the Pinelands is depicted in Plate 8.

The volume of stormwater runoff is generally determined by the soil's characteristics, as classified in the hydrologic groups, and by its hydrologic condition. The condition depends on the soil's moisture content at the time of a storm, its humus and organic content, and its temperature.

Deep aquifer recharge areas were previously defined based on hydrologic soil groups. Included were soils in Group "A," those soils in Group "B" which are completely surrounded by Group "A," and those in the two previous categories which have a depth to water table greater than 10 feet. Pinelands Group "C" and "D" soils are the effective stormwater runoff source areas.

Soil Factors Which Limit Use For Septic Tank Soil Absorption Fields

The previous sections have identified Pinelands soils as being chemically inert and unable to as-

simulate waste placed in or on the land. One major source of waste which has been linked to groundwater problems is septic tank effluent. The following discussion details the transformation and transportation mechanisms which occur in the unsaturated zone of the soil profile as wastewater percolates through it. Although described here in the context of septic effluent, the processes function in a similar manner irregardless of the waste source — for example, fertilizers, landfill leachate, chemical spills, and leaks.

Plate 9 is a representation of those soil factors which limit the use of septic tank and soil absorption systems as a means of on-site wastewater disposal. The factors were broken down into six groups based on water table depth and permeability class. From most restrictive to least restrictive, the groups are:

1) *Flooding frequency: occasional to frequent.* Septic tanks do not function well in flooded conditions, which allow for the movement of bacteria and viruses through the soil.

2) *Seasonal high water table: less than 5 feet. Soil drainage classes: somewhat poorly, poorly, and very poorly drained.* At least six feet of soil is required to prevent the movement of pathogenic organisms from a septic leach field trench bottom to the water table (Brown, 1980). Current Soil Conservation Service mapping techniques only provide seasonal water table information to a depth of five feet. This data, therefore, provides a general guide to soil suitability for septic systems. Site-specific investigations are needed. The group also includes soils with permeability less than 0.2 inches per hour. Septic tanks do not function well in soils this impermeable because movement of liquids in the drainage field is too slow to relieve the build-up in the septic tank.

3) *Permeability: greater than 6 inches per hour. Soil drainage classes: excessively and somewhat excessively drained.* Soils with permeabilities greater than 6 inches per hour present special concern because they do not filter effluent effectively. If current design criteria were followed, septic fields in such soils would have very small bottom trench areas. They may permit rapid downward movement of water, nitrates, pathogenic bacteria and virus. While a biological "crust" will form at the interface of the trench fill material and the undisturbed soils, slowing the movement of leachate, heavy rains would be likely to wash virus from the outside of the crust into the groundwater below these soils. Phosphorus would also move rapidly to the groundwater once the soils' adsorption mechanisms were saturated.

4) *Permeability: greater than 2 inches but less than 6 inches per hour.* Permeabilities between 2 and 6 inches per hour would also be expected to allow rather rapid movement of virus and breakthrough of phosphorus. These soils are the well-drained members of hydrologic group "B." However, since trenches would be designed with larger bottom areas than in more permeable soils, it would take longer for the phosphorus to break through. Concentrations of both phosphorus and nitrate reaching the groundwater are also more dilute since they are spread over a larger area. Only soils in this group which have a sub-surface with permeability less than 2 inches per hour would minimize virus movement.

5) *Variable and undeterminable: Site investigation required.* Consists of soils with problems that require individual attention. Sanitary landfills, coastal beaches, steep slopes, and ironstone are examples. These soils need to be examined on an individual basis since they have been previously disturbed and predictions of their properties cannot be made.

6) *Permeability: Greater than 0.2 but less than 2 inches per hour.* Soils with permeabilities in this range are the moderately drained members of hydrologic group "B." Water is not expected to move fast enough to flush virus to the groundwater, and the phosphorus adsorption capacity should be sufficient to prevent migration to the groundwater for several years. These soils are the least restrictive in the Pinelands for septic leachfields.

Soils as a Waste Treatment Medium

The following discussions describes the soil's ability to renovate a septic tank effluent as it flows through the unsaturated soil column. The transformation and transportation process in sandy soils like those of the Pinelands has been summarized by Bouma (1972):

Unsaturated flow induced by crusts was very effective in removing fecal indicators from the percolating effluent within a few centimeters depth of soil. Absence of unsaturated flow, as observed in one system where the seepage bed was submerged in the groundwater, resulted in considerable lateral movement of fecal indicators in the groundwater. A detailed study of four systems in sandy soils revealed that nitrification of effluent, containing only $\text{NH}_4\text{-N}$ and organic

N, occurred in the aerated subcrust soil. Contents of NO₃-N in the groundwater directly below some of these systems was relatively high, but concentrations decreased at increasing distances from the system as a result of groundwater movement and dilution.

Soils vary in their capacity to remove pollutants from percolating effluent. Sands are relatively poor purifiers as shown in Figure 2.10. In the case of a sandy soil, the percolation test design criteria calls for relatively small field area based on saturated hydraulic conductivity. In fact, the limited capacity of a sand to renovate wastewater may dictate a large absorption field to optimize pollutant attenuation, particularly where a permanent or fluctuating shallow water table limits the depth of unsaturated soil available for wastewater renovation.

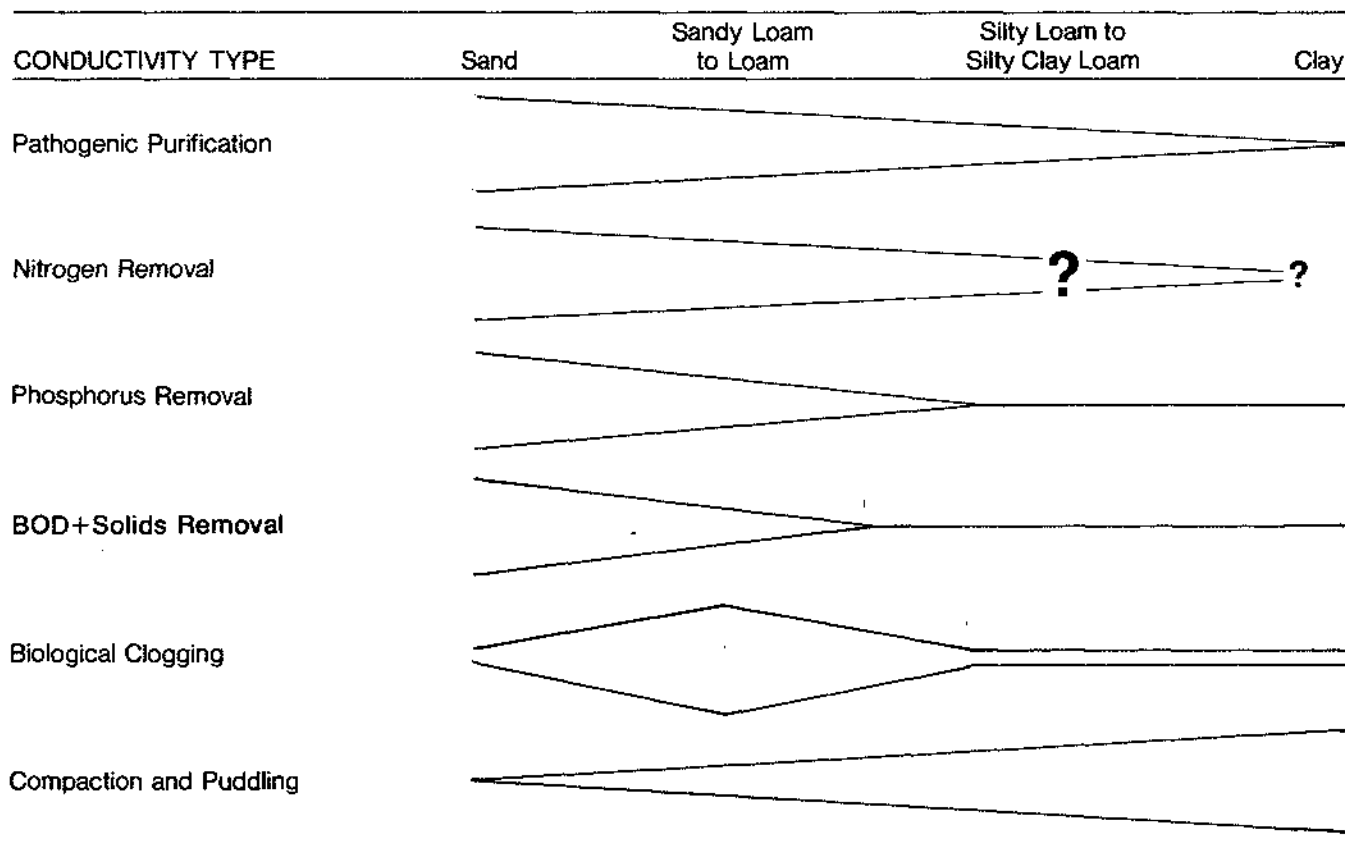


Figure 2.10—Suitability and Limitations of Various Soil Types for Renovation of Septic Tank Effluent.
(Limitations and potential problems increase with band width).

Septic tank effluent is widely variable in composition. Sewage differs according to system usage (i.e., business or school versus home), personal habits, and management practices. The size and design of the septic tank, the degree of sludge and scum accumulation in the tank, tank-water detention time, and waste flow rates determine the effectiveness with which contaminants are removed from the waste stream. The major components of septic effluent include biological contaminants (bacteria and virus), and chemical contaminants. The chemicals include suspended and dissolved organics and various inorganics such as nitrogen, phosphorus, potassium, and salts.

Function of the Septic System

Three basic components of a "standard" system are the septic tank, effluent distribution field, and native soil. Initial treatment by the septic tank functions to remove most of the suspended solids by sedimentation. Baffles within the tank trap any low-density floating scum. Anaerobic conditions initiate chemical and biological alteration of sewage constituents. Partially renovated effluent is then discharged to the soil via the drainfield, which distributes the effluent load as evenly as possible over the entire area. The soil provides final treatment of the wastewater before its loss to either evapotranspiration or deep percolation. The functions of the soil are (1) physical filtering of suspended solids and microorgan-

isms, (2) sorption by ionic exchange, chelation and pH-induced precipitation, and (3) chemical and biological oxidation.

A key to the effectiveness of the standard septic system is the previously mentioned biological crust or "mat," which forms at the boundary of the trench fill and the undisturbed soil. The crust forms anaerobically as a result of continuous inundation of the infiltrative surfaces. Crust development in a new absorption trench can occur within about 100 days of initial use. The infiltration capacity of these crusts generally appears to be unrelated to soil properties.

Crusting can be beneficial, since the organic layer serves as an effective degradative filter to suspended and dissolved organic matter. Also, aerobic, unsaturated flow conditions are encouraged in the soil beside and below the disposal trench. The transmission and renovation capabilities of a soil are dependent upon its interaction with waste effluent constituents in unsaturated flow conditions beneath the crust. Advantages of unsaturated flow are the increased contact time and closer proximity of waste constituents with soil particles, organic matter, and microorganisms. These conditions enhance the purification of the effluent through filtration, sorption, and oxidation.

Two important shortcomings of the standard septic system are related to the conventional methods used to design the absorption field area. The design involves performing a percolation test at the site to determine the hydraulic loading capacity of the soil. However, within a few months of service, the crust limits absorption to well below the soil's capacity. An absorption field area which does not account for crusting could result in effluent ponding with possible discharge on the land surface. A second inadequacy of the "perc" test design method is that only the saturated hydraulic conductivity of the soil is considered. The following discussion of the movement through the soil of pollutants commonly associated with septic tank effluent was prepared by Kirk Brown, Ph.D., as part of his report to the Pinelands Commission.

Nitrogen

Nitrogen is of primary importance in the renovation of sewage effluent because excessive concentrations in groundwater may be a public health hazard and can contribute to eutrophication of surface water. The presence of nitrite (NO_2^-) and, indirectly, nitrate (NO_3^-) in drinking water may lead to methemoglobinemia which can impair oxygen transport in the blood, particularly in infants where gastrointestinal upsets can encourage reduction of nitrate to nitrite.

Research has also demonstrated the ability of nitrites to form nitrosamines in the presence of primary or secondary amines in water, sewage, or soil. The formation of nitrosamines in soil is a potential threat to public health because these compounds are the most broadly acting and among the most potent carcinogens known. The precursors of nitrosamines are quite common in the environment. Nitrites are commonly generated from fertilizers, sewage, and food which contains nitrates. Primary and secondary amines occur in urine, feces, higher plants, and as a result of the degradation of pesticides. Thus, it is imperative that the fate of nitrosamines in soil be understood, and that the passage of nitrosamines into groundwater be prevented.

Highest rates of nitrosamines formation have been observed to take place at a low pH, although the persistence was greater at a higher pH. The highest rate of formation in soils has been observed at a pH of 5.2, while nitrosamine formation in sewage was most rapid at a pH of 3.5. The potential for nitrosamine transmission exists in part because of the persistence of these compounds in soil and water. Indications are that 75-150 days are required for complete reduction of nitrosamines applied to soils at a rate of 15 to 20 parts per million.

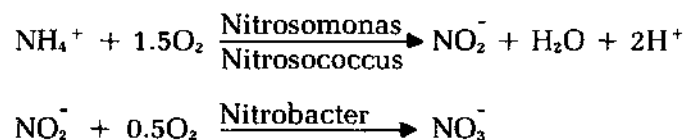
Nitrosamines constitute a human health hazard when they leach through the soil into the groundwater or translocate into plants. Lettuce and spinach grown in soil containing nitrosamines have been observed to assimilate dimethylnitrosamine, which moved into their leaves.

The formation of carcinogenic nitrosamines in soil has not been demonstrated under natural conditions, except where the soil has been treated with both methylamine and nitrite. However, widespread occurrence of these precursors in nature indicate their probable formation. The potency of nitrosamines dictates the use of all available precautions to prevent them from entering the food chain. Such chemicals could form in the surrounding septic leach fields, and could possibly move to the groundwater, particularly in very sandy soils.

Nitrogen Chemistry in the Soil

The fate of nitrogen in the environment is complex. It is the result of a variety of physical, chemical, and biological mechanisms which are in turn greatly influenced by environmental conditions such as temperature, moisture, and atmospheric composition. With regard to septic effluent, considerable nitrogen is introduced into the soil below an absorption trench. About 75 percent of the nitrogen in septic effluent is in the form of ammonium (NH_4^+). The remainder is largely organic nitrogen (N), most of which is sorbed and transformed to ammonium in the crusted zone of the absorption field. Nitrogen thus enters the soil from septic systems almost totally as ammonium. Once there, it can undergo several processes, including nitrification, fixation, adsorption, immobilization, volatilization, and leaching.

Nitrification is the oxidation of ammonium to nitrate. It consists of the biological conversion of ammonium to nitrite by the bacteria *Nitrosomonas* and *Nitrosococcus*, followed by further oxidation to nitrate by *Nitrobacter*. The nitrifying organisms are autotrophs which require no organic carbon source. The reactions may be written as:



Oxygen is the most common environmental restraint to nitrification, which requires 4.56 mg of oxygen per 1 mg of nitrogen oxidized. While the moisture regime of the soil can indirectly control the process by restricting soil oxygen, extremely dry conditions may reduce bacterial populations and also limit nitrification. The optimum temperature range for nitrification is between 30 and 35 °C. At temperatures below 5 °C, the process rapidly decreases.

An abundant base status of the soil is important to nitrification. When the soil is below pH 5, the process can continue in organic soils when sufficient bases are present. In acidic, inorganic soils, long-term application of wastewater near neutrality can increase soil pH into an acceptable range, particularly where the soil has a low buffering capacity as it does in the Pinelands. Although aeration below septic lines should be adequate for nitrate formation, the initially low pH and base status of the Pinelands' soils may discourage the oxidation of ammonium. Additionally, the cold temperatures during much of the year can inhibit activity of the nitrifying bacteria, resulting in movement of ammonium into the groundwater.

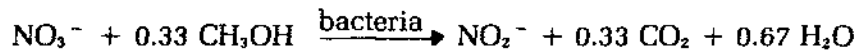
Fixation of ammonium can occur by interactions with either 2:1 layer silicates (clay) or soil organic matter. As the soil's clay and organic matter content increase, ammonium fixation also increases. Once fixed, nitrogen is relatively unavailable. Strongly acid soils inhibit fixation by organic matter.

Adsorption and *desorption* of NH_4^+ in the absence of nitrifying conditions is similar to cation exchange of other ions. The order of affinities for cations in soil solution is Al^{3+} (aluminum) > Ca^{2+} (calcium) > Mg^{2+} (magnesium) > K^+ (potassium) > Na^+ (sodium). The relative strength of adsorption is governed by the ionic strength and hydration radius of a cation species. As in the case of fixation, NH_4^+ competes about equally with K^+ for adsorption sites since both have equivalent charges and ionic strengths. The low cation exchange capacity of Pinelands soils and their strong acidity, indicative of codominance of Al^{3+} and H^+ on exchange sites, suggest that the region's soils will adsorb little NH_4^+ .

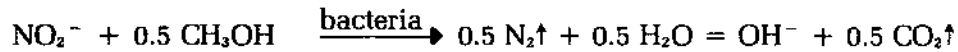
Inorganic nutrients such as ammonium and nitrate also undergo *immobilization* as the result of microbial assimilation into organic compounds. Bacteria, actinomycetes, and fungi most readily assimilate ammonium salts above other nitrogen forms. However, many strains also utilize nitrate, and large quantities can be immobilized in the absence of sufficient ammonium. Immobilization and mineralization are simultaneous processes. The net accumulation of organic or inorganic nitrogen is a function of organic matter availability and the carbon to nitrogen (C:N) ratio of organic substrates. When the C:N ratios of the suspended and dissolved sewage organic matter are lower than the generally recognized critical ratio of 20:1 to 30:1, a net mineralization of nitrogen will occur. This will minimize the immobilization of nitrogen below absorption trenches.

Volatilization is the primary mechanism for gaseous loss of nitrogen from soils. The keys to such losses are the soil redox potential, organic matter content, and presence of denitrifying organisms. The

responsible organisms are facultatively anaerobic bacteria which can use nitrate as a hydrogen acceptor in the absence of oxygen. The conversion of nitrate to free nitrogen gas is known as denitrification. In the first step of the denitrification sequence, (using methanol as a carbon source), nitrate is transformed to nitrite as follows:



In the second step, nitrite is transformed to nitrogen gas:



Anaerobic conditions are necessary for volatilization of nitrate. Acidity, temperature, and adequate oxygen below a septic leach field in Pinelands soils will limit denitrification. Further, the organic matter required as an oxidizable substrate is low in sewage effluent and may be inadequate for this process to occur.

Nitrogen in septic fields undergoes *leaching* predominantly in two forms, NH_4^+ and NO_3^- . Excess nitrogen in these forms which is not attenuated by the other mechanisms will leach with soil water moving toward the groundwater. The nitrogen form or forms which are present, and their ratios, depend on the environmental conditions as modified by the influence of the septic system. Nitrification has been found to commence within 2 cm (0.8 inches) beneath the crusted trench bottom and to be essentially complete within 6 cm. (2.4 inches). Numerous studies have noted that NO_3^- is indeed the predominant form of nitrogen leaching below properly functioning soil absorption systems. Up to 93 percent of applied nitrogen has been found to leach as NO_3^- from a deep sand. Peaks in nitrate leaching occurred in early spring to summer, probably related to nitrification of NH_4^+ accumulated over the winter. Leaching of sewage effluent NH_4^+ is usually associated with a shallow water table which does not allow sufficient aerated soil depth for complete NH_4^+ oxidation. Nitrate reaching the water table subsequently follows the general groundwater flow pattern, except where excessive hydraulic loading causes "mounding" of the water table. Figure 2.11 diagrams a profile of effluent NO_3^- movement in a plume pattern under an operative soil absorption trench. Horizontal flow is predominant with little vertical dispersion. Nitrate and ammonium are conserved once they have entered the groundwater, undergoing no further chemical changes. At this point, dilution is the only mechanism for reducing nitrogen contaminant concentrations.

Summary of the Fate of Effluent Nitrogen

The probable fate of nitrogen in sewage effluent applied to Pinelands soils is largely a function of the climatic regime, regional soil characteristics, and the characteristics of properly functioning septic tank-soil absorption systems. Table 2.22 describes what might be expected. In general, the potential appears to be great for significant nitrate and, at times, ammonium movement into the Pinelands' groundwater.

Phosphorus

Phosphorus (P) in septic tank effluent originates from two main sources, detergents and human waste. The relative contribution from detergent will vary with the amount of detergent used and its P content. This is reflected in the forms of P present in soil solution. Anaerobic digestion occurring in the septic tank converts most of the phosphorus, both organic and condensed, (pyro-phosphate, for instance), to soluble orthophosphate.

The extent to which phosphorus in septic effluent is renovated by filtration through soil is influenced by a soil's pH, its clay content, the chemical and mineralogical composition of this clay, and its cation exchange capacity. Literature pertaining to reduction of phosphate concentrations by soil systems indicates that one of the primary factors in P removal is the tendency of phosphorus to sorb onto soil particles. Soils vary greatly in their ability to adsorb soluble phosphate ions. Contamination of groundwater supplies by phosphorus moving from septic drainage fields could be a severe problem in Pinelands soils where they have low P adsorption capacity.

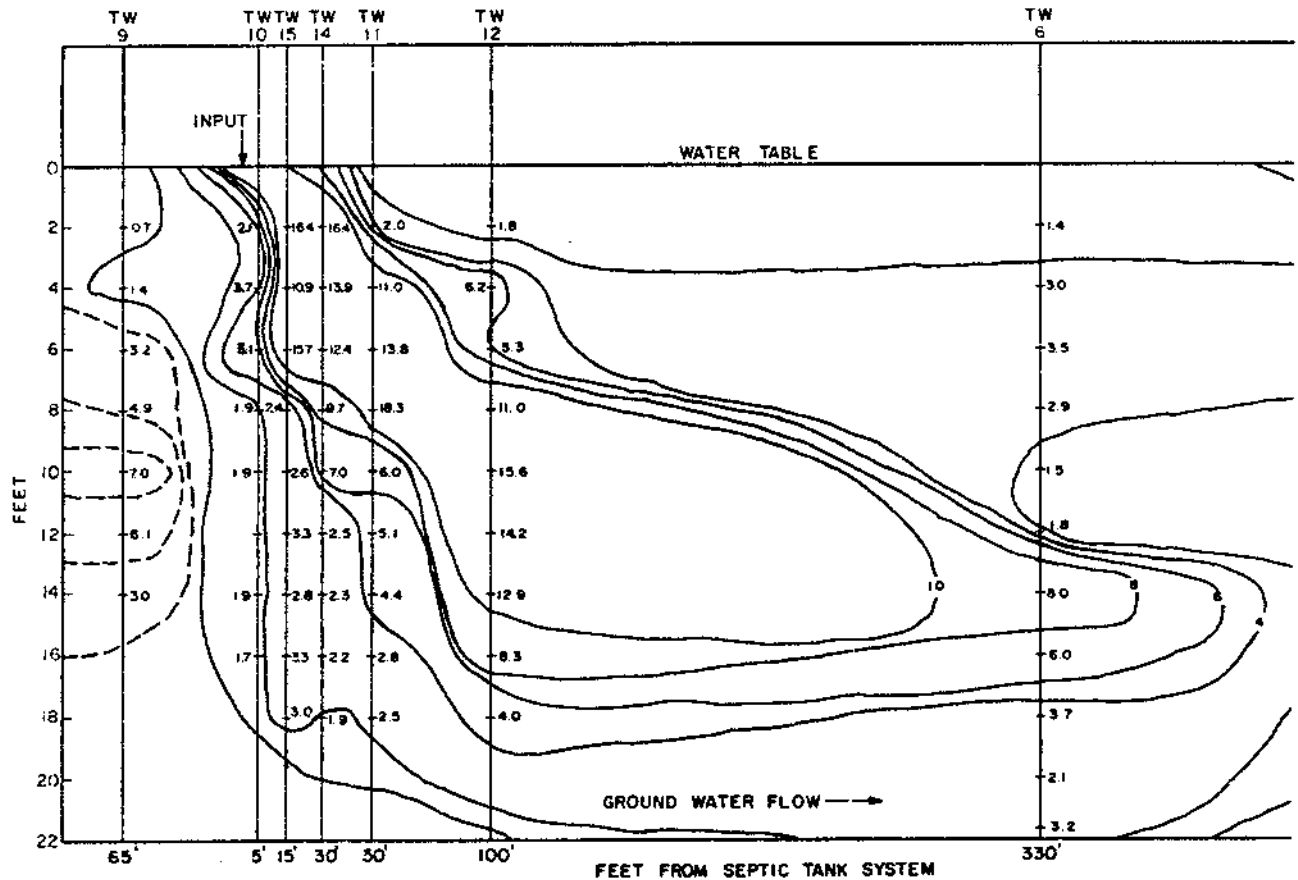


Figure 2.11—Nitrogen Movement In The Groundwater At A Septic Tank Test Site Below A Sandy Soil. (Shows test wells (TW) sampled and the concentration of nitrate-nitrogen in mg/l at two-foot intervals below the water table.)

Source: Ellis and Childs, 1973

Table 2.22—Summary Of The Expected Fate Of Nitrogen In Pinelands Soils Receiving Septic Tank Effluent.

Process	Relative Importance	Limiting Parameters
Plant uptake of NH_4^+ and NO_3^-	<10% of total N	Climate (<i>short growing season</i>) Trench area (<i>high N application rate</i>)
Nitrification	varies; usually large	Temperature (<i>restrictions in winter</i>) pH (<i>acidic; low exchangeable bases</i>)
Fixation of NH_4^+	slight	2:1 clay content (<i>low</i>)
Adsorption of NH_4^+	<1% of total N	Cation exchange capacity (<i>low</i>)
Immobilization of NH_4^+ and NO_3^+	slight	C:N ratio (<i>low; net mineralization</i>)
Volatilization of NH_4^+	negligible	pH (<i>acidic</i>) Gas exchange (<i>depth in soil</i>)
Denitrification of NO_3^-	low	Aeration (<i>abundant O_2</i>) Organic matter content (<i>low</i>) Temperature (<i>restrictive in winter</i>) pH (<i>acidic</i>)
Leaching of NH_4^+ and NO_3^-	75-90% of total N	Attenuation by the above processes
Groundwater movement	unrestricted	Adsorption (<i>low</i>) Volatilization (<i>low</i>)

At low concentrations (<5 mg/l) in equilibrium solution, the phosphate becomes chemisorbed on the surfaces of iron (Fe) and aluminum (Al) minerals in strongly acid to neutral systems. The pH of septic tank effluent is nearly or just above neutral. The pH of soils mapped in the Pinelands range between 3.6 and 7.8, although most fall below 5. Therefore Fe and Al would help immobilize P in septic leach fields to an extent governed by the limits of Fe and Al activities in dilute solution.

Anaerobic conditions under septic fields may result in an increase in inorganic P dissolved in soil solution. At the same time, the released P binds to iron and aluminum hydrous oxides, and a new solution equilibrium is reached.

Phosphorus Absorption Capacity

Phosphorus sorption from solution onto the surfaces of soil particles occurs at two rates. A rapid initial reaction is followed by a much slower reaction that may continue for several weeks. Soil material directly under the drainage field will be exposed to relatively high concentrations of P, participating in a slow reaction.

The kinetics of P movement in soils have been described by Langmuir and Freundlich models. These equations predict a relatively sharp boundary between a zone of maximum P absorption near the drainage tiles and the underlying soil. Field investigations of effluent movement show that in soil solutions at comparable distances beside the septic trench, phosphorus reaches similar concentrations after the system reaches equilibrium or near-equilibrium. After a layer of soil surrounding the trench becomes saturated with P, the concentration of P in that zone (15 cm/5.9 inches) reaches the concentration in wastewater in the trench.

The depth of the phosphorus-saturated layer can be calculated if the loading rate and P immobilization capacity of the soil are known. Prediction of the immobilization capacity utilizes hydraulic conductivity and capillary potential data over a range of saturation values. Also needed are the P equilibrium relationship between the solid phase and the liquid phase, and the value of the overall mass transfer coefficient. Concentration profiles of phosphorus as a function of depth and time can then be determined. Illustrative examples of measured P adsorption capacities are 100 µg per gram of soil for a sandy soil below a septic field, and 121 µg per gram for a sandy soil in laboratory columns.

Phosphorus Retention in Sandy Soils

Based on previous studies of the chemistry of phosphorus in soil solution, it is expected that the potential of a soil to remove phosphate from septic tank effluent is controlled by the mineralogy of the soils rather than by the soil particle size distribution. A review of the literature pertaining to phosphorus renovation mechanisms in soil resulted in the conclusion that the sands and loamy sands of the Pinelands should have a very low P fixation capacity and thereby are unsuitable for septic tank effluent disposal.

Horizontal displacement of effluent caused by a biological crust increases the soil volume available for phosphorus attenuation. Therefore, this crust can delay the leaching of P into potable aquifers or into the regional groundwater flow pattern. Septic tank system studies have indicated that attenuation of phosphorus in sandy aquifers is primarily by dilution. P bearing septic effluent moves in a well-defined plume below the water table. Numerous investigations of phosphorus movement in groundwater have illustrated that phosphorus moves rather freely once it has entered the saturated zone.

pH

Since it is known that the buffering capacity of the acid, sandy Pinelands soils is very low, it is assumed that the subsoil and groundwater pH can be easily changed by the materials leaching from septic systems. Little is known about the strength of effluent components or their chemistry which may influence soil and groundwater pH.

Bacteria, Viruses, and Pathogens

An important consideration for the soil disposal of septic tank effluent is the fate of microorganisms in the soil and groundwater environment. The principle biological contaminants found in domestic wastewater can be divided into four groups: bacteria, viruses, protozoa, and helminth parasites. Diseases

associated with water-borne pathogens include typhoid fever, bacillary dysentery, infectious hepatitis, and amoebic dysentery.

The accumulation and passage of pathogens into the groundwater depends on their survival rates and transport characteristics. The estimated number of pathogens discharged to a unit area of soil is shown in Table 2.23. It depends on the size of the leach field, which is determined by the soil permeability. As the permeability increases, the leach field size decreases, raising the concentration of organisms.

Table 2.23—Estimated Rates of Pathogen Application From Septic Tank Effluent

Soil Hydrologic Group	Effluent (l/m ² /yr x 10 ⁻⁴)	Pathogens (Organisms/m ² /day x 10 ³)			
		Total coliform	Fecal coliform	Fecal streptococcus	Virus
A	3.7	16.9	4.3	0.6	7.7
B	1.5	6.9	1.7	0.2	3.1
C	0.92	4.2	1.1	0.15	1.9

Survival

Survival of bacterial microorganisms in soil can range from a few days to several years. Their persistence in soil is dependent on moisture, temperature, ionic strength, pH, dissolved gas concentration, and nutrient concentration. Population changes occur in response to fluctuations in these factors, which may stem from climatic changes, the actions of microorganisms, or the actions of humans. For all water-borne pathogens the single most important factor influencing survival is soil moisture.

Survival of viruses in soil is greater than of bacteria. Fully infectious virions have been recovered from soil for up to 180 days. Polio virus was observed to disappear within 63 to 91 days after application to sand saturated with distilled water. Viruses in soils are often associated with solids, and can remain infective for extended periods of time. In addition, viruses are protected by the septic tank effluent against inactivation under saturated soil conditions. In dry soils, this protection is lost. The length of survival of viruses at warmer temperatures is substantially less than in cooler temperatures. At 20°C viruses have been shown to survive for up to 60 days. Helminths and protozoa possess an evolved adaptation which enhances their survival under field conditions. Cysts and eggs are extremely resistant under field conditions, although loss of moisture eventually destroys most of them. Viable *Ascaris* eggs have been found after 81 days in a sludge which was dried in a greenhouse at temperatures which frequently reached 46°C. *Ascaris* have been known to survive in moist soils for several years.

Movement

Transmission of bacterial microorganisms is inhibited by the mechanical process of straining at the trench soil interface due to the accumulation of suspended particles and sedimentation of bacterial clusters. The Pinelands' sandy soils could produce a high degree of bacterial purification during unsaturated flow conditions, when the liquid moves only through the smaller pores of the soil. After the first 100 days of septic system utilization, a "clogging zone" develops at the soil-effluent surface which removes many bacteria by filtration. However, large numbers of bacteria can be washed from a drain field by rainfall and move as a front in the direction of the water flow.

Sand bed filtration of septic effluent containing between 970 and 1260 coliforms per 100 ml has been observed to remove most of the coliform bacteria in the first five feet of bed depth. This implies that Pinelands soils require a minimum of 120 cm (47.2 inches) between the discharge point and the groundwater tables. Improperly installed or used septic tanks might create saturated flow conditions, short-circuiting the system and allowing effluent to reach the groundwater unfiltered.

Transmission of viruses is primarily influenced by adsorption because their small size allows them to pass through the filter medium. Salt concentration, pH, organic matter content, and soil composition also affect retention. At low cation concentrations, most viruses pass through sand columns, whereas the addition of calcium chloride and magnesium chloride to the columns drastically reduced the passage of virus particles. In a sandy forest soil, viruses were detected up to 91 cm (37 inches) from the

point of inoculation. Simulated cycles of rainfall and effluent application, resulting in ionic gradients, also released adsorbed virus particles.

The transmission of pathogenic viruses into groundwater may be a problem in the Pinelands soils. The low cation exchange capacity and clay content of these soils provide little resistance to virus movement. However, the low pH could enhance adsorption. During winter months when survival is extended, substantial amounts of rainfall would desorb virus particles and permit their migration through the soil. It appears that a minimum of five feet between the tile drain and the water table is required to provide adequate protection from viral movement to the groundwater. This assumes that rainfall leaching of pathogens will be retarded once a "clogging zone" is established around the septic line, and that the soil under the leach field remains unsaturated.

Organics

An increasing number of organic substances are developed and put into use each year. Many of these, such as septic tank cleaners, are used in the household, while others are used as biocides, wetting agents, and solvents applied to home lawns and agricultural fields. It has also recently become evident that some household products containing chlorine react with the organics in sewage effluent. This may result in the formation of chemicals which are similar to manufactured biocides. While many of the toxic organic compounds entering the soil are vaporized, degraded by microorganisms, or adsorbed onto the soil surface, others are quite resistant to degradation and have properties which allow them to move quickly through the soil profile to the groundwater.

Many organic substances are extremely insoluble in water. This generally prevents large amounts of these compounds from entering the groundwater. However, because many of the substances are toxic at very low concentrations, solubility constraints are often not capable of totally preventing migration at levels which could be biologically significant.

The organic substances which pose the greatest threat to groundwater resources are those which are relatively soluble, have low volatility, and are resistant to breakdown. For such chemicals, we must rely on the adsorption capacity of the soil to prevent their migration. Adsorption characteristics depend mainly on surface area, organic matter, and pH. Both the very high sand content and the low native organic matter content of the Pinelands' soils will result in low adsorption capacities. Acid conditions in the soils may retard the mobility of some organic chemicals, although many of those commonly used will be more mobile under those conditions. Mobility of certain undesirable organic constituents through the unsaturated zone to the groundwater is thus expected to be rather rapid in the Pinelands.

Other Pollution Sources

The mechanisms which govern the movement of septic tank effluent contaminants through the soil also apply to contaminants from other sources. Of specific interest in the Pinelands are nutrients introduced as fertilizers and by the spray irrigation of sewage treatment plant effluent.

Lawn Fertilization

Losses of nitrogen from lawns are primarily dependent on the type and amount of fertilizer applied, and the amount of water leaching through the soil. Once leached past the root zone, the nitrogen is unavailable for plant growth. Of secondary importance are application techniques and frequency, vegetative cover, and soil properties such as pH. In general, the majority of investigators have centered on agricultural losses of nitrogen, and relatively little research has been done regarding losses from home lawns. Studies concerning nitrogen and other chemical losses from golf greens and athletic fields on sandy soils indicate that up to 52 percent of applied N may be leached as NO_3^- from lawns. Losses may be minimized by using lower irrigation rates, smaller and more frequent applications, and slow release organic N fertilizers.

Agricultural Fertilization

Soluble agricultural fertilizers that are not strongly absorbed by the soil are carried below the root zone of plants by percolating water. Water reaching the groundwater below fertilized fields has been found to contain unacceptable nitrate-nitrogen concentrations. Several factors including application

rate and timing, crop uptake, soil permeability and temperature, and the form of fertilizer used will influence the amount of nitrate moving to the groundwater. When applied following a proper management program, nitrate-nitrogen concentrations below fertilized fields of Freehold loamy sand at the Adelphia field station of the New Jersey Agricultural Experiment Station were less than 10 mg/l.

Nitrogen fertilizer is not used to any great extent on crops other than corn. Consequently, the impact of agricultural fertilization in the Pinelands is more local than regional.

Sewage Effluent Irrigation

An alternative to individual on-site septic leachfields is centralized collection and treatment of raw sewage. Secondary-treated sewage effluent often contains in excess of 20 mg/l nitrogen and cannot be released directly into streams without causing pollution. Tertiary treatment to remove nitrogen is expensive and often does not reduce concentrations to less than 5 mg/l nitrogen. Recently, disposal by land irrigation has been used by many communities. When large volumes of water are applied, little or no nitrogen attenuation is achieved. But when lower irrigation rates are used, substantial amounts of nitrogen can be removed.

Secondary-treated effluent contains significant amounts of phosphorus as phosphates. The phosphorus will be utilized by plants and absorbed by the soil. When adsorption sites near the surface are saturated, the excess phosphorus can leach to successively deeper layers. Thus, when irrigation rates are sufficiently low, the combined uptake and adsorption should minimize the downward migration, even in soils with relatively low adsorption capacities such as those in the Pinelands.

VEGETATION

More than any other natural feature, the unique vegetation of the Pinelands gives the region its distinctive, essential character. Low, dense forests of pine and oak, ribbons of cedar and hardwood swamp bordering drainage courses, pitch pine lowlands, bogs, and marshes combine to produce an expansive mosaic which is unsurpassed in the Northeast. This richly patterned landscape is the product of interacting environmental factors, primarily soils, water, fire, and human disturbances. Plate 10 is a map of the Pinelands vegetation. It provides a regional view of the broad forests and the intricate patterns produced by the different plant associations.

A rich diversity of plants is present in the Pinelands, numbering approximately 850 species, and including 580 native species (Fairbrothers, 1979). Seventy-two of these native species are potentially faced with extinction in the Pinelands. More than 20 plants were first described in the Pinelands, including Hirst's panic grass (*Panicum hirstii*), Pine Barrens reedgrass (*Calamovilfa brevipilis*), and Pickering's morning glory (*Brewaria pickeringii* var. *caesariensis*).

The majority of Pinelands plant species have ranges that extend geographically north, west, and south of the Pinelands. However, a distinctive feature of the Pinelands flora is the large number of species which reach either their northern or southern geographical limits here. Of the total, 109 plants of southern affinity reach the northern limit of their range in the Pinelands, and 14 northern plants reach their extreme southern, or southernmost Coastal Plain limit, in the region. These species are referred to as peripheral species. Turkey beard (*Xerophyllum asphodeloides*), pyxie moss (*Pyxidantha barbulata*), bog asphodel (*Narthecium americanum*), and Pine Barrens gentian (*Gentiana autumnalis*) represent the former, and the well known curly grass fern (*Schizaea pusilla*) and broom crowberry (*Corema conradii*) are included in the latter.

Other geographical distinctions in plant species distribution make the flora of the Pinelands unusual. Both the broom crowberry and the curly grass fern are considered by some botanists to be relicts. Relict species are those which formerly had wide distributions, but now occur only as remnants in relatively small areas. Other classes of Pinelands plants are the endemics and the disjuncts. Endemics are species which are restricted to a very small geographical area, such as to a locale within a state, to one state, or to only a few states. The Pinelands have four plant species classified as endemics, specific varieties of which are found only in the Pinelands and nearby Delaware. Included in this group are the sand myrtle

(*Leiophyllum buxifolium*), blazing star (*Liatris graminifolia* var. *lasia*), Pickering's morning glory, and Knieskern's beakrush (*Rhynchospora knieskernii*). Turkey beard, false asphodel (*Tofieldia racemosa*), and pyxie moss may be classified as disjuncts, species which are outliers from the main distribution (Fairbrothers, 1979).

The vegetation of the Pinelands, the major environmental factors affecting plant distribution, and human interaction with the resource will be discussed in this section. Four vegetation studies were completed for the Pinelands Commission. They were: *The Forest Vegetation of the Pinelands* (Andropogon Associates, 1980), *Threatened and Endangered Vascular Plant Species of the New Jersey Pinelands and their Habitats* (Caiazza and Fairbrothers, 1980), *Forestry and the Pinelands* (New Jersey Bureau of Forest Management, 1980), and *Fire Management Plan for the Pinelands* (New Jersey Bureau of Forest Fire Management, 1980). With the exception of the forest vegetation study, which used recent true-color aerial photography to map Pinelands vegetation as well as limited field checks to verify mapping, the material included in these reports was developed from the existing literature, herbarium collections, and information obtained from the public.

Vegetation Types

Differences in groundwater levels result in two distinct Pinelands floristic complexes, the uplands and the lowlands (McCormick, 1979; Robichaud and Buell, 1973). Lowlands are found on sites where water is near or above the surface during some part of the year. The upland complex occurs in the remaining area. The water level of sites occupied by this complex is seldom nearer to the surface than 2 to 3 feet and may be as deep as 60 to 70 feet (McCormick, 1979). This contrast in moisture conditions between the upland and lowland sites is probably intensified by the highly permeable, sandy soils. In the subdued topography of the Atlantic Coastal Plain, however, the boundaries between these complexes are often not sharply defined. Subtle differences in topography result in the rich mosaic previously described. The vegetation map (Plate 10) depicts the extent of the types described below.

Upland Complex

The uplands of the Pinelands support two major vegetation types or associations, pine-oak forests and oak-pine forests. Fire plays an important role in determining the composition of these upland forests. Differences in resistance to fire damage, shade tolerance, and reproductive strategies are responsible for the selective action of fire on the different plant species.

Following a fire, some oaks and pines have the ability to resprout from dormant buds which lie protected beneath the soil surface and along their trunks. This ability varies among the oaks and pines. Oaks are less resistant to both wounding and killing by fire than pitch or shortleaf pine (*Pinus rigida*; *P. echinata*) (Little, 1946; Little and Moore, 1945). The shrub oaks, blackjack and bear oak (*Quercus marilandica*, *Q. ilicifolia*), are more fire adapted than the tree oaks such as white and black oak (*Q. alba*, *Q. velutina*). They exhibit a greater capacity to sprout and produce acorns on much younger sprouts following a fire. Pitch pine is more resistant to fire damage and retains its basal sprouting ability over a longer period of time than shortleaf pine.

Fire also results in the removal of the thick mat of litter covering the forest floor. This provides a more suitable seedbed for pines which, unlike oaks, require mineral soil or a thin layer of litter and minimal shading for the establishment of seedlings. The overall effect of fire favors pine over oak. In the absence of fire or other severe disturbances such as land clearing, pitch pine and shortleaf pine would be replaced by oaks and other hardwoods. If this occurred, the character and composition of the forest would be substantially modified.

Pitch pine is the dominant tree of the upland **pine-oak forest** in the central portion of the Pinelands. This species is commonly associated with blackjack oak, black oak, chestnut oak (*Quercus prinus*), white oak, scarlet oak (*Q. coccinea*), and post oak (*Q. stellata*), as well as southern red oak (*Q. falcata*) in the southern portion of the Pinelands. A large part of the region is covered with pine-blackjack oak, a vegetation type which characterizes the selective action of frequent, severe fire (McCormick, 1979). Pine-post oak and pine-black oak associations also occur in the region but are scattered and may be

limited in size. Common understory shrubs in the pine-oak forests include the shrub-form scrub oak, lowbush blueberry (*Vaccinium vacillans*), and black huckleberry (*Gaylussacia bacata*).

The most extreme example of the pine-oak forest is found in the Plains, where repeated burning has eliminated the tree-form oaks and altered the form of pitch pine. The two largest areas are the East Plains and the West Plains, covering a total of approximately 12,000 acres in Ocean and Burlington Counties near Warren Grove. A smaller tract, the Spring Hill Plains, covers about 270 acres on the northern border of Penn State Forest. The Plains are dominated by a dwarfed, closed-cone (serotinous) variety of pitch pine and associated blackjack and scrub oaks. Lowbush blueberry and black huckleberry are present along with pyxie moss, bearberry (*Arctostaphylos uva-ursi*), broom crowberry, and false heather (*Hudsonia ericoides*). Most shrub and tree regeneration is from sprouts on older root crowns.

The Plains, or "pigmy forest," have been the focus of intense scientific research to determine the reasons for the unique composition and form of the vegetation. Factors considered include soil fertility, soil moisture, and wind. Fire is currently considered to be the most important factor in the development of the Plains vegetation. Recent research (Good and Good, 1975) indicates that genetic factors may also play a significant role in determining the growth characteristics of the dwarfed pitch pine.

In the **oak-pine** forest, stems of the tree-form oaks are more numerous, although they are often smaller than the pines. Pitch pine is almost always present and may be mixed with shortleaf pine. Black oak is the most abundant oak north of the Mullica River, and southern red oak is prominent to the south. Chestnut, white, scarlet, and post oaks are widespread.

The shrubs present in the oak-pine forests are predominantly lowbush blueberry and black huckleberry. Mountain laurel (*Kalmia latifolia*) and other shrub species may also be present. Although oak-pine forests are distributed throughout the Pinelands, they are most extensive at the fringes of the region. Small forests of chestnut oak and black oak often occur on hilltops in the Pinelands. Forests dominated by scarlet oak and black oak mixed with shortleaf pine occur in the eastern half of the region and north of the Mullica River.

Upland Vegetation Trends and Patterns

The vegetation maps prepared for the Pinelands Commission and those prepared by McCormick and Jones (1973) were reviewed to determine if any major vegetational changes have occurred during the past ten years. No major changes in the distribution of oak-pine and pine-oak forests were apparent. However, the analysis indicated that pitch pine lowland may be developing on some areas which previously supported upland forest. Further study will be required to determine if this increase in lowlands is actually occurring, or if the differences observed were due to differences in mapping techniques.

The most pronounced disturbance of upland forests of any watershed within the Pinelands has occurred in the Toms River basin. This is due to expansion of surface mining and to impacts from many small, scattered residential developments and several large ones. Similar disturbances have occurred in the Forked River basin, although large portions of the upland forest within this watershed remain unchanged.

An increase in the development of uplands was also observed in the Upper Great Egg Harbor River, Tuckahoe River, Rancocas Creek, and Maurice River watersheds. The upland forest types are mostly intact and unchanged in the Cedar Creek and Mullica River watersheds. The upland patterns in the Lower Great Egg Harbor River watershed have not changed significantly.

Lowland Complex

Lowland forests in the Pinelands include: Atlantic white cedar swamps, hardwood swamps, pitch pine lowlands, bogs, and inland and coastal marshes. The lowland forests in the region are composed mainly of Atlantic white cedar (*Chamaecyparis thyoides*), trident red maple (*Acer rubrum*), black gum (*Nyssa sylvatica*), and pitch pine. Gray birch (*Betula populifolia*), sassafras (*Sassafras albidum*), and sweetbay magnolia (*Magnolia virginiana*) are often present. Other lowland associations, primarily in the region's periphery, may contain sweet gum (*Liquidambar styraciflua*), pin oak (*Quercus palustris*), willow oak (*Q. phellos*), basket oak (*Q. michauxii*), and water oak (*Q. nigra*). Both natural and man-

made bogs are found throughout the region. Many abandoned bogs have been colonized by grasses (*Gramineae*) and sedges (*Carex* spp.), forming inland marshes. Similar freshwater marshes are also found along Pinelands streams. Extensive tidal marshes are found along the coastal Pinelands borders.

The **cedar swamps** are characterized by dense, even-aged stands of narrow-crowned Atlantic white cedar. Cedar predominates in the canopy but pitch pine is often present. Trident red maple, blackgum, and sweetbay are also common in the understory. Dangleberry (*Gaylussacia frondosa*), high-bush blueberry (*Vaccinium corymbosum*), swamp azalea (*Rhododendron viscosum*), fetterbush (*Leucothoe racemosa*), sweet pepperbush (*Clethra alnifolia*), and bayberry (*Myrica pennsylvanica*) are likely to occur in the shrub layer. Hardwoods and shrubs are far more numerous and can form a dense layer at the edges of the stands or under stands that have been partially cut or are declining. While herbaceous growth is rarely very dense, there is a wide variety of species present in areas where there are canopy openings. These commonly include pitcher plant (*Sarracenia purpurea*), sundew (*Drosera* spp.), and chain fern (*Woodwardia virginica*). A rich carpet of mosses (*Sphagnum* spp.) covers the ground. Cedar swamps are found in narrow bands running along many of the smaller stream courses and in larger configurations in the broader valleys.

Fires rarely begin or spread in the wet and poorly drained cedar swamps. Unless a fire is driven by a strong wind or drought conditions exist, these lowlands usually act as fire breaks. Atlantic white cedars are extremely susceptible to fire injury because of their thin bark and flammable foliage, and they do not sprout after stems are killed by fire. Subsequent reproduction depends on the depth to which the organic soil has been burned, the nature of the previous stand, and the extent of browsing by deer. While the combined effect of fire and cutting has frequently reduced the area in white cedar and favored hardwoods, proper use of both favors cedar (Little, 1950).

The canopy of **hardwood swamp** forests is predominantly trident red maple, commonly associated with blackgum and sweetbay. Sassafras and gray birch also occur frequently. Sweetgum is more typical of the western boundaries of the Pinelands. Although nearly pure stands of broad-leaved hardwoods are common, in some areas pitch pine and white cedar occur in the canopy. They are often as abundant as the maple, blackgum, and sweetbay. The number of woody-plant species and stand composition variability is greatest in the hardwood swamps. The shrubs which occur in the cedar swamps are also present in the hardwood swamps, often forming a very dense understory. The hardwood swamp occurs along both major and minor stream courses and in poorly drained areas. This vegetation type also extends beyond the boundaries of the Pinelands and into the inner Coastal Plain. Near the coast, American holly (*Ilex opaca*) may be a major component of hardwood swamps.

The **pitch pine lowland forest** is characterized by a dense canopy composed almost entirely of pitch-pine. The understory is often dense, supporting maple and blackgum as well as a variety of lowland shrubs, especially sheep laurel (*Kalmia angustifolia*). Black huckleberry, dangleberry, and staggerbush (*Lyonia mariana*) also are common. The shrub layer varies in height, from relatively low shrubs such as sand myrtle and sheep laurel in drier areas, to tall stems of such species as highbush blueberry, pepperbush, and azalea near the swamps. In areas of frequent inundation leatherleaf may form dense, low thickets. In the drier areas a well developed herbaceous layer occurs, composed of such species as bracken fern (*Pteridium aquilinum*), turkey beard, sedges and grasses, and teaberry (*Gaultheria procumbens*). Bracken fern may appear to dominate in the understory just after a fire.

The pitch pine lowland forest is a transition type. It is found in the gradient between upland forest types and the cedar and hardwood swamps. The boundaries of this lowland forest may be rather abrupt or very gradual, often grading into upland forest and extending onto drier soils. The changes in soil moisture conditions are reflected in changes in species composition. As the soil becomes drier, the relative abundance of wetland species decreases and oaks are observed. Small patches of upland forest may occur within the overall fabric of lowland forest. Pitch pine lowlands often occur in a narrow band fringing the swamps along stream courses. In areas of low relief or circular depressions and other poorly drained areas, the pitch pine lowland forest can be quite broad.

The wet conditions in these lowlands reduce the frequency of fire. However, when wild fires do

occur, they are generally intense. The dense, highly flammable understory of sheep laurel, mountain laurel, and leatherleaf increases the probability that the fire will crown, thus burning the pine canopy. The strangely shaped trees of the lowlands are the result of such wild fires (Little, 1979). Straight pines, 75 to 100 feet tall, occur in areas which have not been exposed to these intense wildfires.

Active cranberry bogs, open bogs, and shrub thickets are designated as **bogs** in Plate 10. The predominant vegetation are shrubs, including cranberry (*Vaccinium macrocarpon*), leatherleaf (*Chamaedaphne calyculata*), sheep laurel, highbush blueberry, swamp azalea, sweet pepperbush, and staggerbush. Sphagnum mosses often carpet the ground. Shrub thickets, known locally as sponges, are dominated by leatherleaf and may include highbush blueberry.

An **inland marsh** is a freshwater, herbaceous wetland community composed predominantly of grasses and sedges. This vegetation type, also referred to as a savannah, is found along stream channels and in abandoned cranberry bogs. Existing inland marshes are rather small and collectively cover a rather limited area which probably does not exceed a thousand acres (McCormick, 1979). Inland marshes and bogs are mapped as one category in Plate 10.

The boundaries of the Pinelands are bordered by extensive **coastal marshes**. These marshes, dominated by salt marsh cordgrass (*Spartina alterniflora*) and salt hay (*S. patens*), are often adjacent to bands of hardwood swamp. Rush (*Juncus* spp.), spike grass (*Distichlus spicata*), and glassworts (*Salicornia* spp.) are often associated with the dominant spartinas. Species composition in tidal areas changes as salinity decreases. Upper regions of the tidal influence contain cattails (*Typha* spp.), wild rice (*Zizania aquatica*), and three-square bulrushes (*Scirpus* spp.).

Lowland Vegetation Trends and Patterns

In many areas of the Pinelands, ribbons of hardwood swamp follow drainage channels. Such a pattern can be seen (Plate 10) in the Rancocas, Lower Mullica, Upper Great Egg Harbor, and Manumuskin River watersheds, the central and upper portions of the Tuckahoe River watershed, the main drainage channels of the Batsto and Mullica Rivers, and the tributary streams in the central portion of the Lower Great Egg Harbor River watershed. Coastal areas are characterized by broad marshes and broad bands of hardwood swamp. In the more extensive lowland areas of the central Pinelands, the gradient between pitch pine lowland forest and hardwood or cedar swamp is often expressed as a network of fingers.

While the days of massive cedar harvesting are long gone, the scale of logging is still sufficient to greatly limit the extent of cedar. The cedar swamp was once the most extensive swamp forest type in the Pinelands. It is still an invaluable natural resource and habitat in the region. The extent and distribution of cedar swamps have been reduced substantially by logging between 1970 and 1979. This reduction was observed in most of the major watersheds. Several large cedar stands were recently clearcut. These may return to cedar. It was noted that numerous small cedar patches were also clearcut. Young cedar swamps were observed in some abandoned cranberry bogs, in some areas of burned swamp, in some cut-over cedar swamps, and in some shallow drainage channels in broad lowland areas, especially pitch pine lowlands with shallow undulating relief.

It is difficult to predict exactly what the long-term extent of cedar will be, except to say that cedar would undoubtedly be reduced if current trends continued. The logging of small stands of cedar, especially the removal of only cedar from mixed stands, favors natural succession to hardwoods. This is because too small an opening is left to encourage the development of the shade-intolerant cedar. As the overall distribution of cedar is limited, seed sources also become locally more limited. Clearcut areas in the larger cedar swamps may return to cedar if management is undertaken.

The Value of Wetlands

The lowland associations of the Pinelands are fragile and are a relatively scarce resource. The contribution of this floristic complex to the ecosystem and to man is significant. It supports a large number of animal species designated as threatened or endangered by New Jersey and the U.S. Department of the Interior. Lowlands also provide important habitat for many other Pinelands animal species. More rare plants occur in lowlands than in uplands. The cranberry and blueberry industries depend on the

lowland soils, as does the forester who harvests the valuable Atlantic white cedar.

Wetlands influence the quality and quantity of water in the ecosystem, removing nutrients from surface and ground waters, retaining water during dry periods, detaining it during floods, and acting as natural drainage corridors. These areas have a capacity to trap and store nutrients from upland runoff and to serve as settling basins for silt from upland erosion. However, excess nutrients can have a negative impact on wetland vegetation, resulting in a change in species composition or eutrophication of surface waters. Mineral-sediment deposits are detrimental to Atlantic white cedar and often favor hardwood trees over cedar. In the Pinelands, the lowlands act as a water reservoir between the uplands and surface waters, serving a retention and detention function. Any activity which alters the water level can have adverse effects on the lowlands vegetation. Lowering the water table may adversely affect the establishment of white cedar and encourage the growth of hardwoods (Little, 1950). Aesthetically, the Pinelands cedar swamps, bogs and marshes provide some of the most beautiful vistas in the region. For these reasons, lowlands can be considered to be critical habitats.

Endangered and Threatened Plants

Within this century, several species of plants native to the New Jersey Pinelands have become in danger of extinction in the region. In a study completed for the Pinelands Commission, seventy-one rare species, including ferns, grasses, sedges, and broad-leaved plants, have been inventoried and assigned endangered, threatened, or undetermined status for the Pinelands. These plants are all native to southern New Jersey, and most have been mentioned in American botanical literature since the 1800's. Some species like the curly grass fern and broom crowberry are considered Pinelands symbols.

Eight Pinelands species are currently being evaluated for the national list of threatened and endangered species by the Department of the Interior. Despite a long history of popular knowledge and concern for these plants, they all face ultimate extinction here unless recent trends in Pinelands habitat destruction and exploitation are reversed.

The basic source for this inventory of threatened and endangered plant species is the list presented by Fairbrothers in the book, *Pine Barrens: Ecosystem and Landscape* (Forman, 1979). Two species were deleted from this list, white milkweed (*Asclepias variegata*) and sheathed panic grass (*Panicum cryptanthum*), while sensitive-joint-vetch (*Aeschynomene virginica*) and the crested yellow orchid (*Habenaria cristata*) were added. Changes were made in the status of some species as additional information became available. The individual plants in the inventory are classified as either endangered, threatened, or undetermined for the Pinelands. The definitions for these terms are modified from Fairbrothers, and are as follows:

- **Endangered**—A species of plant whose survival in the Pinelands is in jeopardy. Its peril may result from the destruction of habitat, change in habitat, over-exploitation by people, predation, adverse inter-specific competition, disease, or because the Pinelands are at the edge of its geographical range. An endangered species must receive protection or its extinction here probably will ensue.
- **Threatened**—A species of plant that, while currently not considered near extinction, is one which occurs in such small numbers in the Pinelands that it may become endangered here if its environment deteriorates or other limiting factors are altered. Continued observation of its status is essential.
- **Undetermined**—Currently available information is inadequate to determine the status of a plant species accurately, and additional information is required to classify it more definitely.

Table 2.24 lists the 54 vascular plants identified here as threatened or endangered. A habitat description is given for each species. Table 2.25 lists the total number of these species associated with each habitat. By comparing the total number of threatened and endangered species in each group, it can be seen immediately that the wetland areas dominate all others with respect to total number of species at risk. The species tallies for bogs and herbaceous marshes are among the highest. Hardwood swamps also have a high endangered and threatened species tally, much greater than that of cedar swamps. Ponds, lakes, and slow moving streams harbor a number of threatened or endangered aquatic

Table 2.24—Threatened and Endangered Plant Species of the New Jersey Pinelands

Species	Status	Geographical †Affinity	Habitat						
			Pine-oak	Oak-pine	Pitch pine lowland	Cedar swamp	Hardwood swamp	Water, bog, or marsh	Non- forested
Sensitive-joint-vetch <i>Aeschynomene virginica</i>	T	S						•	
Red milkweed <i>Asclepias rubra</i>	T	S						•	
Silvery aster <i>Aster concolor</i>	T	S	•						
Pickering's morning glory <i>Breweria pickeringii</i>	T	S							•
Pine Barrens reedgrass <i>Calamovilfa brevifolia</i>	F T	S						•	
Barratt's sedge <i>Carex barrattii</i>	T	S						•	
Sickle-leaved golden aster <i>Chrysopsis falcata</i>	T	N							•
Spreading pogonia <i>Cleistes divaricata</i>	E	S						•	
Broom crowberry <i>Corema conradii</i>	E	N	•						
Rose-colored tickseed <i>Coreopsis rosea</i>	T	N					•	•	•
Rushfoil <i>Crotonopsis elliptica</i>	E	N/S							•
Stiff tick trefoil <i>Desmodium strictum</i>	T	S	•	•					
Knotted spike rush <i>Eleocharis equisetoides</i>	E	N/S						•	
Resinous boneset <i>Eupatorium resinosum</i>	T	S					•	•	
Pine Barrens gentian <i>Gentiana autumnalis</i>	E	S	•	•	•				•
Yellow-fringed orchid <i>Habenaria ciliaris</i>	E	N/S				•	•	•	
Crested yellow orchid <i>Habenaria cristata</i>	E	S						•	
Southern yellow orchid <i>Habenaria integra</i>	F E	S						•	
New Jersey rush <i>Juncus caesariensis</i>	F T	S				•	•	•	
Lily-leaved twayblade <i>Liparis lilifolia</i>	E	N/S							•
* Loesel's twayblade <i>Liparis loeselii</i>	E	N/S	•	•	•	•	•		
Southern twayblade <i>Listera australis</i>	T	N/S				•	•	•	
Boykin's lobelia <i>Lobelia boykinii</i>	E	S						•	
Canby's lobelia <i>Lobelia canbyi</i>	T	S						•	
Hairy ludwigia <i>Ludwigia hirtella</i>	T	S						•	
Linear-leaved ludwigia <i>Ludwigia linearis</i>	E	S					•	•	
Climbing fern <i>Lygodium palmatum</i>	E	N/S					•		

Note: Swamp pink (*Helonias bullata*) has been added to the Commission's list. Status — T; geographic affinity — S; habitat — pine-oak and hardwood swamps.

Table 2.24—Threatened and Endangered Plant Species of the New Jersey Pinelands, *Continued*

Species	Status	Geographical †Affinity	Habitat						
			Pine-oak	Oak-pine	Pitch pine lowland	Cedar swamp	Hardwood swamp	Water, bog, or marsh	Non- forested
Torrey's muhly <i>Muhlenbergia torreyana</i>	F T	S			•		•	•	
Yellow asphodel <i>Narthecium americanum</i>	T	S						•	
Floating heart <i>Nymphoides cordata</i>	T	N/S						•	
Narrow panic grass <i>Panicum hemitomon</i>	T	S				•	•	•	
Hirst's panic grass <i>Panicum hirstii</i>	F E	S						•	
American mistletoe <i>Phoradendron flavescens</i>	T	S					•		
Maryland milkwort <i>Polygala mariana</i>	T	S						•	•
Slender rattlesnake root <i>Prenanthes autumnalis</i>	E	S	•					•	•
Awned meadow beauty <i>Rhexia aristosa</i>	E	S						•	
Capitate beakrush <i>Rhynchospora cephalantha</i>	T	S			•		•	•	
Slender beaked rush <i>Rhynchospora inundata</i>	T	S					•	•	
Knieskern's beaked rush <i>Rhynchospora knieskernii</i>	F T	S						•	
Curly grass fern <i>Schizaea pusilla</i>	F	N				•			
Chaffseed <i>Schwalbea americana</i>	E	S							•
Long's bulrush <i>Scirpus longii</i>	F	N						•	
Slender nut rush <i>Scleria minor</i>	T	S					•		•
Reticulated nut rush <i>Scleria reticularis</i>	T	N/S					•	•	
Sclerolepis <i>Sclerolepis uniflora</i>	T	N/S					•	•	
Wand-like golden rod <i>Solidago stricta</i>	E	S					•		•
Little ladies tresses <i>Spiranthes tuberosa</i>	T	N/S	•	•					•
False asphodel <i>Tofieldia racemosa</i>	E	S					•		
Humped bladderwort <i>Utricularia gibba</i>	T	N/S					•	•	
White-flowered bladderwort <i>Utricularia olivacea</i>	E	S						•	
Purple bladderwort <i>Utricularia purpurea</i>	T	N/S						•	
Reclined bladderwort <i>Utricularia resupinata</i>	E	N/S						•	
Yellow-eyed grass <i>Xyris flexuosa</i>	T	S					•	•	•

★ Status codes: T = Threatened (Caiazza and Fairbrothers, 1980)
E = Endangered, (Caiazza and Fairbrothers, 1980)
†N = Northern S = Southern

F = Currently being evaluated for the federal (national) list of threatened and endangered species by the Department of the Interior.

and semi-aquatic plants, while the pitch pine lowlands have the lowest number of inventoried species of wetland habitats. It is within the wetlands that almost all members of the orchid and sedge families, ferns, and many of the grasses from the list can be found.

Table 2.25—Total Numbers of Threatened and Endangered Plants in Each Habitat

Habitat	Endangered	Threatened	Federal evaluation	Total
Pine-oak	4	3	0	7
Oak-pine	2	2	0	4
Pitch pine lowland	2	2	1	4
Cedar swamp	2	4	2	7
Hardwood swamp	6	15	2	21
Bog	11	18	6	29
Marsh (inland and coastal)	6	11	5	17
Water	6	6	2	12
Non-forested	6	7	0	13

The upland associations, pine-oak and oak-pine, combine to offer a smaller number of species at risk than some of the lowland habitats. They are significant species, however, such as Pine Barrens gentian and broom crowberry. Non-forested sites, many of which are found in the uplands, also harbor a good number of endangered species. Roadside ditches, cleared or mowed fields, and land adjacent to railroad tracks are examples of this habitat. Forty of the species reach their geographical range limit within the Pinelands. Thirty-five have a southern geographical affinity, while five have a northern geographical affinity.

Table 2.26—Threatened and Endangered Plant Species of the Pinelands
(Documented occurrence by watershed and by county)

<u>Watershed</u>	<u>Number of Species Recorded</u>
Rancocas Creek	10
Lower Maurice River	1
Manumuskin River	2
Dennis Creek	2
Lower Mullica River	22
Wading River	23
Batsto River	27
Atsion-Mechesactauxin Creek	19
Neschocague Creek	4
Forked River	5
Lower Great Egg Harbor River	5
Upper Great Egg Harbor River	1
Tuckahoe River	3
Cedar Creek	4
Toms River	3
Atlantic Drainage (Absecon and Patcong Creeks)	4
<u>County</u>	
Atlantic	28
Burlington	42
Camden	10
Cape May	3
Cumberland	2
Ocean	18
Gloucester	—

As Table 2.26 indicates, all watersheds in the Pinelands harbor threatened or endangered species. Five areas within the region are exceptionally significant because they are large tracts of land that harbor several threatened and endangered species. They are: (1) Atsion and the immediate vicinity; (2) the Batsto River and its tributaries from Indian Mills and Hampton Gate to Batso; (3) wetlands along the West Branch of the Wading River north of Chatsworth to its confluence with Tulpehocken Creek; (4) wetlands along the Oswego River from Harrisville Pond to Sim Place, and (5) areas in the vicinity of Egg Harbor City which include several bogs and ponds.

Areas harboring fewer threatened or endangered plant species, but which are significant because of the restricted range of those species present are: (1) the entire Plains area; (2) the brackish marsh and mud banks along the Manumuskin River from its mouth to the village of Manumuskin; and (3) the hardwood swamp and bog area just west of Route 9 at Oceanville (an area located along the border of the Pinelands).

Threatened and endangered plants can only be protected through maintenance of suitable habitat. Herbicides and excessive nutrients may have a negative impact on these floral species. Excess nutrients from septic systems, lawn runoff, or agricultural runoff may affect rare plants in several ways. Too much nitrogen in the soil may upset the nitrogen-phosphorous balance required for normal flowering in many species. Many of the threatened and endangered plant species of the Pinelands are adapted to the nutrient-deficient soil conditions found in the region. An increase in nutrients may favor more competitive species, and thus changes in species composition may also be expected. In aquatic systems, algal blooms which are caused by excess nutrient loading have been seen to crowd out bladderworts (*Utricularia* spp.). Alteration of water level in wetlands and mowing of roadside areas and wet meadows at the wrong time can also have adverse effects on some species. Specific types of disturbance may have a beneficial effect on some species, however. Vivian (1978) and Little (1974) have observed that certain small-scale physical disturbances such as clearing and burning may increase the occurrence of several plant species in the Pinelands.

Forest Fire Management

Fire has had a significant impact both on man's perception of the Pinelands landscape and on his use of the region. Human activities have in turn had an influence on the Pinelands fire regime. Accidental and intentionally set fires have characterized human settlement here. Although the severity of a particular fire season is dependent on cyclic weather influences, increased development and utilization of the Pinelands in recent years has greatly increased the human risk factor and fire potential. A five-year (1974-1978) fire occurrence map of the northern and central Pinelands prepared by the New Jersey Bureau of Forest Fire Management indicates that the majority of wildfires occur around developed areas.

Two relatively recent fires demonstrate the impact of Pinelands wildfires. The driest spring on record in New Jersey occurred in 1963. On the weekend of April 20-21 in that year, a series of fires destroyed 183,000 acres of woodland, consumed 186 homes and 197 outbuildings, and was responsible for the loss of seven lives. Thousands were forced to flee and entire communities were evacuated. The estimated financial loss to improved property exceeded \$8.5 million (Cumming, 1964).

On March 31, 1977, 15,000 acres, eight homes, and a number of outbuildings were burned in the southern New Jersey region. Later that year, four firemen were killed while fighting a 2,300-acre blaze in Bass River State Forest.

The first study of the forest fire problem in the Pinelands was conducted by John Gifford in 1895. He reported that 49 fires had burned 60,000 acres that year in Burlington, Atlantic and Ocean counties. Later studies showed that the annual burn may have been as high as 100,000 to 150,000 acres annually, indicating that the entire Pinelands burned once every 10 to 15 years. Gifford's study was included in a report to the state geologist in 1898. It emphasized the need for forest fire control and recommended the establishment of a state forest service. In 1905, the first forest protection laws were enacted in New Jersey, and in 1908, a township firewarden system was established. The present state system for forest fire control was organized in 1923.

Since the advent of organized fire control, the acreage burned and the average area per fire have been gradually reduced. The development of mechanized equipment, and aerial detection and attack, have enabled fire control personnel to combat fires faster. Forman and Boerner (1980) reviewed state fire records and the literature to estimate the frequency of fire in the Pinelands. A comparison of the total area burned annually for the periods 1906-1939 and 1940-1980 indicates a sharp reduction from 22,000 hectares to 8,000 hectares. Earlier in the century, a given point in a Pinelands pine and oak forest burned, on the average, at 20-year intervals compared to a current point frequency of about 65 years. The authors concluded that this change in the point fire frequency, the result of more effective fire con-

tol measures, may result in major changes in the Pinelands ecosystem. The impact will be reflected at the species and community level.

Wildland Fire Hazard Classification

As indicated, the Pinelands contain some of the most hazardous wildland fuel types in the nation. Much of the region's vegetative fuel is in the same high hazard category as California chaparral, according to the National Fire Danger Rating System of the U.S. Department of Agriculture. The New Jersey Bureau of Forest Fire Management (1980) has developed a Wildland Fire Hazard Classification system to rate an area's potential wildfire hazard severity. The primary factor considered by the system is vegetation (fuels). The ratings are based on the rates of fire spread of the native vegetation and their resistance to fire suppression activities.

There are five classes of ratings corresponding to five levels of wildfire hazard severity: low, moderate, high, extreme, and variable. Table 2.27 lists the fire hazard ratings of Pinelands vegetation types. Plate 11 shows the distribution of wildland fire hazard vegetation types. This plate places both pine-oak and oak-pine forests within the moderate to extreme class because of the lack of site specific information on the condition of specific stands. As indicated in Table 2.27, the fire hazard classification depends on size class and spacing. In general, pine-oak forests present a greater fire hazard than oak-pine forests (Cumming, personal communication). Additionally, the fire hazard classification of inland and coastal marshes and bogs is variable, depending on moisture conditions. During extremely dry windy periods, coastal marshes may present an extreme fire hazard.

Table 2.27—Wildland Fire Hazard Classification

Hazard	Vegetation Type
Low	Atlantic white cedar swamps Hardwood swamps
Moderate	Pine-oak or oak-pine greater than 20 ft. tall and less than 20 ft. spacing Non-Pine Barrens forest Prescribed burned areas
High	Pine-oak or oak-pine less than 20 ft. tall and greater than 20 ft. spacing
Extreme	Immature pine-oak or oak-pine Pitch pine lowlands (all size classes) Plains-type vegetation Old field grasses
Variable	Inland marshes Coastal marshes Cranberry bogs

Prescribed or Controlled Burning

Prescribed or controlled burning has been practiced in the Pinelands since about 1928. Its use on state and private lands was adopted as policy by the state Division of Parks and Forestry in 1947 (Little et al, 1948). The objective of prescribed burning is the reduction of hazardous fuels. Low intensity, periodic burning reduces accumulated litter, thereby decreasing the fire hazard. This practice also has a number of beneficial side effects for silviculture, including the preparation of seedbed for pines and management of understory hardwood.

The effectiveness of prescribed fire as a protection measure has been illustrated by Cumming (1964). Five months after the disastrous 1963 fire season, plots were established and measured. One sample was located in the Lebanon State Forest and had a history of prescribed burning. The second sample was on private land that had no prior burning history. Damage in the untreated stands was far greater, with 97 percent of the oaks and 79 percent of the pines killed or severely damaged, compared to 46 percent of the oaks and 17 percent of the pines in the previously treated blocks.

Wildfires of a similar intensity to prescribed surface fires or ground fires do occur, but their point frequency is lower than the preferred 2-3 year cycle employed in controlled burns. Widespread use of

the prescribed burning program in the absence of other severe disturbances such as cutting may result in major changes in the Pinelands' plant and animal communities, creating a parklike forest structure.

The frequency of wildfires before European settlement is not known, yet many ecologists believe that the existing Pinelands landscape is in part the product of wildfires of varying intensities, including crown fires which kill the overstory. As indicated previously, the character of the Pinelands may change in the absence of such high intensity wildfires. Recognizing the ecological role of fire, the New Jersey Bureau of Forest Fire Management employs a fire suppression technique which permits fires to burn to predetermined boundaries. This program, termed DESCON, meets the primary objective of fuel modification, yet results in the establishment of a "natural" fire regime. This same results may be achieved through a controlled burning program which employs varying fire intensities.

Forestry

Utilization of the Pinelands' forest resources dates back to early European settlement. Since that time, the forests have undergone intensive use. Many of the upland and lowland sites have been clearcut at least five times (Little, 1978). Historically, the production of lumber, cordwood, cedar shingles, and charcoal has provided a firm economic base for the region's people, one which has continued to the present time. Both primary and secondary wood-using industries are still active in the Pinelands, producing cordwood, cedar products, wood chips, firewood, furnace poles, piling, pulpwood, saw timber, and manufactured products.

Throughout this period of intensive use, proper forest management has been minimal. At the present level of productivity, most forest land yields only a fraction of its potential. It has been estimated that less than 15 percent of private lands are managed with good forestry techniques (Pierson, 1978). Forest management would increase the growth and value of forest products and would provide additional benefits by maintaining the forests in a healthful condition for other uses.

The Forest Resource

Approximately 81 percent of the Pinelands area is forested, encompassing 756,000 acres. Sixty-nine percent of the approximately 680,000 acres in this area are privately owned. The data for each county are presented in Table 2.28.

Table 2.28—Area of Commercial Forest by County in the Pinelands Area

County	Total Acreage (thousands of acres)	Forestland (thousands of acres)	Percent Forested	Commercial Forestland (thousands of acres)	Percent Privately Owned
Atlantic	246.4	169.9	74	152.9	91
Burlington	336.7	282.8	84	254.5	46
Camden	54.6	31.7	58	28.5	48
Cape May	34.2	27.4	80	24.7	73
Cumberland	45.6	41.0	90	36.9	81
Gloucester	33.2	19.6	59	17.6	96
Ocean	183.0	173.9	95	156.5	81
TOTAL	933.7	756.3	81	680.7	69

The estimated total net volume of growing stock on commercial forest land in the Pinelands for 1972 was 450 million cubic feet. The total net volume of saw timber for the same period was 876 million board feet. This translates into a stumpage value of approximately \$131 million and a mill-delivered value exceeding \$332 million for primary markets. Further value projections such as secondary production market values are undeterminable due to the diverse product range.

The data for each county are presented in Table 2.29. These figures deal only with poletimber (trees which have a diameter of 5 to 10 inches at breast height), and sawtimber stock (greater than 11 inches diameter at breast height). Therefore, these resource value figures can be considered conservative be-

cause growing stock in the 2 to 4.9 inches in diameter class are not considered in the computations. This material does have stumpage and mill-delivered values in the pulpwood industry, firewood industry, and certain landscaping and primary processing markets.

Pinelands Wood Products

Both hardwood and softwood sawtimber are marketed and processed within the Pinelands region. Products include grade lumber, pallet stock, construction timbers and landscaping ties. Because of its special markets, management practices, and properties, cedar is placed in a separate category. In a roundwood form, cedar provides naturally durable posts for fencing, poles for shade tree stakes, and rustic furniture products. In a sawn form, cedar products include shingles, boat boards and lumber for a wide variety of special products.

Since the energy crisis of 1973, the demand for wood fuel as an energy source has been steadily increasing. The private and commercial demand for this Pinelands resource has directly reflected this trend. In 1979, approximately 2,500 cords of firewood from the Pinelands were provided to state residents through the Homeowner Firewood Program. This represents 85 percent of the total state volume provided under the program. In addition, an estimated 32,000 cords of firewood were harvested by private and commercial means. This material provided a caloric equivalent of 4.6 million gallons of fuel, and based on 1978 forest product prices, a value of about \$1.5 million.

There is a major market for pulpwood from the Pinelands. The region presently supplies the great bulk of in-state demand for this material, and also supplies several out-of-state corporations with pulp-

Table 2.29—Economic Value of Forest Resources in the Pinelands

County	Poletimber (5-10 in) Stumpage Value	Mill Delivered Value
Atlantic	\$8,158,000	\$36,750,000
Burlington	9,179,000	41,350,000
Camden	1,143,000	5,150,000
Cape May	1,343,000	6,050,000
Cumberland	1,809,000	8,150,000
Gloucester	1,076,000	4,850,000
Ocean	5,161,000	23,250,000
	<u>\$27,869,000</u>	<u>\$125,550,000</u>

Product values consider firewood, pulpwood, pulp chips, and markets.

County	Poletimber (11+ in) Stumpage Value	Mill Delivered Value
Atlantic	\$28,254,000	\$56,508,000
Burlington	35,904,000	71,808,000
Camden	4,896,000	9,792,000
Cape May	4,437,000	8,874,000
Cumberland	7,344,000	14,688,000
Gloucester	4,029,000	8,058,000
Ocean	18,666,000	37,332,000
	<u>\$103,530,000</u>	<u>\$207,060,000</u>

Product values consider hardwood sawtimber, pine sawtimber, and piling markets.

wood for producing a wide range of paper-based products. Markets for wood chips have recently increased substantially. This product is produced within the Pinelands from roundwood and is used in the treatment of sewage sludge, by roofing shingle manufacturers, and in landscaping. The Pinelands region also has the potential of producing timber suitable for piling. However, the level of forest management would need to be increased greatly to produce sufficient quantities to provide an attractive market for this product.

Silviculture in the Pinelands

The combined effect of repeated wildfires and unregulated cuttings over a long period of time is reflected in the relatively low productivity of the Pinelands forests. The estimated yield for 1977 was 0.09 cord per acre. Not more than 30 percent of the total area of upland forest supports stands of 6 cords per acre or better. A greater annual average yield could be realized under proper management (Pierson, 1978).

Forest management attempts to provide the best possible conditions for the growth of a selected species while protecting the integrity of the environment. Management techniques vary with species composition, site conditions, and objectives, and include reforestation, timber stand improvement, various harvesting methods, prescribed burning, and insect and disease control. For example, pitch pine is a desired species in the Pinelands because it is adapted to the region's soil conditions and is capable of rapid growth. Pines are intolerant of shade and require even aged management for their regeneration. Harvest should be preceded by prescribed burning, which favors the establishment of pine seedlings. Ensuring the survival and good growth of pine seedlings requires elimination of vigorous oak sprouts which compete with the pine. These sprouts must be controlled until the pine is tall enough to maintain its dominance without further aid. After the pines have reached a suitable size, prescribed burning is recommended to reduce damage and mortality from wildfire.

Atlantic white cedar is usually the most valuable lowland tree in the Pinelands. Careful management is needed to ensure regeneration after harvesting. Cedars should be managed in even-aged tracts and harvested by clearcutting. Removal of competing hardwoods and prevention of deer browsing should be continued until the cedar is well established. Improper management of both pine and cedar results in low yields and, in the case of the Atlantic white cedar, possible replacement by less desirable species.

Pinelands Vegetation—A Critical Resource

The Pinelands' vegetation is characterized by expansive, intricately patterned forests, marshes and bogs, threatened and endangered plants, valuable forest resources, and fire. It has experienced 300 years of intensive human exploitation, including logging, mining, and agriculture, and has been partly shaped by these human activities. Despite these past and current impacts on its vegetation, the Pinelands have retained their resiliency and remain a wilderness area of tremendous ecological importance to New Jersey, the region, and the nation.

AQUATIC COMMUNITIES

Three general aquatic habitat types can be recognized in the Pinelands: streams, lakes and ponds, and bogs. Most Pinelands streams are shallow and slow-moving. The tea-colored waters are generally low in nutrients, turbidity, hardness, and dissolved solids, and have a relatively low pH. Substrates are usually sandy, but extensive gravel beds and deposits of decaying organic matter may also be present. Hard substrates, which are provided by logs, stumps, and roots, and which significantly affect the distribution of bottom-dwelling plants and animals, are also present in most streams. There are few natural lakes in the Pinelands, but man-made impoundments along streams have provided many pond and lake-type habitats. The substrate in these waters is usually soft organic muck.

Certain species of aquatic plants and animals are better adapted to the physical and chemical conditions of Pinelands waters than other species. Although few if any species are restricted to the New Jersey Pinelands, many occur repeatedly in collections from the area and are considered to be characteristic of undisturbed Pinelands waters.

The aquatic communities study completed for the Pinelands Commission by T. Lloyd Associates (1980) is summarized in this section. Data on aquatic plants and animals were obtained from published and unpublished sources and by searching local collections. No field studies were conducted. All major watersheds within the Pinelands were inventoried. Except for fish, collections from brackish waters east of the Garden State Parkway were not included. The objectives of the study were to describe the composition of characteristic Pinelands aquatic communities, to identify areas supporting those communi-

ties, to identify areas which appear to be degraded, and to determine the factors which have adverse impacts on the characteristic communities. Indicator species were used to determine levels of disturbance.

Algae

Some 350 taxa of algae have been reported from Pinelands waters. The characteristic algal flora in streams include several species of the red algal genus *Batrachospermum* and numerous species of diatoms and desmids. Diatom species from the genera *Frustulia*, *Fragilaria*, *Eunotia*, and *Pinnularia* are usually present, as well as *Actinella punctata*, a diatom found only in acid waters (Patrick and Reimer, 1966). Genera of green algae generally present are *Mougeotia*, *Zygogonium*, *Zygnema*, *Spirogyra* and *Microspora*. Desmids from almost all known genera are usually present in the streams (Moul and Buell, 1979).

Lakes and ponds of the Pinelands support algal communities similar to other aquatic habitats in the area. Attached algae are abundant along the shoreline, with planktonic species frequently entangled in the filamentous forms. Desmids tend to be less abundant than in streams. Species of *Oedogonium* are frequent on submerged stems of vascular plants. They are often present with *Aphanochaete repens*, a species which is characteristically found on other filamentous algae. *Ulothrix zonata* was also recorded in the spring (Moul and Buell, 1979).

There is little variation in the composition of the algae among Atlantic white cedar swamps and bogs, including cranberry bogs. Many of the species found in the streams are also found in these areas. Desmids are the dominant algal group, and blue-green algae are more common than in streams.

Macrophytes

Typical stream species of aquatic macrophytes include bur-reed (*Sparganium* spp.), water celery (*Vallisneria americana*), rushes (*Eleocharis* spp. and *Scirpus* spp.), golden club (*Orontium aquatica*), and waterwort (*Elatine minima*). Larger streams with increased light may have the following species as members of the flora: bur-reeds, pondweeds (*Potamogeton* spp.), arrowheads (*Sagittaria* spp.) water celery, manna grass (*Glyceria obtusa*), spikerush (*Eleocharis Robbinsii*), swaying bulrush (*Scirpus subterminalis*), golden club, pipeworts (*Eriocaulon* spp.), pickerelweed (*Pontederia cordata*), rushes (*Juncus* spp.), slender blue flag (*Iris prismatica*), bullhead lily (*Nuphar variegatum*), fragrant water-lily (*Nymphaea odorata*), and bladderworts (*Utricularia* spp.).

Swaying bulrush, bullhead lily, golden club, Parker's pipewort (*E. Parkeri*), arrow-arum (*Peltandra virginica*), pickerelweed, arrowheads (*S. Englemanniana*, *S. montevidensis*), and a wild rice (*Zizania aquatica*) are floral components of freshwater tidal regions. Areas of higher salinity are represented by arrow-arum, cattails, threesquare bulrushes (*Scirpus pungens*, *S. americanus*), pondweeds (*Potamogeton perfoliatus*, *P. pusillus*), and water celery in addition to ditch-grass (*Ruppia maritima*) and horned pondweed (*Zannichellia palustris*).

Common aquatic macrophytes in impoundments include species such as fragrant water-lily, spikerush, swaying bulrush, and floating heart (*Nymphoides cordata*), as well as other species previously mentioned for streams. Typical aquatic macrophytes found in open bogs include pipeworts, water-willow (*Decodon verticillatus*), water-milfoil (*Myriophyllum* spp.), mermaid-weed (*Proserpinaca* spp.), and bladderworts.

Macroinvertebrates

Macroinvertebrate communities in uncontaminated Pinelands streams are typically small but often diverse. Aquatic insects are usually dominant. In addition, aquatic earthworms, leeches, crustaceans, and mollusks may be present. Among more than 275 genera of aquatic macroinvertebrates reported in Pinelands waters, 260 are aquatic insects. The three most important orders are dipterans (53 genera), odonates (41 genera), and trichopterans (39 genera). Certain genera were recorded in almost every watershed. Most of these species have widespread distribution in the rest of the state. Data indicates that lakes support fewer species than streams.

Fish

Pinelands streams, including both interior and estuarine segments, support at least 91 species of fish. The 15 species listed in Table 2.30 are thought to be characteristic of acid Pinelands streams. Those listed in Group B are widely distributed throughout New Jersey and the Atlantic Coastal Plain, but nevertheless are considered characteristic of the Pinelands because they have been collected here in substantial numbers.

Table 2.30—Characteristic Pinelands Fish

Group A		Group B	
<u>Restricted Distribution</u>		<u>Widespread Distribution</u>	
Common Name	Scientific Name	Common Name	Scientific Name
Ironcolor shiner	<i>Notropis chalybaeus</i>	American eel	<i>Anguilla rostrata</i>
Yellow bullhead	<i>Ictalurus natalis</i>	Eastern mudminnow	<i>Umbra pygmaea</i>
Pirate perch	<i>Aphredoderus sayanus</i>	Redfin pickerel	<i>Esox americanus</i>
Mud sunfish	<i>Acantharchus pomotis</i>	Chain pickerel	<i>Esox niger</i>
Blackbanded sunfish	<i>Enneacanthus chaetodon</i>	Creek chubsucker	<i>Erimyzon oblongus</i>
Banded sunfish	<i>Enneacanthus obesus</i>	Tadpole madtom	<i>Noturus gyrinus</i>
Swamp darter	<i>Etheostoma fusiforme</i>	Bluespotted sunfish	<i>Enneacanthus gloriosus</i>
		Tessellated darter	<i>Etheostoma olmstedii</i>

Vegetation beds and quiet backwaters provide suitable habitat for the majority of Pinelands species, including the American eel (*Anguilla rostrata*) and redfin and chain pickerel (*Esox americanus*, *E. niger*). This habitat association applies especially to secretive species such as the tadpole madtom (*Noturus gyrinus*), pirate perch (*Aphredoderus sayanus*), and yellow bullhead (*Ictalurus natalis*). The brown bullhead (*Ictalurus nebulosus*) is also present in streams, but it is less common and seems to be more characteristic of modified stream environments.

Sunfishes characteristic of the Pinelands are the mud sunfish (*Acantharchus pomotis*), blackbanded sunfish, and banded sunfish (*Enneacanthus chaetodon*, *E. obesus*). Of these, the blackbanded and banded sunfishes are virtually restricted to the Pinelands in New Jersey, where they are quite common and represent two of the most characteristic species of the area. Another species, the bluespotted sunfish (*Enneacanthus gloriosus*), is common in the Pinelands, but is also found in quiet, densely vegetated waters throughout the state.

Tree roots and indentations along stream margins are favored by the eastern mud minnow (*Umbra pygmaea*). The creek chubsucker is the dominant open-water fish characteristic of the Pinelands, and is usually found in quiet back-water areas. The ironcolor shiner (*Notropis chalybaeus*) is reported to have been commonly observed in small channels in Atlantic white cedar bogs.

In lower reaches of Pinelands rivers and streams, as they expand and become tidal, a quite different assemblage of fishes occurs. Many peripheral Pinelands species are common, as well as marine species which stray into coastal streams and several anadromous forms which move upstream to spawn.

Common peripheral species in the lower reaches of waterways such as the Mullica, Great Egg Harbor, Tuckahoe, and Maurice Rivers are the golden shiner (*Notemigonus crysoleucas*), the spotted shiner (*Notropis hudsonius*), the white sucker (*Catostomus commersoni*), the white catfish (*Ictalurus catus*), the banded killifish (*Fundulus diaphanus*), the mummichog (*Fundulus heteroclitus*), the fourspine stickleback (*Apeltes quadracus*), the three-spine stickleback (*Gasterosteus aculeatus*), the white perch (*Morone americana*), the pumpkinseed (*Lepomis gibbosus*), and the yellow perch (*Perca flavescens*). Some of these species, such as the golden shiner, pumpkinseed, and yellow perch, are well established in some upstream areas. Because they do not normally occur in the typically acid Pinelands waters, their presence usually indicates some type of modification. They are most characteristic of artificial impoundments and are often the result of stocking programs.

Anadromous fishes which spawn in streams of the Pinelands are blueback herring (*Alosa aestivalis*), alewife (*Alosa pseudoharengus*), Atlantic shad (*Alosa sapidissima*), and striped bass (*Morone saxatilis*).

These fishes are generally restricted to the lower reaches of Pinelands streams because their upstream migrations are blocked in most cases by dams. However, alewife spawning has been reported as far upstream as the Nescochague Creek and the Atsion River at Constable Bridge.

The predisposition of most Pinelands fishes to quiet, vegetated backwater areas of streams makes them well adapted to the artificial habitat of an impoundment. Thus, virtually all of the characteristic Pinelands stream fishes are also quite numerous in lake and pond habitats in the area, especially in those where dense aquatic vegetation has developed.

The fish fauna of all but the most acid lakes and ponds of the Pinelands includes several non-native species which have been stocked for angling purposes. The pumpkinseed and yellow perch have been mentioned previously. Other important species are the bluegill (*Lepomis macrochirus*), the largemouth bass (*Micropterus salmoides*), and the black crappie (*Pomoxis nigromaculatus*). These three species are well established in New Jersey waters and exhibit distribution patterns of peripheral Pinelands species. They also occur in some stream habitats within the Pinelands which have modified water conditions, and in the lower tidal reaches of Pinelands streams. Northern pike (*Esox lucius*) has also been introduced into the Pinelands.

The trouts (rainbow trout, *Salmo gairdneri*; brown trout, *Salmo trutta*; and brook trout, *Salvelinus fontinalis*) have been extensively stocked for fishing in New Jersey, including the Pinelands. However, none of these have become established in Pinelands waters, although there have been reports of native populations of brook trout.

The redear sunfish (*Lepomis microlophus*) and fathead minnow (*Pimephales promelas*) have also been stocked in Pinelands waters, but the present status of these populations is unknown. In addition, the introduced black bullhead (*Ictalurus melas*) and channel catfish (*Ictalurus punctatus*) may be established in the lower Maurice River. Two other introduced species which may occur in Pinelands waters are the goldfish (*Carassius auratus*) and carp (*Cyprinus carpio*). These species generally only occur in waters with high biological productivity and thus are excluded from most Pinelands waters. Where they do occur, they are good indicators of excessively disturbed, or even polluted, conditions.

Any of the characteristic Pinelands species of fish could occur in bog environments, but fish usually are not present there in large numbers. Data indicate that only the eastern mudminnow should be expected in such habitats in significant numbers.

Factors Influencing Pinelands Aquatic Communities

Interacting physical, chemical, and biological factors are responsible for the unique character of the Pinelands' aquatic communities. Together, these factors limit the distribution of many species and enable a relative few to survive successfully. Those able to do so are adapted to the chemical qualities of the water, such as high acidity and low nutrients, and to the distinctive physical features of the aquatic habitat, such as current, substrate, light availability, and temperature.

The low pH (in the range of 4.0 to 6.0) is perhaps the most characteristic feature of Pinelands waters. Acidity restricts the distribution of not only individual species, but even much broader taxonomic groups. For example, the combination of high acidity and low nutrients, including calcium, seems to favor diatoms and desmids and restricts blue-green and some green algae. With the exception of some ubiquitous algal species, a change in pH to neutral or alkaline would eliminate most of the existing algal flora (Moul and Buell, 1979).

Some aquatic macrophytes are associated with acid water, but many other Pinelands species tolerate a wide range of pH. In general, low pH restricts the distribution of mollusks, since calcium, the primary shell ingredient, tends to remain dissolved. Pinelands invertebrate data is insufficient to determine the effect of pH on distribution.

Characteristic Pinelands fish species are among a relatively small group of fishes that tolerate acidity ranges down to about pH 4.0. Low pH has detrimental physiological effects on some fish by interfering with respiration or reproduction. Acid water is lethal to largemouth bass at about pH 4.0 (Calabrese, 1969), and to goldfish and channel catfish between 4.0 and 4.5 (Ultsch, 1978).

None of the Pinelands species require acid water, although this has been proposed for some such as the blackbanded sunfish. In addition to its potential toxicity, acid water may also affect the distribution of fishes indirectly by limiting important food sources or by affecting competition. Smith (1953) suggested that the acid nature of the Pinelands waters excludes some fishes from the area. He theorized that when water conditions change, and an area is invaded by peripheral species such as the pumpkinseed, acid water fish, such as the blackbanded sunfish, might be out-competed by them. There is evidence that when pH is elevated, peripheral species do tend to become established, and that acid water species tend to be reduced in numbers or eliminated.

Substrate and current have a significant effect on benthic invertebrates. In the absence of rocks, the only firm substrates that benthic algae and macroinvertebrates can attach to are roots, fallen logs, aquatic vegetation, and debris. Substrate availability may be an important factor affecting biological productivity in the Pinelands, but this relationship has not been extensively studied here.

The absence of strong currents may favor some fish species and limit the distribution of others which might otherwise be able to tolerate the acid water. For example, the sluggish nature of Pinelands streams is of prime importance to most of the 15 characteristic species of fish. In streams where currents are strong, most Pinelands species confine themselves to the quiet backwater areas and undercut banks.

Human Influences

Human influences have had a definite impact on the Pinelands' aquatic flora and fauna, as indicated by changes in species composition. Some human influences such as the impoundment of streams have had beneficial effects for fish and perhaps for macroinvertebrates. However, these influences have generally had a negative effect on the region's aquatic communities. The introduction of nutrients has enhanced the growth of aquatic macrophytes and algae (Patrick, 1979; Academy of Natural Sciences of Philadelphia, 1973). The application of lime or limestone to Pinelands soils or directly to the water has resulted in an increase in pH in some bodies of water. With the possible exception of very mild organic enrichment, pollution tends to reduce species diversity. Stoneflies, mayflies, and certain caddisflies are reduced in numbers or eliminated under these conditions. This has occurred in a few Pinelands streams, including the upper Great Egg Harbor River (New Jersey Division of Water Resources, 1976 unpublished data), and in several locations in the Southwest Branch of Rancocas Creek (Academy of Natural Sciences of Philadelphia, 1973).

The most significant changes are those which affect the natural acidity of the Pinelands water. Elevated pH is usually correlated with other changes in water quality, such as increased nutrient levels, turbidity, or reduced dissolved oxygen. These modifications usually lead to changes in the flora and fauna, either through natural colonization of peripheral species or, in the case of fish, through survival of introduced or exotic species. Any change in water chemistry which raises the pH above 6.0 may result in the replacement of the acid water species, but characteristic species with a tolerance for a wide range in pH may remain.

Fishes can be used to indicate various levels of disturbance. It should be emphasized, however, that such distinctions are not clear-cut and absolute. An undisturbed Pinelands environment can be recognized by the presence of any of the 15 species listed in Table 2.30 and no others. The most reliable indicators are those species with restricted distribution, such as yellow bullhead, pirate perch, mud sunfish, blackbanded sunfish, banded sunfish, and swamp darter.

Characteristic species with "widespread distribution" such as eastern mudminnow, redbfin and chain pickerel, and tadpole madtom do not appear to be directly affected by moderate changes in water quality. As a result, areas where only slight increases in nutrients and/or pH occur often continue to support these species. In some situations, their numbers may actually increase as a result of increased food sources and vegetative cover. But such modifications may also be sufficient to allow the invasion of other species not characteristic of the extremely acid, low-nutrient Pinelands water.

Because the pH tolerance of various fish species varies considerably, there is no single value which can be designated as the maximum pH for typical Pinelands waters. Levels occurring during spawning are especially important, since eggs and larvae are generally more sensitive than adults. In general, how-

ever, available data from the Pinelands indicates that waters below pH 5.0 rarely support peripheral and introduced species. Peripheral fishes like the golden shiner, brown bullhead, pumpkinseed, and yellow perch are the most widely distributed in modified Pinelands waters and thus must be somewhat tolerant of acidity. Pinelands streams supporting a predominance of characteristic Pinelands species plus the four peripheral species noted above might be regarded as supporting slightly modified Pinelands communities. Other less tolerant species which might be added to this community are the bluegill and largemouth bass, which occur in many places because of the long history of stocking.

In some bodies of water, many of the characteristic Pinelands species are not present. The major factors contributing to their recorded decline and disappearance are not known, but a combination of factors is most likely involved including pH, dissolved oxygen, substrate type, turbidity, food availability, and competition between species. Such modified Pinelands aquatic communities can thus be recognized by the reduced abundance of characteristic Pinelands species, especially those with restricted distribution. Other indications of modifications are the increased abundance of peripheral species, as well as the addition of various introduced species.

Watershed Inventory

As a result of the inventory conducted for the Commission, it was possible to identify four watersheds which are known to support aquatic communities characteristic of "pristine" Pinelands streams. These are:

- 1) the entire Wading River watershed (least disturbed of those investigated)
- 2) the entire Batsto River watershed
- 3) Westecunk Creek west of the Garden State Parkway
- 4) Cedar Creek west of the Garden State Parkway

Twelve other watersheds probably support pristine aquatic communities, but should be investigated more thoroughly since limited biological data were available. These include:

- 1) portions of the North Branch of Rancocas Creek east of New Lisbon
- 2) Burrs Mill Brook upstream from its confluence with Gum Spring
- 3) the Manamuskin River upstream from Route 49
- 4) Dennis Creek upstream from Route 47
- 5) the entire Atsion River
- 6) the entire Sleeper Branch
- 7) Landing Creek upstream from Route 30
- 8) the entire Makepeace Stream
- 9) Absecon Creek west of the Garden State Parkway
- 10) Patcong Creek west of the Garden State Parkway
- 11) Oyster Creek west of the Garden State Parkway
- 12) the Forked River west of the Garden State Parkway

WILDLIFE

The animals of the Pinelands function as integral parts of the region's ecosystem. The existing animal communities are shaped by many environmental factors, including vegetation, fire, moisture, and water chemistry. The species which make up these communities also play a role in shaping the Pinelands environment. Maintaining this environment is essential for the preservation of the characteristic Pinelands fish, bird, reptile, amphibian, mammal and invertebrate species.

Thirty-nine species of mammals, 299 bird species, 59 reptile and amphibian species, and 91 fish species have been identified as occurring within the Pinelands. They include two species listed as endangered by the United States Department of the Interior (1979) and 32 species listed as threatened or endangered by the New Jersey Department of Environmental Protection. The DEP defines an endangered species as "one whose prospects for survival within the state are in immediate danger due to one or many factors—a loss of or change in habitat, over-exploitation, predation, competition, disease." A

Table 2.31 — Mammals of the Pineyards and Their Habitats

Species	Status *	Habitats													
		Pine-oak	Oak-pine	Pitch pine lowland	Cedar swamp	Hardwood swamp	Water	Bog	Marsh	Non-Pine Barrens	Agricultural	Urban	Non-forested	Borrow pit	Old fields
Opossum, <i>Didelphis virginiana</i>	C	•	•	•	•	•		•	•	•	•	•			•
Raccoon, <i>Procyon lotor</i>	C	•	•	•	•	•		•	•	•	•	•			•
Long-tailed weasel, <i>Mustela frenata</i>	C	•	•	•	•	•		•	•	•	•				•
Mink, <i>Mustela vison</i>	C	•	•	•	•	•		•	•	•	•				•
River otter, <i>Lutra canadensis</i>	C			•	•		•	•	•					•	
Striped skunk, <i>Mephitis mephitis</i>	C	•	•	•	•	•		•	•	•	•	•			•
Red fox, <i>Vulpes fulva</i>	C	•	•			•				•	•				•
Gray fox, <i>Urocyon cinereoargenteus</i>	A	•	•	•		•									•
Black bear†, <i>Ursus americanus</i>	Ex	•	•	•		•				•	•				•
Bobcat†, <i>Lynx rufus</i>	Ex	•	•	•		•				•	•				•
Eastern coyote, <i>Canis latrans</i>	P/UC	•	•	•		•				•	•	•			•
Gray squirrel, <i>Sciurus carolinensis</i>	C		•			•					•	•			
Red squirrel, <i>Tamiasciurus hudsonicus</i>	A	•	•												
Woodchuck, <i>Marmota monax</i>	UC					•				•	•				•
Beaver, <i>Castor canadensis</i>	C			•	•	•	•	•		•	•				
Muskrat, <i>Ondatra zibethica</i>	C			•	•		•	•	•		•				
Eastern cottontail, <i>Sylvilagus floridanus</i>	C	•	•	•						•	•				•
White-tailed deer, <i>Odocoileus virginianus</i>	C	•	•	•	•					•	•	•			•
Masked shrew, <i>Sorex cinereus</i>	UC	•	•			•		•			•				•
Short-tailed shrew, <i>Blarina brevicauda</i>	UC	•	•	•		•		•							•
Least shrew, <i>Cryptotis parva</i>	UD							•	•						•
Eastern mole, <i>Scalopus aquaticus</i>	C							•			•	•			•
Star-nosed mole, <i>Condylura cristata</i>	UC			•	•	•		•	•		•				
Little brown bat, <i>Myotis lucifugus</i>	UD	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Eastern pipistrelle, <i>Pipistrellus subflavus</i>	UD	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Big brown bat, <i>Eptesicus fuscus</i>	UD	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Eastern chipmunk, <i>Tamias striatus</i>	C	•	•	•		•				•	•	•			•
Flying squirrel, <i>Glaucomys volans</i>	C	•	•	•		•					•				
Rice rat, <i>Oryzomys palustris</i>	UD								•						
White-footed mouse, <i>Peromyscus leucopus</i>	C	•	•			•					•				•
Red-backed vole, <i>Clethrionomys gapperi</i>	C	•	•	•	•	•									
Meadow vole, <i>Microtus pennsylvanicus</i>	C			•	•	•		•			•				
Pine vole, <i>Pitymys pinetorum</i>	C	•	•	•	•	•		•							
Southern bog lemming, <i>Synaptomys cooperi</i>	UD				•	•		•							
Norway rat, <i>Rattus norvegicus</i>	C										•	•			•
House mouse, <i>Mus musculus</i>	C										•	•			•
Meadow jumping mouse, <i>Zapus hudsonius</i>	UD			•	•	•		•							•

* Explanation of status codes:

Abundant (A)— The species reaches its highest population densities in the Pineyards when compared to other areas of New Jersey.

Common (C)— The species population is at a level consistent with the habitat available in the Pineyards, but the density here is exceeded in other areas of New Jersey.

Uncommon (UC)— The species population level is below the level which the Pineyards is capable of supporting, or the species is rarely encountered because of a scarcity of habitat.

Undetermined (UD)— A species about which there is not enough information available to determine status.

Extirpated (Ex)— A species that occurred in the Pineyards within the last 300 years but no longer exists within the region.

Peripheral (P)— The species reaches the limits of its distribution in the Pineyards. It may be uncommon to abundant. This designation will be used along with another status.

†Potential habitats exist for these extirpated species.

threatened species "may become endangered if conditions surrounding the species begin to or continue to deteriorate."

The results of bird, reptile and amphibian, and mammal studies completed for the Pinelands Commission are discussed in this section. The studies were: *An Assessment of the Birdlife of the Pinelands National Reserve/Pinelands Area* (Brady, 1980); *Reptiles and Amphibians of the Pinelands* (Conservation and Environmental Studies Center, Inc., 1980); and *An Assessment of the Game Mammals and Birds and Small Mammals of the Pinelands* (New Jersey Division of Fish, Game and Wildlife, 1980).

Mammals

Thirty-five species of mammals can be found in the Pinelands. Two native species have been extirpated here. Table 2.31 lists these species, their habitats, and the population status assigned to each by the Division of Fish, Game and Wildlife. Four additional bat species are found in the area during migration (Wolgast, 1979). This species total is a good representation of the 49 mammal species reported to occur in New Jersey. Although none of the Pinelands species is currently designated as threatened or endangered by New Jersey or the U.S. Fish and Wildlife Service, human influence has resulted in the regional extinction of some mammals, including the bobcat and the black bear. The beaver was eliminated through unregulated trapping but has been reintroduced and is now considered to be common in the Pinelands.

Sixteen of the Pinelands mammal species excluding the extirpated bobcat and bear are classified as either game species or furbearers. Game species are hunted for food or for sport, and furbearers are sought for their pelts. The largest of the game species is the white-tailed deer (*Odocoileus virginianus*). All twelve medium or intermediate-sized mammals, including the gray fox (*Urocyon cinereoargenteus*), beaver (*Castor canadensis*), and muskrat (*Ondatra zibethica*), and three small mammals, the gray squirrel (*Sciurus carolinensis*), red squirrel (*Tamiasciurus hudsonicus*), and long-tailed weasel (*Mustela frenata*), are placed in one of the two categories. The 19 remaining species, all less than 10 inches in length and classified as small mammals, include 5 insectivores, 3 breeding bat species, and 11 rodents.

The distribution of mammals in the Pinelands reflects the variations which exist in the vegetation. Certain species are more closely associated with hardwood forests or agricultural land and occur more frequently along the western borders of the region where these habitats are more common. Other species, such as the red squirrel, are abundant in pine-oak and oak-pine areas. Table 2.32 summarizes the number of mammal species associated with each vegetation type.

Table 2.32—Total Number of Pinelands Mammals Associated with Each Habitat

Habitat	Number of Species
Pine-oak forest	23
Oak-pine forest	24
Pitch pine lowland	25
Cedar swamp	18
Hardwood swamp	27
Water	6
Bog	20
Marsh (inland and coastal)	13
Non-Pine Barrens forest	15
Agricultural	26
Urban	13
Non-forested	3
Borrow pits	4
Old fields	24

Long-tailed weasels, minks (*Mustela vison*), river otters (*Lutra canadensis*), muskrats and beavers are medium-sized mammals which are closely associated with water. The long-tailed weasel is the only weasel known to occur in the Pinelands, reaching its highest densities along the western borders of the region. This species and the mink are common in a variety of upland and lowland habitats. The mink occurs more frequently in the eastern and southern portions of the Pinelands.

Beavers and otters are associated with streams, lakes and swamps. Over 100 beaver colonies are now established in the Pinelands, a remarkable comeback for a species which was formerly eliminated in the area. Salt marsh and freshwater rivers are extremely important to the muskrat, New Jersey's most valuable furbearer.

Many of the small mammals are at least partially dependent on the lowlands as habitat. These species include the masked shrew (*Sorex cinereus*), the red-backed vole (*Clethrionomys gapperi*), star-nosed mole (*Condylura cristata*), and the white-footed mouse (*Peromyscus leucopus*). The meadow vole (*Microtus pennsylvanicus*), southern bog lemming (*Synaptomys cooperi*), and meadow jumping mouse (*Zapus hudsonius*) inhabit bogs and herbaceous wetlands. Both the least shrew (*Cryptotis parva*) and the rice rat (*Oryzomys palustris*) prefer marshes bordering rivers.

The white-tailed deer is common in the Pinelands and is distributed throughout the region. Deer densities in deer management zones within the Pinelands for 1979 are shown in Figure 2.12. The greatest densities are found in the northeastern section of the region. This species is essentially a forest-edge animal, preferring shrub thickets alternating with open areas such as abandoned fields. Although they usually move freely through their range, during severe winters with deep snow they are restricted to certain sheltered areas. In the Pinelands these wintering areas are often found in dense Atlantic white cedar swamps. The development of any of these swamps would place an additional strain on the Pinelands deer herd since it would eliminate an important habitat.

Although the opossum (*Didelphis virginiana*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), and gray fox are distributed throughout the Pinelands, they occur more frequently along the western portion of the region. The woodchuck (*Marmota monax*) is also found here occasionally. Both the opossum and skunk occupy a variety of habitats. The raccoon and red fox (*Vulpes fulva*) prefer the hardwood and oak-pine forests located near farms. The former shows a close association with streams, bogs, marshes, and lakes. The gray fox and red squirrel are both abundant in the Pinelands. Both species inhabit hardwood and mixed oak and pine forests, and occur most frequently in the central Pinelands.

The eastern cottontail rabbit (*Sylvilagus floridanus*) is found in a variety of habitats, reaching the greatest densities around cedar swamps, in recently burned areas, and along the edges of agricultural land (Applegate, 1979). The chipmunk (*Tamias striatus*), pine vole (*Pitymys pinetorum*), eastern mole (*Scalopus aquaticus*), and flying squirrel (*Glaucomys volans*) are most frequently found in the upland forests. The short-tailed shrew (*Blarina brevicauda*), a tunneling insectivore, has been found in most major habitats except the Plains (Connors, 1953).

The little brown bat (*Myotis lucifugus*), the big brown bat (*Eptesicus fuscus*), and the eastern pipistrelle (*Pipistrellus subflavus*) occur where buildings and hollow trees provide roosting areas. Four other bats found in the Pinelands during migration are the Keen's bat (*Myotis keenii*), the red bat (*Lasiurus borealis*), the hoary bat (*Lasiurus cinereus*), and the silver bat (*Lasioncyteris noctivagens*). Two introduced rodents which are also found near human settlements are the ubiquitous house mouse (*Mus musculus*) and Norway rat (*Rattus norvegicus*).

Historically, both the bobcat (*Lynx rufus*) and the black bear (*Ursus americanus*) occurred in the Pinelands, although both are now listed as extirpated in the region. The eastern coyote (*Canis latrans*) is a newcomer. This species appears to be increasing in both range and population density within the state. As it extends its range southward, its status may change in the Pinelands from peripheral to common.

Birds

Although the variety of bird species found in the Pinelands is not considered to be unusually rich, a total of 299 species and three subspecies that occur regularly in the area have been identified. Of these, 163 are breeding species. Included in this total are two birds designated as endangered by the federal government and all bird species which are present on the New Jersey official list of endangered and threatened species. These species and their habitats are listed in Table 2.33.

The region supports 44 species of game birds including 3 species of geese, 2 species of swan, 10 species of surface-feeding ducks, 10 species of bay ducks, 6 species of sea ducks, 3 species of rails, and

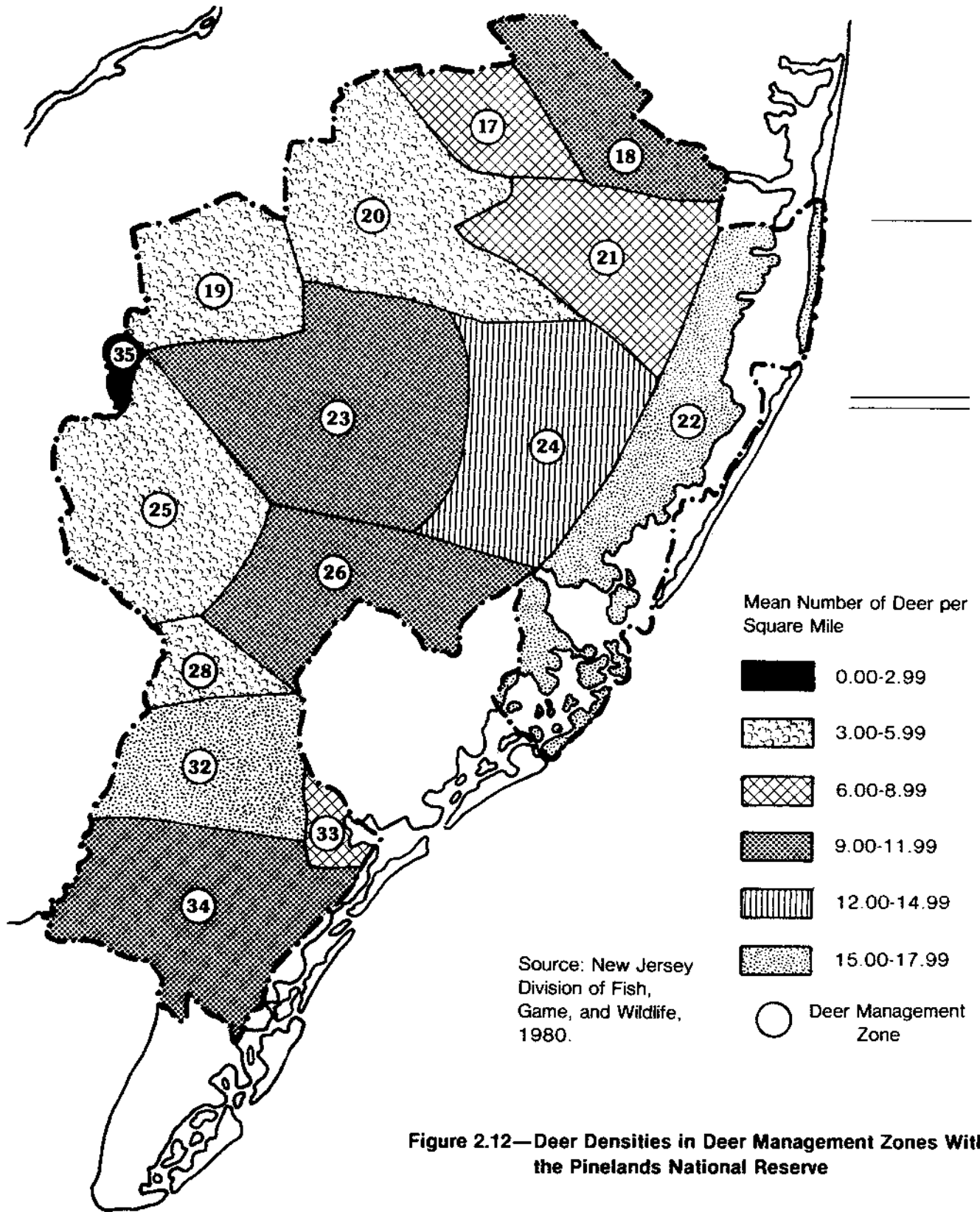


Figure 2.12—Deer Densities in Deer Management Zones Within the Pinelands National Reserve

2 species of crows. Others include the American woodcock (*Philohela minor*), the common snipe (*Capella gallinago*), the common gallinule (*Gallinula chloropus*), and the American coot (*Fulica americana*). Upland game species include the common bobwhite (*Colinus virginianus*), the ringneck pheasant (*Phasianus colchicus*), and the ruffed grouse (*Bonasa umbellus*).

The approximate number of species associated with each of the Pinelands habitats is listed in Table 2.34. Owing to a lack of habitat-specific field reports and to underreporting of certain habitats, these figures can only be considered estimates. The true richness of breeding species in these habitats may vary from the figures given.

The birds that breed in the Pinelands favor certain habitats over others. The upland pine-oak and oak-pine forests provide habitat for 34 and 40 breeding bird species, respectively. Both habitats may have formerly provided breeding habitat for the Cooper's hawk (*Accipiter cooperii*), and the sharp-shinned hawk (*Accipiter striatus*). These species apparently no longer nest in the Pinelands, but they do still use these habitats in winter and on migration. The great blue heron (*Ardea herodias*) may use any forest habitat near suitable feeding areas. The one known Pinelands colony of this species is in upland pine woods in Pomona, Atlantic County. Colonies of the red-headed woodpecker (*Melanerpes erythrocephalus*) are generally located in oak-dominated woodlands with little understory. Known locations are Batsto, Pomona and Cedar Run Lake.

Typical breeding birds of oak-pine forests include the rufous-sided towhee (*Pipilo erythrophthalmus*), which is probably the most abundant bird in the Pinelands, the screech owl (*Otus asio*), downy woodpecker (*Dendrocopus pubescens*), blue jay (*Cyanocitta cristata*), tufted titmouse (*Parus bicolor*), red-eyed vireo (*Vireo olivaceus*), ovenbird (*Seiurus aurocapillus*), and black-and-white warbler (*Mniotilta varia*). Species most likely to nest in pine-oak forests are the towhee, pine and prairie warblers (*Dendroica pinus*; *Dendroica discolor*), and the brown thrasher (*Toxostoma rufum*). The one known New Jersey record for the red crossbill (*Loxia curvirostra*) comes from the pine-oak forests of the Pinelands.

Common in all upland habitats are two birds of prey, the turkey vulture (*Cathartes aura*) and the American kestrel (*Falco sparverius*), two game birds, the ruffed grouse and the bobwhite, and several birds of southern affinity, including the Carolina chickadee (*Parus carolinensis*), the Carolina wren (*Thryothorus ludovicianus*), and the northern mockingbird (*Mimus polyglottos*). The whip-poor-will (*Caprimulgus vociferus*) nests on the ground in upland wooded habitats and the eastern bluebird (*Sialia sialis*) nests in open pine-oak and oak-pine forests.

The low number of breeding-bird species estimated for pitch pine lowland may be due to a lack of field investigation and documentation. This habitat is used by the Cooper's hawk and the sharp-shinned hawk in winter and on migration. Common breeding species include the gray catbird (*Dumetella carolinensis*) and the common yellowthroat (*Geothlypis trichas*). The white-eyed vireo (*Vireo griseus*) breeds

Table 2.33—Threatened and Endangered Bird Species of the Pinelands and Their Habitats

SPECIES	Pine-oak	Oak-pine	Pitch pine lowland	Cedar swamp	Hardwood swamp	Water	Bog	Inland marsh	Coastal marsh	Agricultural	Bay	Urban	Non-forested	Non-pine barrens	Old fields	Barrier beach	Island
ENDANGERED:																	
Bald eagle* <i>Haliaeetus leucocephalus</i>			•			•	•	•	•		•						
Peregrine falcon* <i>Falco peregrinus</i>							•	•	•						•	•	
Osprey <i>Pandion haliaetus</i>						•	•	•	•		•					•	•
Cooper's hawk <i>Accipiter cooperii</i>	•	•	•	•	•		•					•		•	•	•	
Least tern <i>Sterna albifrons</i>									•		•			•		•	•

Table 2.33—Threatened and Endangered Bird Species of the Pinelands and Their Habitats
Continued

SPECIES	Pine-oak	Oak-pine	Pitch pine lowland	Cedar swamp	Hardwood swamp	Water	Bog	Inland marsh	Coastal marsh	Agricultural	Bay	Urban	Non-forested	Non-pine barrens	Old fields	Barrier beach	Island
Black skimmer <i>Rhynchops niger</i>									•		•					•	•
THREATENED:																	
Pied-billed grebe <i>Podilymus podiceps</i>						•	•	•	•		•						
Red-shouldered hawk <i>Buteo lineatus</i>	•	•	•	•	•		•							•			
Great blue heron <i>Ardea herodias</i>					•	•	•	•	•		•						•
Merlin <i>Falco columbarius</i>							•	•	•							•	
Upland sandpiper <i>Bartramia longicauda</i>										•			•				
Roseate tern <i>Sterna dougallii</i>									•		•					•	•
Barred owl <i>Strix varia</i>	•	•	•	•	•									•			
Short-eared owl <i>Asio flammeus</i>								•	•				•		•	•	•
Red-headed woodpecker <i>Melanerpes erythrocephalus</i>	•	•												•		•	
Cliff swallow <i>Petrochelidon pyrrhonota</i>						•	•	•	•	•	•					•	
Short-billed marsh wren <i>Cistothorus platensis</i>							•	•	•								
Bobolink <i>Dolichonyx oryzivorus</i>								•	•	•			•				
Savannah sparrow <i>Passerculus sandwichensis</i>								•	•	•			•		•	•	
Ipswich sparrow <i>Passerculus sandwichensis princeps</i>																•	
Grasshopper sparrow <i>Ammodramus savannarum</i>									•	•			•		•	•	
Henslow's sparrow <i>Ammodramus henslowii</i>							•	•	•						•		
Vesper sparrow <i>Pooecetes gramineus</i>										•			•		•	•	
Northern harrier <i>Circus cyaneus</i>							•	•	•	•			•		•	•	•

* Listed as endangered by U.S. Department of the Interior.
All others listed as endangered or threatened by New Jersey.

in most thickets in this habitat.

Atlantic white-cedar swamps are specialized habitats with a comparatively low total of 11 breeding-bird species. Further investigation might reveal others. The barred owl (*Strix varia*) and the hooded warbler (*Wilsonia citrina*) are known to breed in these swamps. The northern parula (*Parula americana*), designated extirpated in New Jersey, may be reestablishing itself as a breeder in the Pinelands cedar swamps. Species which are either restricted to or observed most often in cedar swamps are the saw-whet owl (*Aegolius acadicus*), the eastern wood pewee (*Contopus virens*), the wood thrush (*Hylocichla mustelina*), the prothonotary warbler (*Protonotaria citrea*), the black-throated green warbler (*Dendroica virens*), and the Louisiana waterthrush (*Seiurus motacilla*). Other breeding species include the catbird, the yellow-throat, the American redstart (*Setophaga ruticilla*) and the song sparrow (*Melospiza melodia*).

Table 2.34—Estimated Number of Bird Species in Each Habitat

Habitat	Number of Breeding Species	Total Number Of Species
Pine-oak forest	34	100
Oak-pine forest	40	140
Pitch pine lowland	15	83
Cedar swamp	11	39
Hardwood swamp	41	101
Bog	29	116
Water	—	57
Inland marsh	18	67
Coastal marsh	43	122
Agricultural	33	66
Urban	24	42
Non-forested	10	49
Old fields	24	70
Islands	20	43
Barrier beach	20	153
Bay	—	96
Non-pine barrens forest	46	114

Forty-one breeding bird species are characteristic of hardwood swamps. This association provides breeding habitat for the red-shouldered hawk, (*Buteo platypterus*), the barred owl, the hooded warbler, and the eastern bluebird.

Cranberry bogs and their environs support a breeding-bird community of about 29 species. They are exceptionally important as wintering areas for certain waterfowl and as migration habitat for waterbirds, raptors, and shorebirds. The number of birds associated with water is also significant. Noteworthy species found on or near water during some part of the year include the red-necked grebe (*Podiceps grisegena*), the bald eagle (*Haliaeetus leucocephalus*), the osprey (*Pandion haliaetus*), the great blue heron, and the American coot (*Fulica americana*).

Although inland marshes do not support any species that are not found in coastal marshes, the relative scarceness of this inland habitat makes it important. Without it such species as the sora rail (*Porzana carolina*) and swamp sparrow (*Melospiza georgiana*) would breed only rarely within the central Pinelands.

Coastal marshes are an important habitat complex for entire groups of birds including waterfowl, raptors, wading birds, and shorebirds. Coastal marsh provides migration, wintering, and potential breeding habitat for the osprey and feeding areas for the black skimmer (*Rynchops niger*). It is also the site of the attempted reintroduction of the peregrine falcon (*Falco peregrinus*), although it was not this species' natural breeding habitat in New Jersey. As a breeder, the northern harrier (*Circus cyaneus*) is now virtually restricted to saltmarsh in New Jersey and uses this habitat in winter. Coastal marshes provide migratory habitat for merlin (*Falco columbarius*), and the most important breeding and wintering habitat in the Pinelands for the short-eared owl (*Asio flammeus*). Short-billed marsh wren (*Cistothorus platanensis*) may breed at the saltmarsh-upland interface, and has been recorded from the Heislerville Wild-

life Management Area. Coastal marshes are also significant wintering habitat for the savannah sparrow (*Passerculus sandwichensis*).

Coastal bays, including tidal flats, saltmarsh edges, and lower reaches of estuaries, are the primary migration and wintering habitat for loons and grebes, including the red-necked grebe, and a host of swans, geese, and diving ducks. The greater scaup (*Aythya marila*), the bufflehead (*Bucephala albeola*), and the red-breasted merganser (*Mergus serrator*) are particularly common. Although only about 20 species of birds are recorded as breeding on islands in coastal bays, almost all the species involved are virtually dependent on these islands, whether natural marsh or spoil, as their only breeding habitat in New Jersey. These species include the least tern (*Sterna albifrons*) and black skimmer. Barrier beaches can be ex-

Table 2.35—Selected Reptiles and Amphibians of the Pinelands and Their Habitats

Species	Status*	Pine-oak	Oak-pine	Pitch pine lowland	Cedar	Hardwood	Water	Bog	Marsh	Non pine barrens	Agricultural	Urban	Non-forested	Borrow pit	Old fields
Eastern hognose snake <i>Heterodon platyrhinos</i>	D	•	•								•		•		•
Eastern worm snake <i>Carphophis a. amoenus</i>	U	•	•	•						•			•	•	•
Northern black racer <i>Coluber c. constrictor</i>	U	•	•	•	•	•			•		•	•	•	•	•
Rough green snake <i>Opheodrys aestivus</i>	—	•	•	•				•			•		•	•	•
Corn snake <i>Elaphe g. guttata</i>	T	•	•	•						•	•		•		•
Black rat snake <i>Elaphe o. obsoleta</i>	U	•	•							•	•		•		•
Northern pine snake <i>Pituophis m. melanoleucus</i>	T	•	•		•	•							•	•	•
Eastern king snake <i>Lampropeltis g. getulus</i>	U	•	•		•	•	•	•	•						•
Northern scarlet snake <i>Cemophora coccinea copei</i>	U	•	•											•	•
Timber rattlesnake <i>Crotalus horridus</i>	E	•	•	•	•	•							•		•
Spotted salamander <i>Ambystoma maculatum</i>	D	•	•	•			•			•					
Marbled salamander <i>Ambystoma opacum</i>	D	•	•	•			•								
Eastern tiger salamander <i>Ambystoma t. tigrinum</i>	E						•						•	•	•
Four-toed salamander <i>Hemidactylium scutatum</i>	D				•	•	•	•							
Eastern mud salamander <i>Pseudotriton m. montanus</i>	T				•	•	•	•	•						
Northern red salamander <i>Pseudotriton r. ruber</i>	D				•	•	•	•	•						•

Table 2.35—Selected Reptiles and Amphibians of the Pinelands and Their Habitats, Continued

	Status *	Pine-oak	Oak-pine	Pitch pine lowland	Cedar	Hardwood	Water	Bog	Marsh	Non pine barrens	Agricultural	Urban	Non-forested	Borrow pit	Old fields
Eastern spadefoot toad <i>Scaphiopus h. holbrooki</i>	D	•	•	•			•								
Northern cricket frog <i>Acris c. crepitans</i>	U			•	•	•	•	•	•					•	•
Pine Barrens treefrog <i>Hyla andersoni</i>	E	•	•	•	•	•	•	•	•					•	•
Southern (Cope's) gray treefrog <i>Hyla chrysoscelis</i>	E			•		•	•		•	•	•			•	•
Carpenter frog <i>Rana virgatipes</i>	U				•	•	•	•	•						
Spotted turtle <i>Clemmys guttata</i>	U			•	•	•	•	•	•	•					
Wood turtle <i>Clemmys insculpta</i>	T			•			•			•					
Bog turtle <i>Clemmys muhlenbergi</i>	E				•	•	•	•	•						
Map turtle <i>Graptemys geographica</i>	U						•		•						
Red-bellied turtle <i>Chrysemys rubriventris</i>	U				•		•	•	•						
Ground skink <i>Scincella lateralis</i>	U	•	•							•	•				
Five-lined skink <i>Eumeces fasciatus</i>	U	•	•							•		•	•		
Queen snake <i>Natrix septemvittata</i>	U						•			•					
Northern red-bellied snake <i>Storeria o. occipitamaculata</i>	—	•	•	•	•	•	•	•							

*Status codes assigned by New Jersey Division of Fish, Game, and Wildlife: E—Endangered D—Declining
T—Threatened U—Undetermined

pected to support at least 20 breeding-bird species, and in addition are exceptionally important migratory habitats for a wide variety of species.

Agricultural areas within the Pinelands provide open country with various kinds of vegetation attractive to a rather high number of breeding birds, estimated at 33 species. Species commonly found around human developments include the introduced, non-native species such as the starling (*Sturnus vulgaris*), the house sparrow (*Passer domesticus*), and the rock dove (*Columbia livia*), as well as the robin (*Turdus migratorius*) and the chipping sparrow (*Spizella passerina*).

Reptiles and Amphibians

As a group, amphibians and reptiles contribute to the uniqueness of the Pinelands fauna. The total number of amphibian and reptile species in the Pinelands is relatively large for an area with a northern

climate. Some species are not found elsewhere in New Jersey. Many of these species are now threatened with extinction.

The present Pinelands herpetofauna includes some species that are wide-ranging over areas of eastern and northeastern North America. Some species probably invaded from the northwest in the cooler period after the retreat of the glacier. However, southern Coastal Plain species contribute substantially to the diversity of the Pinelands herpetofauna. These species probably arrived in the warmer period of post-glacial time.

Fifty-nine species of reptiles and amphibians (herptiles) are found in the Pinelands, including 15 species of frogs and toads, 11 species of salamanders, 12 species of turtles, 18 species of snakes and three species of lizards. Four of these species have been introduced by man. Of the remaining 55 native Pinelands species, 29 are considered to be common and nine are classified as endangered or threatened by New Jersey.

Seven herptile species have a limited distribution in New Jersey and occur only within the Pinelands. They are the corn snake (*Elaphe g. guttata*), Pine Barrens treefrog (*Hyla andersoni*), the northern pine snake (*Pituophis m. melanoleucus*), the northern scarlet snake (*Cemophora coccinea copei*), the carpenter frog (*Rana virgatipes*), the ground skink (*Scincella lateralis*), and the northern red-bellied snake (*Storeria o. occipitomaculata*). The rough green snake (*Opheodrys aestivus*) and the eastern king snake (*Lampropeltis g. getulus*) are confined chiefly to the Pinelands, but are also found in the oak fringe areas surrounding the region. With the exception of the Pine Barrens treefrog and the pine snake, these species are distributed widely throughout the Atlantic Coastal Plain.

Thirty Pinelands herptile species were selected for intensive study by the Commission because of their distribution patterns or because their populations are known to be declining. The status and habitats (breeding and non-breeding) of each of the species are shown in Table 2.35. The number of species associated with each habitat is presented in Table 2.36.

Table 2.36—Number of Selected Pinelands Reptile and Amphibian Species Associated with Each Habitat

Habitat	Number of Species
Water areas	19
Oak-pine forest	17
Pine-oak forest	17
Old fields	15
Cedar swamps	14
Hardwood swamps	14
Marshes	12
Bogs	12
Pitch pine lowlands	14
Borrow pits	9
Non-Pine Barrens forest	10
Non-forested	10
Agricultural	7
Urban	2

Pitch pine lowlands, savannahs, marshes, ponds, lakes, bogs, cedar swamps, and hardwood swamps provide habitat for 25 of the 30 species studied. These include almost all the salamanders, toads, frogs and turtles. Certain snakes, the queen snake and the eastern kingsnake, are also dependent on these areas. All of the salamanders and toads rely on bodies of water within these wetlands for breeding.

Fewer species are supported in upland habitats. These fauna include the majority of snakes, the skinks and swifts, and the spotted and marbled salamanders (*Ambystoma maculatum*; *Ambystoma opacum*), which not only breed near water but also in temporary wet depressions in the woodlands. Gravel pits, borrow pits, old fields, (including abandoned cranberry bogs or blueberry fields), old home sites, abandoned and fallen buildings, and dumping grounds containing materials such as tree slash, tree stumps, and trash with no toxic outflow are disturbed areas which become micro-communities with prey populations for many herptiles. The ties of an abandoned railroad bed provide such a micro-

community for small rodents which serve as food for several snake species.

Each of these habitats are of importance if herptiles are to be maintained in the New Jersey Pinelands. Oak-pine, pine-oak, pitch pine lowlands, cedar swamps, hardwood swamps, bogs, marshes, open water, and most disturbed areas within these habitats are all essential habitats for at least some herptile species either in their adult or larval stages.

The number of species reported to occur in each watershed is presented in Table 2.37. This data may underestimate the true species richness of each watershed because of the limited amount of distributional data available and the biases of reported sightings.

Reptiles and amphibians are sought most often by collectors or hunters in easily accessible areas or areas with previous records of the animals' occurrence. This has led to numerous records from some areas, while vast expanses of the Pinelands which presumably contain suitable habitats have been overlooked. Collection by amateur and professional herpetologists has concentrated on the "popular," more showy species. Many herptiles, such as the salamanders and skinks, are secretive animals. Also, only frogs and toads call or sing, so these are the only herptiles detectable without actual sightings. Another reason for the lack of distributional data is that many collectors do not keep detailed or accurate records of their field work.

Endangered and Threatened Species

Nine Pinelands herptile species are listed by New Jersey as endangered or threatened here. The endangered species are the Pine Barrens treefrog, the timber rattlesnake, the bog turtle (*Clemmys muhlenbergi*), the southern gray (Cope's) treefrog (*Hyla chrysoscelis*), and the tiger salamander (*Ambystoma t.*

Table 2.37—Distribution of Reptiles and Amphibians by Watershed

Watershed	Number of Species
North Branch Rancocas Creek	23
Lower Maurice River	23
Batsto River	18
South Branch Rancocas Creek	21
Dennis Creek	20
Toms River	21
Cedar Creek	20
Upper Great Egg Harbor River	18
Tuckahoe River	17
Lower Great Egg Harbor River	16
Neschocague Creek	11
Lower Mullica River	14
Forked River	17
Wading River	15
Atsion/Mechesactauxin Creek	12
Atlantic Drainage	6
Crosswicks Creek	5
Bass River	6

tigrinum). Threatened species include the northern pine snake, the corn snake, the wood turtle (*Clemmys insculpta*), and the mud salamander (*Pseudotriton m. montanus*).

The timber rattlesnake inhabits oak-pine and pine-oak forests and pitch pine lowlands which border cedar and hardwood swamps. This species has a number of known populations in Burlington, Camden, Cape May, and Ocean Counties. Major strongholds occur in the Rancocas Creek and Mullica River watersheds. The timber rattlesnake population has been sharply reduced by a number of direct human actions including collecting, deliberate killing, and reduction of habitat by residential development.

Adult Pine Barrens treefrogs are found in and around cedar swamps, hardwood swamps, bogs, and small streams or ponds with acid waters. The larvae are aquatic. This species was first described in New Jersey. Disjunct populations also exist in North Carolina, South Carolina, Georgia and western

Florida. The Pine Barrens treefrog is widely distributed throughout the Pinelands in Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, and Ocean Counties, and has been recorded in every major watershed. It does not, however, occur anywhere else in New Jersey outside of the Pinelands. Although it occurs throughout the region, its habitat is vulnerable to any land use which raises the pH of wetland waters or causes a drop in the water table level.

In the field, the southern (Cope's) gray treefrog is indistinguishable from the more common gray treefrog (*Hyla versicolor*). They are separated only by distinct characteristics of blood cells and by the analysis of tracings of call frequency recordings. The presence of *H. chrysoscelis* in two counties, Cumberland and Cape May, has been verified by these means. Whether all gray treefrogs in Cumberland and Cape May Counties are indeed *H. chrysoscelis* or whether some of each species are present is uncertain. But it is probable that all gray treefrog habitats contain some *H. chrysoscelis*. The southern gray treefrog is vulnerable to increased residential or industrial development which eliminates wetlands, especially in those areas of Cape May and Cumberland Counties which support populations of these species.

Bogs and slow streams with muddy bottoms are inhabited by the bog turtle. This species has been recorded in Atlantic, Burlington, Cape May, and Ocean Counties. More recently, it was recorded in the Wading River watershed.

The tiger salamander breeds in borrow or gravel pits with permanent or temporary ponds located in a variety of habitats. It cannot tolerate extremely acid water. Scattered records of this species exist for the entire Pinelands region, with the last remaining "stronghold" in Cape May County. Attempts have been made to introduce a population in the Brigantine National Wildlife Refuge in Atlantic County, but its success seems questionable.

The northern pine snake favors pine-oak and oak-pine forests, but also occurs in pitch pine lowlands and cedar and hardwood swamps. This species is scattered throughout the Pinelands, with numerous records from Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester and Ocean Counties and from most of the major watersheds.

Like the pine snake, the corn snake inhabits upland forests. This species is distributed throughout the Pinelands with numerous records in Atlantic, Burlington, Ocean and Cumberland Counties. The greatest number of recent sightings have come from the Toms River and Mullica River watersheds.

The wood turtle is a non-Pine Barrens species. There are records of its occurrence at the periphery of the Pinelands in Burlington County. It probably penetrated the northern section of the Pinelands by moving upstream from the Inner Coastal Plain (Conant, 1979) along water courses like the Rancocas Creek.

Adults of the eastern mud salamander have been recorded in Burlington County within a portion of the Rancocas Creek basin near the Pinelands boundaries. Where it is known to exist, its typical habitats include muddy wetland areas, including cedar and hardwood swamps, bogs, marshes, streams, and ponds. Larvae of the species are strictly aquatic.

Arthropods

The insect fauna of the Pinelands has been characterized as unique (Boyd and Marrucci, 1979) and "extremely rich" (Smith, 1910). There are approximately 10,000 species of arthropods in the region. This group, including insects, spiders, and mites, makes up at least 75 percent of all plant and animal species in the Pinelands (Schweitzer, 1980). The occurrence and distribution of arthropods is dependent on the existence of suitable habitat, especially food plants. Weis and West (1924) compared the total number of insects found in two habitats, an open area and a mixed pine and oak woods. They collected a total of 383 insect species in the mixed woods and 248 species in the open area. Boyd and Marucci point out that although insects which exploit pine, oak, and sandy areas are abundant, the modest flowering plant diversity in the region limits other groups. The low pH of the Pinelands soils also limits some arthropods either directly or indirectly.

Like many plant and vertebrate species of the Pinelands, some insects exhibit northern and southern

affinities (McCormick, 1970). More species probably reach their northern than their southern limits in the region (Boyd and Marucci, 1979). The leaf-cutting ant (*Trachymyrmex septentrionalis*), a common ant in the region, is rare or absent in other parts of the state (McCormick, 1970), and is an example of a species which reaches its northern limit in the Pinelands. Fifty Lepidopteran species reach their southern limits in the Pinelands. Two moth species, *Agrotis buchholzi* and *Crambus daeckellus*, appear to be restricted to the Pinelands and are considered endemics. Four undescribed moths may also be endemics (Schweitzer, 1980). Characteristic Pineland species include several underwing moths (*Catocala* spp.) and the buck moth (*Hemileuca maia*). A number of species may be faced with extinction and deserve threatened or endangered species status. For example, the decline of one species, *Lithophane lemmeri*, may be the result of the reduction in mature Atlantic white cedar acreage (Schweitzer, personal communication). Approximately 100 moth species and one butterfly, Hessel's hairstreak (*Mitoura hesseli*), deserve special attention because of their limited distribution (Schweitzer, 1980).

Wildlife and Fisheries Resources

The wildlife and fisheries resources of the Pinelands have traditionally provided a considerable amount of recreational and economic benefit to area residents and others. In addition to the traditional activities of hunting and trapping, nature observation and nature photography have become important wildlife related activities. All generate economic benefit either directly, as in the case of trapping, or indirectly through expenditures for equipment, travel, food, and lodging.

An estimated annual average of \$29.7 million are spent by New Jersey residents pursuing wildlife-oriented recreation in the Pinelands (Penkala, 1977; U.S. Fish and Wildlife Service, 1977). There are an estimated 100,000 Pinelands hunters and trappers who spend an annual average of \$19.2 million. The income derived from the sale of the pelts of furbearing animals trapped in the region is approximately \$900,000 annually (Hahn, 1977).

In 1973, 20 percent of all fishing licenses sold in the state were purchased by residents of the counties that are entirely or partially within the Pinelands National Reserve. Based on the estimate of 476,000 warm-water, recreational fishermen in New Jersey, who spent \$56 million in 1975 (National Analysts, 1975), an estimated 95,200 people may spend up to \$11.2 million annually on fishing in the Reserve.

Sixty lakes, ponds, and reservoirs are open to the fishing public within the Pinelands. But of most importance are the estuarine bays and rivers within the National Reserve boundary. They include Barnegat Bay and its tributaries between Island Beach State Park and Brigantine Inlet, and the Great Egg Harbor River west of the Garden State Parkway. These areas serve as important nursery and spawning grounds for many transient marine fish, as well as habitats for resident estuarine fish. The preservation of water quality in the tributary wetlands and estuarine areas is essential. Saltwater fishery stocks depend on the young fish from these nursery areas to support a multi-million-dollar commercial and recreational saltwater fishing industry in New Jersey and neighboring states.

The 1975 National Analysts survey showed that 48 percent of the estuarine fishermen in New Jersey used Barnegat Bay, 13.4 percent fished in Great Bay, 12.1 percent in Little Egg-Manahawkin Bay, and 11.3 percent in the Great Egg Harbor River. This same survey showed that 643,000 people fished in estuarine areas in 1975 for 5,659,000 man-days of fishing. They generated \$261,524,000 worth of sales for New Jersey businessmen.

Commercial catches of marine finfish species in New Jersey that use estuarine areas as nurseries, or live there as transients, migrants or year-round residents, totaled more than \$7.9 million at dockside in 1978. A multiplier of 2.5, which adjusts the value to ultimate sales, raises this value to about \$19.75 million. Thus, the overall annual economic value of the marine finfish resources of the area is somewhat less than \$281 million, probably around \$270 million.

The shellfish of the Pinelands also provide excellent recreational and commercial opportunities. Important species include the hard clam, soft clam, oyster, blue mussel, bay scallop, and blue crab. The total value of the shellfish harvested annually within the National Reserve is estimated to be more than \$24 million.

According to Figley (1979), approximately 90 percent of the state's shellfishing activity, excluding

crabbing, takes place within the National Reserve. This activity accounts for some 212,000 man-days per year. About two-thirds of the fishing is recreational, but commercial operators harvest some two-thirds of the shellfish in this category. Applegate (1975) reported that 62 percent of the state's crabbing took place within an area now bounded by the National Reserve, accounting for an estimated 7 million man-days per year.

Management Practices

Common wildlife and fisheries management practices include manipulation of habitat, wildlife populations, human activities, and their interactions. Manipulation of habitat includes activities such as clearing, burning, planting and mowing. All of these procedures are being, and historically have been, carried out in the Pinelands. Burning and cutting have played critical roles in the development of the Pinelands' vegetation. These two techniques are the most economical methods of accomplishing habitat changes in the region and are consistent with maintenance of its character.

The manipulation of a wildlife population can be accomplished in several ways. The population level can be changed through modification of the mortality rate, or through changes in the age structure or sex ratio. Populations can be artificially bolstered through the stocking of propagated species, or a population can be re-established through reintroduction, as in the case of the wild turkey.

Sport harvest (hunting, fishing, and trapping) and various regulations controlling these activities are the most common methods of manipulating population levels, age structure, and sex ratios. An example of stocking is the liberation of game farm pheasants currently being carried out by the New Jersey Division of Fish, Game, and Wildlife. This stocking causes no long-term changes in the local population. It merely increases the population temporarily for recreation.

Methods of manipulating the human impacts on wildlife consist of regulations controlling the use of wildlife (game codes), land use regulations, and providing information to foster an understanding of the natural system and the effects of human activities.

Several considerations are applicable to the management of the Pinelands fisheries. Scientifically based control of seasons for fishing, size and creel limits, and the allowable manner and means of fishing are provided through the state fish and game code. Establishing offstream impoundments and manipulation of water chemistry in designated areas provides suitable habitat for desirable game-fish species. Stocking in certain areas and steps such as maintenance feeding and providing bypasses for anadromous fish also contribute to the recreational value of the Pinelands.

Management of estuarine fish and shellfish involves the maintenance of acceptable water quality and restrictions on catch, gear utilization, and season. Existing shellfishing laws and regulations establish minimum size requirements, harvest limitations, harvest seasons, and gear restrictions. Other active management programs include habitat protection, leasing of oyster and clam grounds to shell-fisherman for "wet" storage of shellfish or as seed planting areas, oyster seed transplanting, and relaying of clams from condemned areas to open waters where they naturally purge themselves of bacterial contamination.

Wildlife Management Areas

Areas of publicly owned open space in New Jersey have become an increasingly important recreational resource. These areas consist primarily of state parks, forests, and fish and wildlife management areas. The Division of Fish, Game, and Wildlife administers over 170,000 acres of wildlife management areas, statewide. Of this total, approximately half are in the Pinelands region (see Plate 23). There are 18 areas varying in size from just over 100 acres to over 14,000 acres (Table 2.38). They exhibit vegetational communities of every habitat type found in the Pinelands region.

Wildlife management areas are managed primarily for hunting, fishing, and trapping. However, a study by Applegate (1975) of a typical wildlife management area demonstrated that users spent more time on activities such as photography and bird-watching than they did on hunting, fishing, and trapping. The system of wildlife management areas has served to preserve critical and representative portions of the Pinelands. This has benefitted all of the animal species found in the region and provided countless recreational opportunities for the public.

Table 2.38—Wildlife Management Areas in the Pinelands National Reserve

Name	Acreage	County	Name	Acreage	County
Absecon	3,548	Atlantic	Manahawkin	965	Ocean
Beaver Swamp	2,700	Cape May	Manchester	2,376	Ocean
Butterfly Bogs	103	Ocean	Pasadena	3,100	Ocean
Colliers Mills	12,212	Ocean	Peaslee	14,276	Cumberland
Dennis Creek	5,109	Cape May	Port Republic	755	Atlantic
Great Bay Boulevard	4,141	Ocean	Stafford Forge	2,788	Ocean
Greenwood Forest	9,000	Ocean	Swan Bay	1,078	Burlington
Heislerville	3,844	Cumberland	Whiting	1,200	Ocean
Lester G. MacNamara	12,438	Atlantic-Cape May	Winslow	5,940	Camden-Gloucester

The Importance of Habitat Protection

The mosaic produced by the Pinelands vegetation directly affects the distribution of individual animal species and the composition of animal communities. The vertical and horizontal structure of the vegetation has been shown to effect the distribution of some animal species. According to studies performed for the Commission, species of birds, mammals, and reptiles and amphibians are associated with certain Pinelands vegetation types. Fire may affect the composition of animal communities by altering vegetation and soil litter. Ursner (1926) observed changes in the abundance of Pinelands bird species following a fire. Populations of soil arthropods are also affected by fire. The effect depends on the frequency of burning and the species present (Dindal, 1979).

Man has had a major influence on the Pinelands' animals, both directly by eliminating species such as the beaver through over-trapping and indirectly by destroying the habitat. Most of the species breeding in cedar swamps, such as the saw-whet owl, wood thrush and black-throated green warbler, are uncommon in other habitats. Destruction of significant amounts of their habitat would definitely jeopardize their existence in the Pinelands. These swamps are also critical as wintering areas for the white-tailed deer.

Several snake, turtle, and lizard species are sought by amateur and professional collectors who sell them for their skins, for display, for study, or for pets. This has resulted in over-collecting of many species. The timber rattlesnake and pine snake populations have been reduced as a result of this over-collection.

Degradation of existing water quality may also have a direct impact on many Pinelands species. For example, the low pH of Pinelands waters may be responsible for preventing the establishment of non-Pinelands fish which are not tolerant of high acidity. A similar effect of pH has been noted for amphibians. Gosner and Black (1957) observed that unlike the Pine Barrens treefrog, many species of amphibians could not breed in highly acid waters. It is quite possible that changes in pH due to changes in land use may have an effect on the Pineland's amphibian communities.

The minimum size of a habitat required to maintain the existing Pinelands plant and animal communities is not known. Any reduction in habitat will have a negative impact, however subtle it may be. From their study of Piedmont forest islands, Forman et al. (1976) determined that parcels of at least 40 hectares (approximately 100 acres) are apparently needed to support a diverse, forest interior insect-eating bird community. They recommended that large parcels of land be protected to maintain maximum diversity. This study is not directly applicable to the Pinelands, and further study is required to determine minimum parcel sizes for the Pinelands region.

The continuity of the Pinelands landscape may be fragmented by leapfrogging of development, scattered single home construction, highways, and land clearing. Robichaud (1980) emphasizes that fragmentation of the landscape into small isolated patches will result in decreased species and community diversity and reduce the ecosystem's capacity to maintain itself. Larger, contiguous patches of habitat are capable of supporting more plant and animal species, with a lower probability of any one species becoming locally extinct. If the size of any one of these patches is reduced, the numbers of individuals of the species within the patch are reduced. Local extinction is not unusual and can happen for

a number of reasons. The process can be reversed if recolonization by the same species from a nearby habitat occurs. Undisturbed landscapes serve as dispersal corridors for plant and animal species.

The lack of dispersal corridors would also have an adverse effect on the natural development of genetic variability in the Pinelands plant and animal species. Genetic exchange among individuals within a population on a contiguous site, among sites within the Pinelands, and between the Pinelands and ecosystems outside the region is necessary to ensure the variability and continued evolutionary capacity required for the survival of characteristic Pinelands flora and fauna.

Subtle changes in the environment can have major adverse cumulative impacts on the Pinelands' plant and animal communities. This is clearly stated by Dr. Beryl Robichaud in her discussion of the long-term effect of fragmentation:

"Many impacts are local or of a defined geographic nature. The effects may be easily apparent by the extinction of a rare species or the disappearance of a particular vegetation type. But the impact on the Pinelands ecosystem as a whole may not be apparent for some time. Because of the complexity of ecosystem processes and the spatial and temporal heterogeneity in patterns of biological distribution, small changes are often obscured. The critical concept to incorporate into landscape planning is that small changes can have dramatic effects on the continued viability of natural communities, particularly those that exist in the Pinelands."

This concept applies to all human activities which influence the Pinelands ecosystem.

CLIMATE

The Pinelands, like all of New Jersey, are characterized by a predominantly continental climate. They experience significant seasonal, daily, and day-to-day temperature fluctuations. Climate has affected and continues to affect the Pinelands ecosystem, including soil conditions, the region's hydrology, and the occurrence and distribution of plant and animal species.

Temperatures in the Pinelands vary from an average of approximately 23°C in the summer months of June, July, and August to a winter average of approximately 1°C during the months of December, January, and February (Tedrow, 1979). The spring and autumn transitions are periods of frost, an especially critical period for vegetation. Havens (1979) estimated the average spring and autumn frost periods in Indian Mills to be approximately 39 days long. The length of the frost-free period varies from north to south, reaching a maximum range of 190 to 200 days in the Cape May area (Robichaud and Buell, 1973).

Annual precipitation in the Pinelands averages between 42 and 46 inches with a range of 25 to 68 inches. July and August have recorded the highest rainfalls for individual months, while January, February, June and October tend to be the driest months on the average. The region has been affected by drought and heavy rains, although precipitation is distributed relatively evenly on a geographic, annual, and monthly basis when compared to many areas of the United States. The longest and most severe drought in the Pinelands extended from the early to mid-sixties. During that period, in 1963, the region's most devastating wildfire in recent history occurred.

Mean annual precipitation increases slowly through the central portion of the Pinelands and then decreases rapidly toward the bays and oceans (Robertson, 1978). During a 30-year period ending in 1972, mean annual precipitation ranged from about 44 inches near the western boundary to about 46 inches in the central portion of the region. Precipitation along the coast was approximately 38 inches per year. The general precipitation increase from west to east results from increasing proximity to the ocean. The rapid decrease in precipitation near the coast is caused by oceanic cooling during the summer months.

Wind direction is highly variable in the Pinelands as it is throughout New Jersey. During the winter and early spring, the dominant winds are from the northwest. During the spring and summer, southerly onshore winds predominate on the eastern side of the Pinelands. This sea breeze influence is absent on the western side of the region, where the dominant winds from April through October are from the southwest (Havens, 1979).

Havens emphasizes that although the climate in the Pinelands is similar to that of surrounding regions, variations in microclimate occur. The microclimate is the climate in a small site or habitat. For example, temperature, wind velocity, light, and humidity at the floor of a cedar swamp are different than at the canopy. Land use may have an impact on microclimate. If natural vegetation and soil are replaced with a large area of asphalt paving, for instance, air and soil temperature, relative humidity, and precipitation runoff will be affected.

AIR QUALITY

Maintenance of acceptable air quality in the Pinelands is critical to the protection of public health and welfare, as well as the ecosystem. The major pollutants of concern are suspended particulates, lead, sulfur dioxide, carbon monoxide, ozone, and nitrogen dioxide. All adversely affect human health, although only ozone now reaches unhealthy levels in the Pinelands. Some of these pollutants have been linked with injury to vegetation, including tissue damage and a reduction in productivity.

The Bureau of Air Pollution Control in the New Jersey Department of Environmental Protection (DEP) summarized Pinelands air quality for the Commission. To describe existing conditions, the bureau used its own air monitoring network. Its air pollution source inventory is based on reports produced by Engineering-Science, Inc. (1976, 1977) for the DEP, and by GCA Corp. (1977) for the U.S. Environmental Protection Agency. Because atmospheric transport of pollutants makes it impractical to isolate Pinelands air quality from the impact of sources in surrounding areas, eight complete counties in southern New Jersey (the seven Pinelands counties plus Salem) were included in the source inventory.

There is one continuous air monitor within the Pinelands, at Ancora Psychiatric Hospital, for which historical data are available. Also, an air sampling network is operated for measuring suspended particulate concentrations. Total suspended particulates (TSP) include both solid and liquid material dispersed in the air. A 24-hour sample is taken once every six days using a high-volume air sampler.

Several high-volume sampler sites are located within the Pinelands National Reserve. They are listed in Table 2.39, along with another group of sites located in southern New Jersey outside the Pinelands boundary. This group may be important to consider in cases when data from within the Pinelands are scarce. The sites listed in the table provide a fairly good representation of air quality in the Pinelands, with eight samples sites within the boundary and 21 other sites in the vicinity. Five of these sites, including one in the Pinelands, are also being analyzed for lead (Pb) on a regular basis.

The concentrations of the six major pollutants listed in Table 2.39 (particulates, lead, sulfur dioxide, carbon monoxide, ozone and nitrogen dioxide) are indicators of local air quality. These are the pollutants for which ambient air quality standards have been set by the U.S. Environmental Protection Agency. For some pollutants, both primary and secondary standards exist. The primary standards have been set to protect the public health, while the secondary standards are intended to protect the public welfare (to prevent damage to vegetation, deterioration of visibility, etc.). In the following section, pollutant concentrations in the Pinelands are compared to the air quality standards. Also, concentrations observed in the Pinelands are compared to concentrations in other parts of southern New Jersey, and some of the trends in pollution levels over the last six years are examined.

Particulates

Concentrations observed at the eight particulate monitor sites in the Pinelands National Reserve from 1973 to 1978 indicate that total suspended particulate levels in the Pinelands are low relative to the secondary standard of 60 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$). Four sites, Ancora State Hospital, Hammonton, Jackson Township, and Tuckerton, show some deterioration in particulate air quality over the six-year period, while two sites, Island Beach State Park and Tuckahoe, show some improvement. The two remaining sites, Medford Township and Waretown, show little change. A survey of other southern New Jersey monitoring sites reveals similar trends. However, the average concentration at these sites was $40.7 \mu\text{g}/\text{m}^3$ in 1978, while the average at the eight sites within the Pinelands, $35.2 \mu\text{g}/\text{m}^3$, was lower.

**Table 2.39—Air Quality Monitoring Sites
In and Near the Pinelands National Reserve**

Pollutant Measured	Pinelands Sites	Other Southern New Jersey Sites	
TSP	Ancora Psych. Hospital Hammonton Island Beach State Park Jackson Twp. Medford Twp. Tuckahoe Tuckerton Waretown	Atlantic City Berlin Twp. Bridgeton Buckshutem Burlington Twp. Camden Cape May Court House Cherry Hill Chesterfield Twp. Clayton Collingswood	Glassboro Parvin State Park Pedricktown Pilesgrove Twp. Salem Springfield Toms River Vineland Woodbury Woolwich Twp.
Pb	Hammonton	Bridgeton Camden	Pedricktown Salem
SO ₂	Ancora Psych. Hospital Nacote Creek Research Station*	Atlantic City Burlington Camden (2) Freehold	Paulsboro Penns Grove Toms River Vineland*
CO	Ancora Psych. Hospital	Atlantic City Burlington Camden (2) Freehold	Paulsboro Penns Grove Toms River Vineland*
O ₃	Ancora Psych. Hospital Nacote Creek Research Station*	Bivalve Camden	McGuire A.F.B. † Vineland*
NO ₂	Camden	Vineland*	

*Began operation in 1979.

†Data available from 1975-1977.

Lead

The New Jersey Bureau of Air Pollution Control began monitoring lead (Pb) concentrations at ten sites around the state in 1978. One of these sites, Hammonton, is located in the Pinelands. The maximum quarterly mean concentration at this site was observed to be 0.953 $\mu\text{g}/\text{m}^3$ during the fourth quarter of 1978. This level of Pb is low relative to the standard of 1.5 $\mu\text{g}/\text{m}^3$. Four other sites in southern New Jersey monitor Pb. These sites show a wide range of observed concentrations, from a maximum quarterly average of 0.555 to 1.450 $\mu\text{g}/\text{m}^3$. This wide range may be best explained by the sensitivity of ambient Pb concentration to local sources of Pb. Most of the Pb observed at the Hammonton site is probably due to traffic nearby on Route 30, a major route across the Pinelands to the shore.

Sulfur Dioxide

Sulfur dioxide (SO₂) is monitored in the Pinelands at Ancora Psychiatric Hospital. For the period 1973-1980, annual average levels observed at this site ranged from 0.005 to 0.010 ppm. These are much lower than the New Jersey secondary standard of 0.02 ppm annual average concentration. Data from 1973-1978 show a slight increase in SO₂ concentrations at Ancora. Seven other cities in southern New Jersey all report higher SO₂ levels than the Ancora site, with concentrations at these sites ranging from 0.010 to 0.019 ppm in 1978. However, most of these sites are still well below the secondary standard.

Carbon Monoxide

Carbon monoxide (CO) is monitored in the Pinelands at Ancora Psychiatric Hospital. The levels observed at this site, ranging from annual averages of 3.7 to 6.0 ppm in the 1973-1978 period are much lower than the standard of 9 ppm for an eight-hour average. Data from these years show an decrease in the CO concentration at Ancora, probably due to improved controls on automobiles which took place during that period. Seven other sites in southern New Jersey all report higher CO levels than the Ancora site, with concentrations at these sites ranging from 9.3 to 18.5 ppm in 1978. All of these sites exceed

the standard. However, there have been decreases in CO concentrations similar to that observed at Ancora.

One important difference between Ancora and the seven other sites should be noted. The seven sites located outside the Pinelands are in the downtown area of cities where traffic congestion is likely to occur. The Ancora site, on the other hand, is not in a built-up area. It is located near the hospital parking lot, which is usually free of traffic congestion. Actual CO levels throughout the Pinelands most likely range from something less than the Ancora concentration, in areas far from the main highways, to something less than the 9 ppm standard, in the most developed areas of the Pinelands.

Ozone

The single ozone (O₃) monitor in the Pinelands, at Ancora Psychiatric Hospital, shows maximum one-hour concentrations that are well above the national air quality standard. The observed annual average levels for the 1973-1978 period range from 0.147 to 0.216 ppm and exceed the standard of 0.12 ppm. Three other sites in southern New Jersey show similarly high levels over the 1973-1978 period. These levels reflect the high O₃ concentrations observed throughout the state. Phenomena such as the atmospheric transport of pollutants — from the Philadelphia-Camden metropolitan area, for example — and the gradual speed of chemical reactions make O₃ pollution a regional problem. The presence or absence of local sources of ozone's precursors, hydrocarbons and nitrogen oxides, has little effect on local concentrations of ozone.

Nitrogen Dioxide

There are no nitrogen dioxide (NO₂) monitors located within the Pinelands National Reserve. In fact, there is only one NO₂ monitor in all of southern New Jersey, although there are plans to increase the network. Presently, this lack of NO₂ data is not a serious problem because levels at the five monitoring sites throughout the state are very low relative to the air quality standard. Data from the one site in southern New Jersey, in Camden, for the 1973-1978 period demonstrated annual average range from 0.029 to 0.044 ppm, compared to the national ambient air quality standard of 0.05 ppm. The data show that there has been some improvement in NO₂ levels over the past six years.

Sources of Air Pollution

The concept of local air basins is generally not relevant for air pollution dispersion in the Atlantic coastal region. For this reason, the Pinelands National Reserve cannot be isolated from the air pollution generated in the urban areas surrounding it. The prevailing winds across the country are from the west; consequently, the Pinelands often receive a pollution burden from the metropolitan Philadelphia area and beyond. Summer winds commonly carry pollution to the Pinelands from areas to the southwest. In the winter, northwesterly winds may bring pollutants from that direction. In addition, during periods of light winds, a sea breeze can carry pollution from the Atlantic City area into the Pinelands.

A regional phenomenon caused by the long-range transport of atmospheric nitrate and sulphate pollution is the acidification of rain. Acid rain has been associated with decreases in the pH of surface waters in certain locales in the northeastern United States, and with negative effects on aquatic and terrestrial communities. Johnson (1979) has analyzed 17 years of data which indicate that a pH decrease of approximately 0.4 unit has occurred in two Pinelands streams, McDonald's Branch and Oyster Creek. It has not been determined what effect, if any, a decrease in pH will have on Pinelands plant and animal species, which are typically adapted to acid surface waters, or whether acid rain will have any direct effect on terrestrial species.

Air pollution sources can be divided into three types: point, area, and line. Point sources are generally the type that emit large quantities of pollutants to the atmosphere through a stack, such as power plants and factories. Line sources are transportation-related, such as traffic on highways or railroads. Area sources include all sources that are not point or line sources. Examples of area sources are residential fuel combustion, airports, and forest fires. Table 2.40 summarizes pollutant emissions from the three source types in the eight southern New Jersey counties, and in the Pinelands portion.

Point Sources

There are five fossil fuel-burning power plants and a variety of industries in southern New Jersey

which account for a total of almost 1,000 point sources. Only about 3 percent of these sources are actually located in the Pinelands, but they account for about 35 percent of the suspended particulate emissions and 27 percent of the sulfur dioxide emissions in the Pinelands area.

Area Sources

The most common area sources of suspended particulates in the Pinelands are fugitive dust related and fuel combustion related. Fugitive dust can come from forest fires or unpaved roads, for example, while pollutants from fuel combustion can be emitted by residential space heating systems, boats, and aircraft.

To make a rough estimate of area source TSP emissions in the Pinelands, five source categories were considered: residential fuel combustion, commercial and institutional fuel combustion, prescribed fires, uncontrolled forest fires, and unpaved roads. Emissions from the two fuel combustion categories are allocated according to the fraction of each county population estimated by the Pinelands Commission to be living within the National Reserve. All emissions from prescribed and uncontrolled forest fires are assumed to be from within the Pinelands. All dust emissions from unpaved roads in Atlantic, Burlington, Cape May and Ocean Counties, and half of the emissions in Camden and Gloucester Counties, are assumed to be from within the Pinelands. These rough emission estimates probably define a lower limit on TSP emissions in the Pinelands. They represent 42 percent of the total estimated TSP emissions for southern New Jersey. It should be noted that although the TSP emission rates from unpaved roads are orders of magnitude larger than from other sources, these particulates are generally large and non-respirable and are not likely to constitute a health problem.

Almost all sulfur dioxide emissions in the Pinelands come from residential, commercial, and institutional fuel combustion. Population figures were used to calculate the amount of area source SO₂ emissions originating in the Pinelands, estimated to be about 9 percent of the southern New Jersey total.

Table 2.40 — Summary of Estimated Pollutant Emissions in Southern New Jersey (Eight Counties)

Source Category	Suspended Particulates			Sulfur Dioxide			Hydrocarbons		
	Total	In the Pinelands		Total	In the Pinelands		Total	In the Pinelands	
	Tons/Year	Tons/Year	% Total	Tons/Year	Tons/Year	% Total	Tons/Year	Tons/Year	% Total
Point	18,800	6,590	35	130,010	35,080	27	—	—	—
Area	513,290	214,610*	42	19,810	1,840	9	—	—	—
Line	7,880	2,454	31	3,800	1,206	31	118,220	37,036	31
Total	539,970	223,654	41	153,620	38,126	25	118,220	37,036	31

* Data not available for emissions from forest fires (prescribed and wild) in Burlington, Camden, and Gloucester Counties.

Line Sources

The most important line source in the Pinelands is traffic on the highways which cut across the area. Vehicles are responsible for the emissions of particulates and sulfur dioxide, as well as carbon monoxide, nitrogen oxides, and hydrocarbons (HC). The last two pollutants are precursors of ozone, the only pollutant known to reach unhealthful levels in the Pinelands. Ozone generated in the air flowing over the Pinelands is primarily the product of vehicle traffic and industry in the Philadelphia area, with contributions from other areas to the south and west, and from traffic through the Pinelands to the shore resorts.

Informal studies by the Bureau of Air Pollution Control show that about half of the vehicle miles traveled on highways each year in Atlantic and Ocean counties are within the Pinelands and the other half are in adjacent developed areas. This ratio can also be applied in Burlington County, which has a similar Pinelands distribution. The section of Cape May County within the Pinelands is assumed to generate about one-third of the total county line source emissions since it includes the Garden State Parkway. Only a small portion of the vehicle miles traveled in Camden, Cumberland, and Gloucester Counties, estimated to be 10 percent, are likely to be within the Pinelands because only small parts of these counties are included in the Pinelands National Reserve. Based on these estimates, about 31 percent of the total vehicle emissions in southern New Jersey are actually being emitted within the Pinelands.

Development in the Pinelands, whether residential, commercial or industrial, will generate additional traffic. Since vehicles emit carbon monoxide, nitrogen dioxide, lead, and other particles, and the precursors of ozone, an increase in traffic could have a significant impact on air quality.

CHAPTER THREE

Prehistoric, Historic, and Cultural Resources

The Pinelands of New Jersey represent an unusual, diverse ecosystem that has been occupied and exploited by humans during the last 10,000 years. Over this time, cultural perceptions of the area have undoubtedly undergone many changes. While one can only speculate about how the long-ago Indians perceived the value and usefulness of these woods, it is now thought that the region could have supported dispersed prehistoric subsistence settlements.

During historic times, the Pinelands were utilized successively for such resources as lumber and forest products, bog iron, water for power, sand for glass-making, and berries for commercial marketing. In the late 19th century, there was an attempt to exploit the Cohansey aquifer that underlies the region as a source of potable water for Philadelphia, and as recently as the 1960's, public officials and private citizens were considering this "barren," flat expanse of land as the site for an international airport. Since then, however, a consensus has emerged that the Pinelands are too valuable—ecologically, historically, and culturally—for that kind of large-scale exploitation to be permitted. The federal and state Pinelands legislation under which the Comprehensive Management Plan has been developed is the result of that consensus.

PREHISTORIC ARCHAEOLOGY

The Red Man, at least as far as Southern New Jersey is concerned, is forgotten. He and his people may be forgotten, as you say, but continually there are turned up tangible reminders of days before our coming, days when the Indian was lord of all he surveyed.

Henry Charlton Beck, a noted author of the history of the Pinelands, wrote these words in his 1936 book, *Forgotten Towns of South Jersey*. The "reminders" he referred to are still to be found here. They represent a major resource for understanding the prehistory of New Jersey and the Middle Atlantic Coastal Plain.

An inventory and assessment of prehistoric archaeological site locations has been conducted during the course of studies leading to the development of the Comprehensive Management Plan. This undertaking has resulted in the identification and mapping of 1,046 locations within the region as federally and ecologically defined. By their sheer numbers alone, the sites represent a quantum leap toward increasing our understanding of a region which previously could be dealt with by archaeologists only in a speculative manner.

The study undertaken by the Pinelands Commission, in cooperation with the New Jersey Department of Environmental Protection and Monmouth College, was the first to attempt a systematic and thorough investigation of prehistoric cultural resources in the Pinelands. Earlier site surveys had been undertaken in New Jersey, but for a variety of reasons, the Pinelands had received very little serious investigation.

In 1912 the New Jersey Legislature sponsored the first statewide survey of prehistoric sites. The survey resulted in the recording of about 1,000 sites, of which only a dozen occurred in the Pinelands. During the Depression era, New Jersey prehistory became the focus of a Work Projects Administration (W.P.A.) study. Only 50 Pinelands sites were recorded out of a total of 600 investigated locations.

These surveys scarcely penetrated the Pinelands, largely because extensive forest cover masked site locations and poor roads made access difficult. Because of these and other logistical problems, the early surveys concentrated on the intensively farmed and accessible lands of the Delaware Valley. On the basis of the findings of the 1912 survey, it was observed that "The great mass of villages and cemeteries . . . are along the Delaware River and its tributaries . . . It will be observed that the interior is practically devoid of sites, except on the headwaters of the more important creeks and rivers. This lends support to the tradition that the sandy interior of South Jersey was more of a hunting ground than anything else." (Skinner and Schrabisch, 1913.)

Despite the apparent unevenness of regional coverage, the results of the preliminary survey efforts have generally been taken as evidence that the Pinelands were unoccupied, or at best sparsely settled in prehistoric times. For example, Harshberger (1916), after reciting the inhospitable and forbidding qualities of the pine forest, went on to say that "Even the Indians . . . rarely penetrated these pine-barrens except for hunting and fishing . . ." This notion of the lack of aboriginal settlement has proven to have wide popular appeal, and has persisted down to the present day despite the frailty of the evidence upon which it is based.

Most of the archaeological inquiry in the Pinelands has been undertaken not through government-sponsored surveys but through the efforts of a few interested individuals. In 1955 Charles F. Kier, Jr. conducted a survey of prehistoric sites in the drainages of the Nescochague Creek, the Mullica River, and the Batsto River. Through a combination of surface inspection and subsurface testing, Kier found a total of 19 site locations.

Beginning in the late 1960's, Richard Regensburg investigated numerous sites within the Pinelands in the vicinity of Marlton, Burlington County. The most prominent of these sites is the Savich Farm, which contained more than 50 cremated human skeletons with associated grave goods in a Late Archaic cemetery. The site also yielded evidence of numerous components dating from Early Archaic to Late Woodland times. At least some of the components have been dated by means of radiocarbon assays. The Savich Farm is currently the only prehistoric site in the Pinelands to be listed upon the State and National Registers of Historic Places.

Also in the late 1960's and early 1970's, R. Alan Mounier conducted extensive surveys and excavations in the Maurice River drainage basin, and to a lesser extent in the watershed of the Great Egg Harbor River. The numerous sites along the Maurice River—representing the entire span of prehistory in southern New Jersey—appeared to cluster along the margins of the watercourse. They also appeared to form a graded series, ranging from very substantial habitations along the river's main trunk to small campsites at the mouth and in the headwaters. The extent to which this pattern can be reasonably projected to other drainage networks remains to be determined.

This research, and most other investigations dealing with the prehistory of South Jersey, focused on aboriginal settlements in the context of extant river systems. However, as a result of extensive fieldwork, Anthony Bonfiglio and John A. Cresson began to recognize a consistent association of early cultural materials with certain geomorphic features in other settings (Bonfiglio and Cresson, 1976, 1978). These features are referred to as thermokarst basins or "pingoes."

Pingoes are relict structures of a periglacial environment dating to Pleistocene times, and therefore bear no particular association with present riverine drainages. Resulting from the collapse of ice cones during late and post-glacial warming, pingoes comprise circular or oval depressions which tended to collect water. They supported a variety of flora and fauna. The resources proved in turn to be attractive to human populations, who left artifacts characteristic for the most part of Paleo-Indian and Archaic traditions. Of the 94 pingoes thus far examined by Bonfiglio and Cresson, 89 have yielded evidence of human use.

This research is of considerable importance because pingoes occur quite commonly across the Pinelands. Rhodehamel (1979) estimates that "approximately 2 percent of the Pine Barrens region is covered by relatively small, shallow, undrained depressions that have largely impermeable clayey layers beneath them." Other settings, such as the headlands between drainage systems, have also recently proven to yield remnants of aboriginal occupation. It is clear that the formerly prevailing concepts of aboriginal

settlement in the Pinelands seriously underestimate not only the frequency of site occurrences, but also the range of habitats utilized by the native inhabitants of the region.

The Prehistoric Overview

The significance of the prehistoric resource base of the Pinelands can be best understood if one is acquainted with the prehistory of the state as a whole. The prehistory of New Jersey and the Middle Atlantic Coastal Plain is best defined by three major cultural traditions: the Paleo-Indian, the Archaic, and the Woodland. Each of these is characterized by distinctive adaptations to changing environments together with specialized technologies.

The Paleo-Indian Tradition (10,500 B.C. to 8,000 B.C.)

The earliest recognized prehistoric population on the North American Continent was represented by groups of hunter-gatherers known as the Paleo-Indians. Ranging over a wide geographic area of the hemisphere, this group's presence is marked by a distinctive type of projectile point which was used to tip javelins, spears, or knives. Easily recognized by the presence of single or multiple flake scars which extend vertically from the base upwards toward the tip of the artifact, they are collectively referred to as "fluted points."

To date, over 200 fluted points have been found in New Jersey. The largest number have been discovered in areas near the Delaware River and its principal tributaries. Recently, however, several Paleo-Indian sites and a number of fluted points have been documented for the Outer Coastal Plain and the New Jersey Pinelands. Their discovery is notable because of the contentions made by past researchers regarding the lack of sites and projectile points in the Outer Coastal Plain.

The Archaic Tradition (8000 B.C. to 1000 B.C.)

Like the Paleo-Indian tradition, most of what is known about the Early Archaic period in New Jersey has been based upon surface-collected artifacts. The first excavated site to reveal evidence of Early to Middle Archaic occupation was located in the upper Delaware Valley (Kraft, 1975). It is suspected that small bands of hunter-gatherers may have made sporadic incursions into this area.

Sites of the Middle to Late Archaic periods (circa 5000 to 1750 B.C.) are far more frequent throughout New Jersey. This is probably due to environmental shifts which were conducive to the support and growth of aboriginal populations. The increase in resource availability also allowed for the exploitation of more diversified environments, and a more sedentary lifestyle as opposed to the nomadic hunter-gatherer existence in earlier times.

The majority of Late Archaic site excavations have been conducted in the upper Delaware Valley. In the Outer Coastal Plain, however, a significant Late Archaic cemetery was excavated at the Savich Farm in Marlton (Regensburg, 1970). The complex produced cremated burials and accompanying grave goods, and was radiometrically dated between 2300 and 1900 B.C. The site also contained evidence of Early Archaic occupation.

The Woodland Tradition (1000 B.C. to A.D. 1700)

This tradition is divided into three successive periods: Early, Middle and Late Woodland. The Early Woodland is separated from the previous Late Archaic and a transitional period by the introduction and use of ceramic vessels and the probable beginnings of plant domestication. Settlement patterns appear to be similar to that of previous periods.

During the Middle Woodland Period (circa 500 B.C. to A.D. 700) coarse cord-marked pottery was replaced by net-impressed, and at one site by zoned ceramics. Net sinkers, attesting to the use of fish as a food source, have also been found. The Late Woodland period (circa A.D. 700 to A.D. 1700) is well represented throughout New Jersey. The largest sites are usually located on major waterways and probably represent base camps which may have been occupied most of the year. Smaller sites are abundant on tributaries and feeder streams, as well as near natural springs. These probably functioned as temporary or seasonal camps for the purpose of exploiting specific resources in a variety of rich microclimates.

While most of the artifacts of the Late Woodland period are similar to those of the Middle Woodland, there are distinct differences in several classes. Late Woodland projectile points lack stems, are triangular, and are primarily manufactured from flint. The bow and arrow was the principal weapon. Ceramic vessel collars became more prominent, and incised geometric designs were the dominant decorative motifs in the later phases. The practice of hoe-type horticulture was well established, although hunting, gathering, and fishing continued as major activities (Cavallo, 1977).

The historic period Indians of New Jersey called themselves "Lenape," but were renamed the "Delaware" by the Europeans. While their artifacts and general settlement patterns were similar to that of the Iroquois, they differed linguistically; the Lenape were Algonquian speakers. They also differed in socio-political organization. During the period of European contact, the Lenape could not be described as a tribe in the strict sense, but existed as loosely structured autonomous bands or lineages, residing in small dispersed settlements (Kraft, 1974).

Increased contact brought about a breakdown of traditions and increased reliance on European trade goods in exchange for furs and land. Warfare, disease, and alcoholism decimated the population to the extent that by 1759 it was estimated that only 300 Lenape remained in New Jersey. Two hundred of these resided in the nation's first Indian reservation, which was located in the Pinelands at the present town of Indian Mills in Burlington County. Conditions on the reservation became undesirable, and the group ultimately followed the remaining survivors westward. By 1800 there was scarcely a Lenape left in the state. Their descendants reside in Oklahoma and Canada.

The Pinelands Inventory

For the purposes of the inventory conducted during development of the Comprehensive Management Plan, the "site" serves as the basic unit of study. Sites are defined as places which once served as the locus of human activity. They are composed of aggregates or clusters of associated cultural remains (artifacts), and culturally related non-artifactual remains (ecofacts). Sites appear on the surface as scatters of flakes resulting from the manufacture of stone tools hundreds or thousands of years ago. These locations may also yield a wide variety of stone tools and/or the remains of animals or shellfish which were consumed by the Indians. The majority of sites listed in the inventory had been discovered in farm fields. Many areas of the Pinelands, however, have not been farmed, and prehistoric sites within them lie in an undisturbed, pristine state below the ground surface.

Following the prevailing cultural/temporal model, the cultural traditions used in the inventory include Paleo-Indian, Archaic, and Woodland. A fourth category, Unspecified Prehistoric, was used where cultural affiliation could not be identified. The environment was divided into four categories which together cover all of the site locations currently reported in the Pinelands. These categories include tidal wetlands, riverine settings, drainage divides, and pingoes. The region's prehistoric archeological resources were then examined in the context of "study units," which provide a conceptual framework for organizing technical data. The study unit approach has been developed by the Heritage Conservation and Recreation Service of the U.S. Department of the Interior as a means of translating research data into useful management information. The four cultural traditions were combined with the four environmental categories to produce the study units summarized below.

Woodland/Wetlands: This unit includes components of the Woodland period identified in tidal wetlands or on the immediately adjacent fast ground. Chronologically, they may range from about 1,000 B.C. to about 1650 A.D. Early, Middle, and Late Woodland expressions are either known or suspected on sites of this kind. The components seem to represent areas of hunting and collecting activity which formed part of a broad subsistence system.

Generally, Woodland sites occur in two kinds of settings in wetland environments: either on slight eminences (so-called "islands") on the salt meadow itself, or on the fast ground at the edge of the meadow. The sites do not generally appear to represent permanent base camps, but rather seasonally occupied procurement and processing stations. There are, however, several exceptions to this, one being a large Late Woodland site near Brigantine thought to be a base camp settlement (Regensburg, personal communication). A total of 24 Woodland components in wetland habitats have been identified. These com-

prise 20 percent of all presently recognized Woodland occupations within the Pinelands National Reserve, and 24 percent of all components and sites in tidal wetland situations.

Woodland/Riverine: This unit comprises components which have been recognized in a variety of settings associated with networks of riverine drainage. Sites which represent the entire duration of Woodland cultural development frequently occur on well-drained uplands directly abutting the margins of streams. In some areas, such as the Maurice River drainage, Woodland sites appear to cluster along river systems and to form graded series. These range from substantial habitations along the main trunk to smaller campsites at the mouth and headwater areas. Very large sites may be located in the headwaters of Rancocas Creek.

Woodland components in riverine settings appear to represent a wide range of functionally related activities having to do with patterns of settlement and subsistence. Material from these sites reflects a long occupational history by a series of cultural groups of diverse age and origin. The inventory for Woodland components in riverine settings comprises 80 percent of all Woodland occupations so far recognized in the Pinelands. About 24 percent of all riverine components have been identified as having some Woodland affiliation. A total of 96 sites have been identified for this study unit.

Woodland/Divides: No Woodland components are recognized in drainage divides. This may reflect the inactivity of archaeologists within this environmental zone.

Woodland/Pingoes: No Woodland components are known to occur in association with pingoes or similar geomorphic features in the Pinelands. The apparent absence probably reflects at least two factors: environmental changes making these features generally less attractive to later prehistoric populations, and a lack of regional surveys to identify pingo locations and to quantify cultural remains in association with these features.

Archaic/Wetlands: This unit includes five sites in tidal wetland habitats. These account for 4.2 percent of all Archaic representations in the inventory and 5.1 percent of all prehistoric sites presently known in wetlands of the Pinelands. These sites may represent rather late Archaic periods (possibly from 3000 B.C. to 1000 B.C.), since rising sea levels have inundated many earlier coastal sites (Saliven, 1965).

Archaic/Riverine: The inventory has identified 101 Archaic components in riverine settings. These account for 85 percent of all Archaic components and approximately 25 percent of all known sites in riverine environments. Generally, the sites occupied by Archaic groups also show evidence of repeated occupation by later, and sometimes earlier, groups. It is believed that the Archaic sites span a period from 7,000 B.C. to 1,000 B.C.

Archaic/Divides: Two Archaic sites have been identified on drainage divides. These represent about 2 percent of all Archaic components and about 13 percent of all sites recorded on divides. These sites are represented by sparse surface scatters of artifacts or by isolated finds. To date, only Middle and Late Archaic specimens, dating perhaps from 4000 B.C. to 1200 B.C., have been found. The artifacts are mostly projectile points. The characteristics of the sites suggest that hunting was their principal function.

Archaic/Pingoes: This study includes all Archaic components found within the Pinelands in association with pingoes (thermokarst basins), bogs, spungs, or other basin-like areas with internal drainage. To date, 11 sites of Archaic occupation have been identified in relation to pingoes. These represent 9.2 percent of all Archaic representations and 55 percent of all pingo sites.

Paleo-Indian/Wetlands: Currently, no Paleo-Indian components have been identified in wetland habitats in the Pinelands. The probability of recovering Paleo-Indian materials is somewhat lessened due to the rise of relative sea levels. However, two sites outside, but contiguous to the Pinelands have yielded the characteristic fluted points.

Paleo-Indian/Riverine: Two Paleo-Indian components have been identified in riverine habitats of the Pinelands. These represent the earliest occupations of the sites on which they were found. These sites represent 100 percent of the Paleo-Indian sites known in the Pinelands and 0.5 percent of all components in riverine habitats. The known sites produced a few artifacts, chiefly fluted bifaces, which

were surface finds. As stated previously, the discovery of Paleo-Indian sites in the Pinelands has been limited to a degree by the belief that no such remains were to be found here.

Paleo-Indian/Divides: No Paleo-Indian sites have been identified in this study unit.

Paleo-Indian/Pingoes: No Paleo-Indian sites have been identified in this study unit. However, sites have been located in association with these features elsewhere. It is likely that further research will produce material. Very little has been done in the past to investigate pingoes in the Pinelands for cultural remains.

Unspecified Prehistoric/Wetlands: Seventy unspecified prehistoric components occur in wetland habitats in the Pinelands according to the present inventory. These represent nearly 71 percent of all cultural expressions in wetlands and approximately 24 percent of all unspecified prehistoric sites. The distribution relates to the combined record of Woodland and Archaic components (a total of 24.2 percent) and suggest that the unspecified components are made up of both Woodland and Archaic in a ratio of 5:1 respectively.

Unspecified Prehistoric/Riverine: Half of the prehistoric sites recorded in the inventory of riverine settings lack a definable cultural identity. As in all other cultural categories, riverine settings predominate in this grouping (68.3 percent). The classifications represented in this category probably include a combination of Paleo-Indian, Archaic, and Woodland. If existing frequencies provide an adequate measure of distribution, the sites would be roughly equal between Woodland and Archaic with a few Paleo-Indian remains.

Unspecified Prehistoric/Divides: 13 unspecified sites have been delineated on drainage divides. These account for nearly 87 percent of all sites so situated and 4.5 percent of the unspecified prehistoric representations.

Unspecified Prehistoric/Pingoes: The inventory yields 9 sites of unspecified cultural affiliation in association with pingoes or similar geomorphic structures. The remains at these sites represent 45 percent of the known sample of pingo-related sites in the Pinelands and 3.1 percent of the unspecified prehistoric components.

Study Unit Summary

By placing the available data regarding sites in the Pinelands into a study unit matrix, it has been

Table 3.1 — Distribution of Prehistoric Archaeological Sites

CULTURAL TRADITIONS	ENVIRONMENTAL SETTINGS				Total sites in tradition	Percent of all known sites
	Wetlands	Riverine	Divides	Pingoes		
Woodland						
No. of sites	24	96	0	0		
Percent of tradition	20%	80%	0%	0%	120	22.56
Percent of setting	24.2%	24.1%	0%	0%		
Archaic						
No. of sites	5	101	2	11		
Percent of tradition	4.2%	84.9%	1.7%	9.2%	119	22.37
Percent of setting	5.1%	25.4%	13.3%	55%		
Paleo-Indian						
No. of sites	0	2	0	0		
Percent of tradition	0%	100%	0%	0%	2	0.37
Percent of setting	0%	0.5%	0%	0%		
Unspecified Prehistoric						
No. of sites	70	199	13	9		
Percent of tradition	24.1%	68.3%	4.5%	3.1%	291	54.70
Percent of setting	70.7%	50%	86.7%	45%		
Sites in setting	99	398	15	20	532	
Percent of all known sites	18.61	74.81	2.82	3.76		

possible to provide a preliminary characterization of archaeological remains thus far recognized in the region. Cultural representations spanning the whole of prehistory have been recorded. Table 3.1 indicates the distribution of sites by temporal and environmental settings. The general location of these sites is depicted in Plate 13.

While the inventory shows what is known about prehistoric settlement in the Pinelands, it also shows what is not known. The assumptions of the past must yield to the recognition that many more sites of archaeological interest remain in relatively pristine settings of the Pinelands National Reserve. They need only to be discovered.

A Predictive Model

Since it is not feasible to survey every square foot of the New Jersey Pinelands to identify what is suspected to be a large reservoir of prehistoric archaeological sites, the Commission, with its consultants, has moved toward the development of a predictive model for the identification of likely environmental characteristics of prehistoric occupation sites. The primary intent of the model is to recognize sites that may be impacted by modern development. The crucial variables include present land use, proximity to fresh or salt water, number of hydrological types in a given grid area (rivers, bays, stream confluences, etc.), altitude parameters, soil types, slope, and ratios of eroded to deposited soils.

A predictive model would provide a strong tool for protection of prehistoric archaeological sites in the future. It would also provide the basis for the exploration and delineation of new sites of archaeological interest in the Pinelands National Reserve.

HISTORIC RESOURCES

An essential part of Pineland history and culture is the "built environment." This includes people's houses; the mills, factories, furnaces, and farms where they worked; and the churches, schools, granges, clubs, and lodges where they socialized, worshipped, and educated their children. The heritage includes scattered rural buildings, crossroads communities, and commercial centers or villages. It includes buildings which represent vernacular architecture unique to the Pinelands and buildings which display the prevalent styles of their time. Some of the buildings and villages remain in close to their original condition and embody particular historic periods. Others have changed, and represent man's reworking of an environment to suit different tastes or needs. Still others have disappeared as industries declined and people moved, and yet these sites may yield valuable information. These historic resources, as well as the people who developed them, are important elements of the Pinelands landscape.

The Historic Overview

At the time of European contact, the Lenape Indians inhabited the Pinelands region. As Europeans began to populate southern New Jersey, the Indians sold or abandoned their lands. Disease and sporadic fighting with whites reduced the native population. By 1758, the few remaining Indians in the state were placed on the Brotherton Reservation at Indian Mills (Shamong Township), located within the Pinelands. This 3,258-acre reservation was one of the first in North America. By the turn of the 19th century, most of the Indian families had left Brotherton and moved to New York or to Indian territory in the West.

The first Europeans to come to the Pinelands were woodcutters. From the early 1700's, these men exploited the vast forests. For lumber merchants, the Pinelands represented an untapped and apparently inexhaustible supply of materials for shipbuilding, pitch, tar, and turpentine. By 1749, the reduction of timber in some areas was so great that Benjamin Franklin "advocated conservation and intelligent forestry to combat the reckless and wanton slaughter of the woods" (Pierce, 1957).

The maritime industry in the Pinelands was flourishing prior to the Revolutionary War. New Jersey's coastal plain provided most of the raw materials needed for shipbuilding, including timber such as cedar, oak, pine, maple, hickory, walnut, and wild cherry. In addition, the Pinelands yielded tar used to caulk hulls, pine resins used to produce turpentine for hull preservation, and iron products necessary to make ship hardware. By 1800, the shipyards of southern New Jersey supplied 10 percent of the vessels needed for commerce in the Philadelphia area.

Another important 18th century economic activity was the production of iron from the limonite ore found in stream beds and bogs throughout the Pinelands. From the mid-1700's to the mid-1850's, the forests provided the ore, the charcoal used to produce the iron, and the water power used to operate the furnaces. "Company towns" developed around the furnaces and forges, with the local population serving as the labor force and wealthy residents of the Delaware Valley acting as the financiers.

Unlike the lumber industry, the bog iron industry required enormous outlays of money. Businessmen were willing to make substantial investments in the Pinelands in the hopes of reaping great profits. But some furnaces ran into financial difficulties even before they were completed. With the discovery of anthracite in Pennsylvania during the 1840's and the advent of the railroads in the 1850's, the New Jersey bog iron industry could no longer compete with the Pennsylvania ironworks.

As the bog iron industry collapsed, the buildings and water-power installations were converted to glass factories, paper mills, cotton mills, sawmills, and brick and tile factories. These industries, however, could not assure continuity of employment. Persistent forest fires plagued the mills and factories. Workers often migrated between towns in search of job opportunities.

After the Civil War, production of cranberries in the Pinelands began on a commercial scale. By 1928, approximately 13,000 acres of lowland were cleared for use as cranberry bogs. By the mid-1950's, however, only 6,136 acres were being worked. Blueberry cultivation began on a commercial scale before 1916, and occupied 8,500 acres by 1963. Cranberry and blueberry growing represent domestication, improvement, and commercial use of plants native to the area. The industries are self-sustaining, in contrast to lumbering, which was self-destructive for lack of conservation practices.

Since the 18th century, the Pinelands have been a refuge for European immigrants. The earliest settlers favored coastal areas. They generally avoided inland areas, which were unsuitable for agriculture and which posed transportation problems because of swamps (Rutgers, 1978). After 1850, ethnic groups including Germans, Russians, Italians, and Jews began to move into the interior areas of the southern Pinelands (south of the Mullica River). They were drawn by the availability of land previously used for industrial ventures, the introduction of chemical fertilizers to make the soil more suitable for farming, and the presence of railroads which permitted easier access (Marsh, 1979).

Study Units

A complex network of ethnic settlements, natural resources, land uses, transportation routes, and economic activities must be investigated to comprehend the significance of historic sites. This network in the Pinelands has been classified into study units for systematic analysis, in keeping with the approach developed by the U.S. Department of the Interior's Heritage Conservation and Recreation Service. For example, a study unit on the 19th century Pinelands iron industry would cover the extraction and processing of bog iron, production and distribution of the iron, and the supporting social, economic, and political systems. Study units provide a context for evaluating the significance of individual historic properties, which in the case of the Pinelands iron industry would include furnaces, forges, workers' houses, and transportation facilities. The following study units were defined in a recent project undertaken for the Commission (Sinton, 1980). Plate 14 depicts the location of Pinelands historic sites.

Forest Activities and Industries

Sawmills (1700-present): Sawmills were often the sites of earliest settlement in the Pinelands. Many local industries, such as shipbuilding, iron, glass, cotton, and paper, required wood. Since early sawmills could not be moved, permanent communities developed around them. With the advent of steam-powered mills in the 1870s, mills could be moved; mobile gasoline-powered mills still exist. After the 1930s, however, the number of small mills began to decline as it became more economically feasible to cut the timber and truck the logs outside the Pinelands to large sawmills. Long-time rural residents continued to operate approximately 50 mills throughout the region in order to supply local needs for housing and boat construction. An example of a restored 19th century sawmill in operation is located at Batsto, a bog iron community in Washington Township, Burlington County.

Charcoal (1740-1960): Charcoal was vital to the bog iron industry. After 1850, it was used primarily for fuel and cooking. In the 19th century, newly arrived immigrants, especially Irish and German, often

became colliers and made considerable amounts of money. The last colliers quit work in Whiting during the early 1960's after a steady decline in the industry during the prior 100 years. A large but uncounted number of coaling sites remain throughout the Pinelands, although no associated cabins are known to exist. Remnants of this former forest industry can be discerned by the absence of vegetation and the presence of scattered charcoal.

Tar kilns and turpentine stills (1700-1890): Little is known about tar kilns and turpentine stills in the Pinelands. Both tar and turpentine were used for shipbuilding but apparently were never major industries. For example, turpentine was distilled in large quantities only during the Civil War. The kilns and stills were operated by long-time rural residents up until the turn of the century, when these activities were abandoned. The number and location of the former kilns and stills can only be estimated. These sites should be found in association with shipbuilding along major rivers and the coast.

Shipbuilding and Seafaring

Sneakboxes, garveys, and oreboats (1700-present): Sneakboxes and garveys are indigenous to the New Jersey coast and were the basic means of short-distance travel until automobiles became common. Small boat builders and their places of business played important roles in communities along the coast and up the major rivers, especially the Mullica, Great Egg Harbor, Maurice, and Toms. Today, these small boats are still in demand for such activities as waterfowl hunting and shellfishing. Related sites can be found in most commercial and community centers.

Schooners and sloops (1700-1900): Until 1850 schooners and sloops were the major carriers for goods from the eastern section of the Pinelands. No rural industrial center, such as Batsto or Mays Landing, could have existed without its boatbuilding industry. During the last half of the 19th century, the introduction of railroads made schooners and sloops increasingly obsolete. By 1900, these ships were no longer being constructed. Several sites of large boatworks have been located at the forks of the Mullica River, and in Mays Landing, Dorchester, and Leesburg. No associated buildings are extant. While some of these boats may still exist in the Chesapeake region, only sunken hulls are left in the New Jersey coastal areas. The list of known wrecks is extensive. However, this list does not include the many aging vessels driven into banks on extreme high tides to become bank retainers.

Power boats (1930-present): The construction of rum runners, PT boats, and recreational power boats in the Pinelands has been a source of local pride since the 1930's. These boats are internationally known, and the older ones from local boatworks are considered to be collector's items. Working sites can be found on the Bass and Mullica Rivers, and at Egg Harbor City and Mays Landing. Most of the builders are long-time residents.

In summary, there are numerous documentary references to, and physical remains of, shipbuilding and seafaring activities in the coastal Pinelands from the Revolutionary War period to the present. Historic evidence exists of the boats and ships, shipyards, lighthouses, Coast Guard stations, and workers' housing, as well as the tools of the carpenters, carvers, glaziers, joiners, sailmakers, coopers, and blacksmiths who were involved in the various aspects of construction. Two sites in the Pinelands National Reserve associated with these activities have received state or national recognition. The Barnegat Lighthouse in Ocean County is listed in both the State and National Registers of Historic Places. The Mullica River-Chestnut Neck Historic District, located in parts of Atlantic, Burlington, and Ocean Counties, is listed in the State Register. This district includes the site of the original settlement of Chestnut Neck, (a center for smugglers during the colonial period and privateersmen during the Revolutionary War), as well as the remains of vessels destroyed and sunk by the British in 1778. At least two of these vessels have been located in the Mullica River.

Hunting, Gathering, Trapping, and Fishing (1700-present)

Hunting, gathering, trapping, and fishing represent the oldest ongoing activities in the forest sections of the Pinelands. These activities were and are basic to the lifestyles of both old-time and present-day rural residents, and are undertaken for subsistence, recreational, and commercial purposes. Hunting clubs are scattered throughout the region, with more than 200 clubhouses.

Agriculture

Grist mills (1700-1920): Many grist mills were important sites in the Pinelands' commercial centers.

These mills were often located on "little" dams upstream from sawmills. Little dams needed several days to build up enough water so the mill could operate. Therefore, such mills worked only intermittently. While most grist mills were powered by water, a few wind mills existed. The precise number of grist mills in the Pinelands is not known, but probably no more than 50 ever existed. The best working example is at Batsto Village.

Row crop and truck farming (1700-present): This is the most important economic activity in much of the western Pinelands region from Gloucester County north to Wrightstown, and it occurs to a lesser degree elsewhere. Throughout the years, crops have been produced for both market and local uses. Barns, farmhouses, and market places associated with row crop and truck farming are found in all areas of the Pinelands except in the most forested sections. Examples include the Jonathan Haines House in Burlington County, listed on the State and National Registers of Historic Places, and the Berlin Auction site in Camden County.

Cranberry growing (1835-present): The cranberry industry represents an important agricultural activity in the northern and southern forest sections of the Pinelands. Because the industry is a distinctive feature of the Pinelands culture, many bogs, as well as industry-related structures, can be considered historic resources. The site of the first commercial bog is Burr's Mill Pond near Vincentown. The only early cranberry packing house known to be still standing is at The Birches near Tabernacle, Burlington County. Approximately 200 acres of cranberry bogs and an associated village have been preserved in Double Trouble State Park in Ocean County. Many former bogs have been converted into recreation sites for boating, fishing, and camping.

Blueberry growing (1915-present): Wild blueberry or huckleberry gathering was a seasonal occupation here before the domestication of the blueberry in the early 20th century. Since 1915, blueberry fields and related structures have become important aspects of the Pinelands landscape. The most famous of these are located at Whitesbog, Burlington County, where Elizabeth White, pioneer of the cultivated hybrid blueberry, was active.

Iron (1765-1865)

The iron industry accounted for the century-long population boom in the forest areas of the Pinelands. Iron production required charcoal, which consumed enormous amounts of pine wood and thus helped to create the modern landscape. About 30 furnaces and forges existed here during the 100-year history of this industry. Although most of the associated buildings have disappeared, many of the sites contain significant archaeological resources. One of the more famous ruins, Martha, was investigated by an archaeologist but was covered over again to prevent further vandalism. The furnace at Batsto, originally built in 1766, rebuilt in 1786 and again in 1829, continued to cast iron until 1848. As with many furnaces, a village grew up around it. Batsto village included a lime kiln, charcoal house, stamping mill, sawmill, gristmill, store, and workers' cottages sufficient to house over 500 people. The site has been restored by the state and it attracts thousands of visitors.

Glass (1800-1875)

Glass was an important rural industry in the Pines. It supported the 19th century population after the decline of the furnaces and forges. The glass houses were worked by long-time rural residents with the help of Germans and Belgians who immigrated to the region in the 1830's and 1840's. Twenty-eight glass house sites have been located in the area from Cumberland County to the north central region of the Pines. Most of these sites contain archaeological remains. Estellville, the best preserved, is unique for its stone construction. A few glass houses were worked until 1920.

Minor Rural Industries (1830-1930)

Some rural industries were never considered major economic activities in the Pinelands. After the collapse of the bog iron industry, paper and cotton producers took over the abandoned buildings. For example, Pleasant Mills (first known as Clarks Mill) was a gristmill as early as 1740. The major development of the village, however, centered on a fulling mill, which later became a cotton mill, and then a paper mill. The paper mill closed in about 1926. It remains standing today along with three 18th century houses. Other vestiges of these rural industries have been found in good condition at Harrisville (a paper mill), Atsion (a cotton mill), and Pasadena (a terra-cotta factory).

Land Transportation (1700-present)

The transportation network along with the associated taverns and stations constitute important historic resources. Roads and railroads served important commercial functions and prompted development throughout the region. For example, new towns were created around railroad stations, and existing villages were often enlarged. Taverns, usually found at crossroads, became centers for social and political gatherings. Many sand roads dating from the eighteenth century still exist in the Pinelands, the most famous being the Tuckerton Stage Road. Three well-known tavern sites are located along this road—Quaker Bridge, Mount, and Washington. U.S. Route 9, or the Shore Road, is an historic road that runs along the coast. In addition, railroad routes can be found throughout the Pinelands. Several historic railway stations, such as the one at Chatsworth, still stand.

Commercial Centers, Religious and Institutional Structures (1700-present)

This category includes taverns, hotels, schools, municipal buildings, libraries, churches and graveyards, all of which tend to be clustered in crossroads communities. It may also be considered to cover houses in those communities. A wide range of architectural styles, including Federal, Greek and Gothic Revivals, Italianate, and Queen Anne can be found in a variety of adaptations. Some reflect prevalent pattern book detailing, while others seem to represent a more locally distinct vernacular. The clustering of many of these resources indicates potential for locally designated or State and National Register historic districts.

Ethnic Settlements (1700-1960)

The Pinelands have been a cultural refuge for the English, Irish, Germans, Italians, and Jews in the 18th and 19th centuries, and for Russians, blacks, and assorted urbanites in the 20th century (see the section on cultural resources). About a dozen ethnic settlements were founded in the southern half of the region, including ones at Hammonton, Egg Harbor City, and Woodbine. Of the few scattered settlements in the north, Rova Farm, a Russian community in Jackson Township, Ocean County, is the largest and most successful today. These settlements have given the Pinelands an added cultural dimension as an "ethnic archipelago" (Marsh, 1979). None of these settlements have received State or National Register recognition. Although the synagogue at Woodbine has been nominated for Register listing, the historic district potential of Woodbine (and other ethnic settlements) has not yet been realized.

Tourism, Recreation and Vacation Houses (1850-present)

Scattered throughout the region are recreation and vacation structures. They include the hunting lodges, which were discussed above. A number of the speculative land development schemes which the Pinelands have harbored over the past 100 years have included recreational spots and vacation homes. Few of these were built. Medford Lakes, however, the site of an 18th and early 19th century industrial area, was developed in the 1920s as a summer colony. A consciously rustic "log cabin" style characterized its buildings. This study unit includes Sunshine Park in Atlantic County, one of America's early nudist camps, many children's camps in the forest regions, and the site of Prince Mario Ruspoli de Poggio-Suasa's villa. Next to the villa, the prince and his friends built the Chatsworth Country Club, modeled after Chatsworth, the noted English country house. Although that turn-of-the-century pleasure ground was short-lived, the nearby community of Shamong was renamed Chatsworth.

Conclusion

The existing historic site inventories of the Pinelands indicate a wealth of resources in various states of preservation and use. A number of historic industrial settlements have been preserved as open-air museums or archaeological sites. However, the historic significance of many scattered farms, crossroads communities, and villages which have remained in use over the years has not been fully appreciated. Only a small percentage of properties eligible for the State and National Registers of Historic Places have been listed, although historic districts such as Atsion and Batsto have long been officially recognized. Local and state surveys covering parts of the region and an area-wide inventory of known sites undertaken for the Commission (Liggett and Wilson, 1980) represent the latest attempts to fully describe the area's historic resources so that they may be adequately protected.

The range and diversity of historic sites in the Pinelands discredits the myth that this region was

“barren” culturally. The delineation of study units is a method of organizing the existing information on economic activities, historic settlements, and individual sites into a meaningful framework. Surveys, inventories, and study units are important because they provide the necessary background materials to develop a historic preservation plan for the Pinelands that is responsive to both the resources and the people who use them.

CULTURAL RESOURCES AND ATTITUDES

A close relationship exists between the availability of natural resources in a region, the ways the land is viewed, and the prevailing cultural patterns. This section discusses the interplay of these factors in the Pinelands, and how the region's distinctive overall culture has evolved.

Land uses may be classified as extensive or intensive. Extensive use is possible only where large contiguous tracts of land are left free of development, as they are throughout much of the Pinelands. This land is the setting for typically rural Pinelands activities such as berry agriculture, hunting, fishing, and trapping. Intensive land uses in the Pinelands include the older towns and villages which serve as commercial and agricultural centers, various other local economic centers such as government facilities, and the newer suburban communities on the region's fringe. The latter began to appear in the mid-1950's in response to growth pressures from the nearby Philadelphia and New York metropolitan areas.

Extensive land uses are generally associated with older cultures. This is borne out by the fact that out of the 18 “study units” described in the previous section on historic resources, 12 relied chiefly on the existence of large tracts of open space. These Pinelands activities, particularly rural industries, all originated prior to the 20th century. The extent to which contemporary Pinelands residents still engage in these activities is a sign that their culture remains closely tied to the past. But the spread of intensive land uses through modern economic development has brought about an inevitable shift from a traditional to a more urbanized lifestyle.

Generalizations may be made about the traditional, rural Pinelands lifestyle. It is intimately related to and dependent on the existence of large, contiguous tracts of open land and the activities associated with them. Long-time residents have engaged in rural pursuits such as hunting, fishing, gathering, farming, and berry growing. Economically, there is a long history of utilization of local resources. In a social context, family ties are close and communities are centered on churches, granges, and fire companies. This culture, often referred to as the “Piney” culture, is similar to that found in many rural areas of the United States. What makes it unusual is that it has continued to exist so close to a sprawling megalopolis.

John McPhee has given perhaps the best-known accounts of the attitudes and self-sufficient lifestyles characteristic of these Pinelands residents. In an article for *National Geographic* (1974), he referred to the Pineys as “inhabitants of a separate world,” exhibiting customs and livelihoods apart from the mainstream of the urbanized Northeast but similar to those of the last century. These people have lived off the resources of the Pinelands forests, following a yearly cycle of charcoal making, moss gathering, berry picking, and hunting. On the whole, their overt reliance on the region's resources has diminished in recent years. Most rural residents now also hold jobs unrelated to direct use of the land, including employment by public agencies such as the state and county highway departments, state schools, and military bases. Yet, the influence of the traditional ways still affects their characteristic nature. It surfaces in their self-sufficiency and restlessness. It is also evident in the confidence they feel that the woods can provide them a livelihood if they are, in a sense, “left alone.”

Settlement Patterns

Settlement of the Pinelands has taken place in three general patterns. These are the coastal and river-oriented pattern, a second one influenced by construction of the railroads, and the relatively recent pattern of suburbanization. The first two patterns evolved directly from historic land uses which were tied to the exploitation of available resources.

As early as the 17th century, the New Jersey coast was used for shellfishing, boatbuilding, and agri-

culture. By the mid-18th century a series of settlements was established along the coastal mainland and the Mullica, Great Egg Harbor and Maurice Rivers. Residents' livelihoods were dependent on the waterways and the forests.

The railroad lines, built during the 1850's and 1860's, opened the Pinelands to increased settlement, agriculture, and commerce. Many of the towns which grew up along these lines were ethnic centers such as Woodbine, Mizpah, and Egg Harbor City. The railroads provided links with markets in metropolitan areas, contributing to the growth of Pinelands agriculture into the successful commercial enterprise it is today.

The third settlement pattern, suburbanization, represents a spillover into the Pinelands of conventional, present-day culture from surrounding developed areas. Suburban residents are a less homogeneous cultural group whose economic activities are essentially unrelated to the use of the Pinelands' natural resources. Their presence, however, reflects the exploitation of what has become one of the Pinelands' most valuable commodities—open, developable land.

Over the years, the three settlement patterns have resulted in a distribution of actual settlement types throughout the Pinelands. In a study performed for the Commission, Berger (1980) groups these settlement types into three major cultural regions: the northern and southern forests, the agricultural and rural suburban area on the Pinelands' western side, and the coast. The three regions are shown in Plate 15, and are divided into smaller units according to the key presented in Table 3.2.

The extensive land use which characterizes the Pinelands is most evident in the forest region, where many residents continue to pursue traditional activities such as berry agriculture, hunting, and gathering. The northern forest is the area which outsiders often define as the Pine Barrens. It is in fact this area which has received the most study over the years by botanists, ecologists, historians, and planning groups. Publicly owned lands predominate in the northern forest, accounting for over 60 percent of the land area with tracts such as Wharton and Lebanon State Forests, Manchester and Pasadena Fish and Wildlife Management Areas, and Fort Dix, McGuire Air Force Base, and Lakehurst Naval Air Station. The result is a largely unbroken landscape, disrupted only by an occasional village, farm house, and hunting club. It is a haven for recreationalists. The landscape has produced a group of residents who are historically self-supporting, who resent incursions on their land and intrusions on their lifestyle.

The southern forest, although similar in terms of its extensive land use, differs in many ways from the northern forest. Of all areas of the National Reserve, the southern forest has received perhaps the least attention over the years from Pine Barrens enthusiasts, developers and others. The major industries here are sand and gravel mining, blueberry agriculture, and to a lesser extent, forestry, field crop agriculture, and animal husbandry. With the exception of Weymouth in Hamilton Township, the area did not experience the boom and bust cycles of 18th and 19th century industry which contributed to the history of the northern Pines. Settlements which did occur in the south were largely a phenomenon of the late 19th century, when ethnic groups came here seeking a refuge. Other developments proposed in this area turned out to be mostly dreams, or "land scam" developments which are traceable only in historic records and deeds. With its large forests and frequently recurring wetlands, the area has proven to be an ideal setting for hunting and trapping. Because of its land forms and history, the southern forest is culturally more diverse than the north, and has in fact been described as an "ethnic archipelago" (Marsh, 1979).

The western crop agriculture and rural suburban region is extremely diverse, with sub-elements in various stages of transition. Historically, the entire western and southwestern fringe of the Pinelands contained some of the area's most viable agricultural uses, producing berries, field crops, and vegetables and supporting dairy farms. While agriculture remains the primary focus in centers such as Hammonton and Buena, suburban development is causing significant changes in the character of many parts of the region. The Medford and Marlton areas, for example, once dominated by traditional farming, are increasingly characterized by individual and tract development. Medford Lakes, first a cranberry area and then a resort, is now a totally developed year-round community. Southampton, Shamong, and Tabernacle Townships, although still largely agricultural, are torn between maintaining their existing character and capitalizing on the housing pressures emanating from the Philadelphia-Camden area. Com-

munities to the southwest appear stable for the near future, but their proximity to transportation corridors connecting the west with Atlantic City may produce changes in this landscape as well. The resulting social patterns are therefore as diverse as the levels of development—old farming families, clusters of younger exurbanites, and stable ethnic communities. This block of land is truly a composite of sub-regional characteristics rather than a consistent, homogeneous region.

Some portions of the coastal region are in transition, while others have lost their traditional character altogether. The first area of the Pinelands National Reserve to be settled, the coast has also experienced the most substantial impacts related to tourism, recreation, and year-round development. Nowhere has this change been more evident than in Ocean County, which has seen a virtual explosion in population over the past 20 years. This dramatic shift from extensive to intensive land uses has been accompanied by a change in prevailing social patterns, with suburban or mixed urbanizing groups gradually replacing the traditional baymen and other rural groups. In contrast, the central and southern tidal navigation corridors and those areas draining to the Delaware Bay have remained remarkably stable during this time. Maintaining an orientation to water-related industries, these areas continue to exhibit the natural qualities which made them attractive to settlement in the first place.

Cultural and Ethnic Groups

As Plate 15 indicates, residents of the Pinelands display a range of cultural differences. It is possible to identify groups of these residents based on similar land use activities, ethnic and religious backgrounds, and family ties. In recent years, scholars have paid increasing attention to the identification and study of these groups. One investigator has described the rich cultural heritage of the southern part of the Pinelands as an “ethnic archipelago” (Marsh, 1979.)

Work performed for the Pinelands Commission resulted in the identification of a number of these cultural or ethnic groups (Sinton, 1980). The following is a brief discussion of these groups, including their geographic location, economic activities, and relative stability within the Pinelands today.

Baymen

The first European settlers in the region came from Long Island to establish small fishing communities along the seacoast. Their descendants, the present-day baymen, run their lives seasonally, making most of their income from shellfishing in spring, summer, and fall, and trapping in winter. They do not constitute the majority of any Pinelands community, but they have a powerful voice in running local affairs in the Barnegat Bay region. The viability of small-time fishing is now in doubt. Unless steps are taken to ensure its economic feasibility, the younger baymen will search out other means of livelihood and the culture will vanish.

Blacks

Chesilhurst in Camden County is the Pinelands’ oldest black community, originating before the Civil War. Other small, rural black communities were begun by people who came to New Jersey from the South after World War I. They tend to be family-oriented, stable communities whose residents farm, hunt and work for such institutions as the state schools or for the building trades. One community where blacks exert political influence as a group is the South Egg Harbor area of Galloway Township. The character and social structure of these communities is stable and expected to remain so.

Germans

Several German settlements developed in southern New Jersey in the mid-19th century, including the farming communities of Germania and Cologne, and Egg Harbor City. Only Egg Harbor City remains as a German center, and the German elements of this area are being assimilated into the cultural mainstream. Few young people speak any German, and people of Italian descent from nearby areas like Hammon-ton are moving into once solidly German neighborhoods. The last remaining German cultural group is expected to blend into the larger mixed urbanizing groups of Atlantic County.

Table 3.2—Cultural Regions and Sub-Regions in the Pinelands (See plate 15)

Map Symbol	Northern and Southern Forest Region
NFA	North of the Mullica throughout Burlington and Ocean Counties
NFB	Cranberry Watershed
NFC	The Plains
NFD	Military
NFE	Retirement—Manchester Township and Leisuretowne
NFF	The Lakes—Pemberton, Hampton, Bamber
SFA	Inhabited Forest—Atlantic County
SFB	Inhabited Forest—Cumberland County
SFC	Primary Use Agriculture—Belleplain
SFD	Industrial/Commercial—Woodbine
SFE	Uninhabited Forest—Atlantic County
SFF	Uninhabited Forest—Cumberland County (Sand and Gravel)
SFG	Uninhabited Forest—Cumberland County (Land Scarce Development)
SFH	Uninhabited Forest—Cape May County (Ex-Agricultural Woodland)
SFI	Belleplain State Forest
Western Crop Agriculture and Rural Suburban Region	
WCA	Rural/Residential—Medford, Marlton
WCB	The Lakes—Medford, Evesham
WCC	Primary Use Agriculture—Pemberton and Southampton Field Crops
WCD	Primary Use Agriculture—Southampton Dairy Farms
WCE	Primary Use Agriculture—Berries
WCF	Agriculture/Forest Transition—Medford, Shamong, Tabernacle
WCG	Primary Use Agriculture—Vegetables
WCH	Primary Use Agriculture—Ethnic Town Center (Hammonton)
WCI	Primary Use Agriculture—Ethnic Town Center (Egg Harbor City)
WCJ	Primary Use Agriculture—Buena and Franklin Field Crops
WCK	Rural Residential/Suburban—Winslow
WCL	Rural Road Settlements—Monroe
WCM	Agriculture/Forest Transition—Atco, Waterford
WCN	The Pikes—Williamstown, Berlin
WCO	Rural Residential—Folsom
WCP	The Lakes—Monroe
The Coast	
CNA	Bay and Land-Oriented Traditional Communities—Cedar Run to New Gretna; Barnegat
CNB	Manahawkin Mixed Development
CNC	Mixed Traditional Suburban North—Forked River, Waretown, Lanoka Harbor, Toms River
CND	Marshes—Atlantic Coast Salt Marshes and Adjacent Wetlands
CNE	Bays—Barnegat Bay, Manahawkin Bay, Great Bay, Mouth of the Mullica
CNF	Barrier Islands—Long Beach Island, Island Beach
CTA	Tidal Navigation Corridors—Great Egg Harbor River, Mullica River
CSA	Remnant Agricultural Suburban—Cape May County
CSB	Lower Route 9—Beesley's Point to Cape May
CSC	Route 49 Corridor—Head-of-River, Tuckahoe, Marshallville, Petersburg
CDA	Delaware Bay Marshes
CDB	Maurice River Township Core—Port Elizabeth, Bricksboro, Dorchester, Leesburg, Heislerville
CSD	Route 47 Corridor—Dennisville, Delmont, Eldora

Italians

Construction of the railroads brought many of the first Italian-American families to the Pinelands. In time, many of them turned to agriculture. They remain the predominant cultural group in the truck and row crop agricultural regions, and form large stable elements of the population in such areas as Hammonton and Williamstown. They are expected to remain a stable cultural group.

Jews

Several Jewish communities have been founded in the southern third and along the northeastern fringe of the Pinelands. The earliest of these settlements, including Woodbine, Norma, Alliance, and

Garton Road, were established in the 1880's along the net of rail lines that operated in the southern Pines at that time. Those in the north came later, and were settled primarily by persons who fled Europe during and after World War II. Many of the Jewish settlements lasted no more than a generation, although Woodbine continued as a viable ethnic community until the 1950's. Today, Woodbine's Jewish community has the strongest ethnic identity remaining in any of these settlements.

Mixed Urbanizing

As development has increased in the region, many areas of the Pinelands have steadily lost their distinctive cultural differences. Persons associated with the mixed urbanizing groups fall into the following categories: suburbanites and exurbanites, chiefly from the Philadelphia and New York City metropolitan areas; people attached to military installations, especially Fort Dix; and residents of coastal areas dominated by second homes, many of them vacant more than half of the year. It is anticipated that in areas slated for growth under the Comprehensive Management Plan, mixed urbanizing communities will supercede cultural groups associated with more rural lifestyles.

Puerto Ricans

Puerto Rican communities are found principally in Atlantic and Camden Counties, although some are also associated with cranberry operations in the central Pinelands. While Puerto Rican migrant workers have worked in southern New Jersey since World War II, families have tended to settle permanently in the Pinelands only over the past 15 years. Church and family ties are strong. Most families rent rather than own their land, but their communities are stable and expected to remain so.

Quakers

The old towns of Medford and Marlton on the Burlington County Pinelands fringe form part of the originally extensive pattern of Quaker settlements throughout the Rancocas Creek basin. In these areas, the influence of long-time resident Quaker families remains strong despite large influxes of suburbanites and exurbanites in the past decade. Quaker cultural elements are expected to remain stable.

Rural Residents

Rural residents, including Pineys, have disparate backgrounds. The majority are of English, Irish, and Scottish extraction, and are descendants of people who came to the Pinelands in the 18th and 19th centuries. Those settlers were joined by the Dutch, Germans, and a few blacks and other ethnic groups. More recently, some long-time hunters and vacationers from the Delaware Valley and other parts of New Jersey have taken up this rural lifestyle on a permanent basis. Rural residents share cultural traits which include scattered or loosely grouped settlements, orientation toward family and church, and frequent participation in seasonal activities such as hunting, fishing, and berry gathering. Many rural residents are employed either full-time or part-time by local industries or government. The continued existence of this culture in the Pinelands depends on the extent of available open space and the freedom with which people will be allowed to pursue their activities. The more that development impinges on extensive, rural land uses, the more tenuous the traditional Piney culture becomes.

Russians

Three Russian-American communities exist in the Pinelands. Rova Farm in Jackson Township was settled in the 1930's, and the other two, in southwestern Atlantic county, in the 1950's. Of the three, Rova Farm is the largest and most stable. It is expected to remain an important Russian cultural center. The fate of New Kuban in Buena Vista and the small settlement near Mays Landing will depend on the desire of the younger residents to sustain the identities of their communities.

Culturally Significant Areas

Cultural groups leave their marks physically on the landscape. Because of members' shared values and activities, they tend to produce distinctive structures and landscape types. To a large degree, the traditional Pinelands landscape is a product of extensive land use. The existence of vast amounts of open space contributes to the essential Pinelands character as well as to the region's national significance. Nevertheless, settlement and the signs of society also characterize certain portions of the Pinelands. Analysis of residents' attitudes toward the region's actual appearance, including both natural and man-made elements, is important in determining which landscape elements rank highest as cultural resources.

Historic Sites of Cultural Interest

Historic sites can be important to a culture because their links with the past lend historic continuity to a cultural group. Many historic, archaeological, and architectural sites are significant from the viewpoint of a professional. Historic sites of cultural interest, however, are defined internally by local residents. Important sites of this type are eligible for both the State and National Registers of Historic Places.

The sites listed in Table 3.3 are of historic interest in an academic sense and are of cultural value to residents as well (Sinton, 1980). These sites are all well known to local residents, who use them for recreational and other activities or value them simply as part of their heritage. Examples include:

- Whitesbog—a berry production area in Pemberton Township historically significant because of its association with the development of the cultivated blueberry.
- Savich Farm—a site near Marlton which is on both the National and State Registers of Historic Places because of its historic and prehistoric importance. The existing buildings date from the late 18th Century. The site also contains a wealth of prehistoric Indian artifacts.
- Carranza Memorial—a site in Tabernacle Township of local and national interest. It is in the area where Emilio Carranza, a Mexican aviator on the return leg of a goodwill flight between Mexico and New York, crashed and died in 1928. Each year a service is held at the memorial commemorating this event.
- Harrisville—formerly known as McCartyville, in Washington and Bass River Townships. Harrisville was the site of 18th and 19th century industry including a sawmill and paper mill. Ruins of the paper mill still exist in the area. Harrisville Pond is noted for its scenic and recreational value.
- Renault Winery—another site on the National Register, located in Galloway Township. The winery was started in 1864 by L.N. Renault, and is still active.
- Batsto—probably the best known and most visited historic site in the Pinelands. Batsto was a major industrial village which produced iron from local ores from 1766 to 1855. The village contained a sawmill, grist mill, over 60 houses, a mansion and a large farm complex. Many of these structures have been restored by the state.

Contemporary Cultural Sites

These sites are the physical aspects of a society or community which help to unify it and to strengthen its identity. They have great symbolic value as places where people share common experiences. Some sites, such as churches, have long histories. Others, such as schools, may have been recently constructed, but social and political gatherings are so often conducted there that they serve as a social nexus. Volunteer firehouses are important cultural features of the Pinelands, as are cemeteries.

Hunting and Farming Areas

Many areas in the Pinelands are culturally significant because they form part of a common social experience. The most important are hunting areas, agricultural areas, and areas valued for aesthetic reasons.

Hunting and trapping are extremely important activities for both residents and non-residents of the Pinelands, as indicated by the fact that there are more than 200 gun clubs throughout the region. These serve as important social gathering places. The oldest club, Atlantic County Game Preserve, was founded in 1905, while most clubs were founded in the 1930's. Membership in many gun clubs is closely associated with membership in voluntary organizations such as fire companies. Because of the large land use requirements of hunting, gun club members have a stake in preserving hunting territories and, therefore, open space in general.

There is a long history of people moving into the Pines and adopting rural lifestyles as a result of their hunting experiences here. Joe Albert and his late brother George were prime examples of this trend. The Alberts moved from Middlesex County to the Waretown area in the 1930's, and eventually inspired the formation of the Pinelands Cultural Society, a country music group.

Table 3.3—Historic Sites of Cultural Interest

U.S.G.S. Quad Sheet	Site Index No.	Site	U.S.G.S. Quad Sheet	Site Index No.	Site
New Egypt	2.3	Cookstown	Toms River	19.1	Lanoka Harbor
	2.5	Brindletown		19.2	Forked River
Cassville	3.1	Lakehurst Naval Air Station		19.4	Waretown
	3.4	Colliers Mills		19.6	Barnegat
Pemberton	3.5	Rova Farm	Barnegat Light	20.2	Barnegat Lighthouse
	7.1	Burr's Mill Pond	Williamstown	22.2	Chesilhurst
	7.2	Red Lion	Hammonton	23.10	Winslow
	7.3	New Lisbon		23.15	Hammonton (Old City)
	7.6	Buddtown	Atsion	24.17	Batsto
	7.7	Vincentown		24.18	Pleasant Mills
	7.8	Pemberton (New Mills)		24.19	Quaker Bridge
Mt. Holly	7.9	Retreat (present location)		24.27	Atsion
	6.2	Medford	Jenkins	25.5	Crowleytown
Browns Mills	8.4	Ong's Hat		25.7	Jenkins Neck
	8.8	Mt. Misery		25.10	Harrisville
	8.9	Whites Bogs		25.11	Martha
	8.12	Browns Mills		25.18	Hog Wallow (Fellowship)
Whiting	9.4	Wheatland (Pasadena)	Oswego Lake	26.2	Sim Place
Moorestown	5.2	Marlton	Buena	30.6	Friendship Church
	5.4	Savich Farm	Newtonville	31.5	Weymouth
Toms River	11.1	Double Trouble	Egg Harbor City	32.1	Sweetwater
Clementon	13.1	Long A Coming (Berlin)	Green Bank	33.5	Renault Winery
	13.5	Atco		33.8	Gloucester Furnace
Medford Lakes		All the lakes		33.9	Gloucester Landing
	14.2	Aetna Furnace		33.19	Clarks Landing
	14.6	Taunton Furnace		33.16	Lower Bank
	14.12	Delette		33.17	Green Bank
	14.14	Leander Fox Homestead	New Gretna	34.1	New Gretna
Indian Mills	15.1	Indian Mills		34.2	Oyster Creek
	15.3	Carranza Memorial		34.4	Port Republic
	15.8	Tabernacle	Tuckerton	35.5	Tuckerton
	15.14	Moore's Meadow and	Mays Landing	38.3	Mays Landing
		The Birches		38.6	Estellville
Chatsworth	16.3	Hedger House	Oceanville	40.1	Smithville
	16.4	Paisley (White House)	Port Elizabeth	42.5	Port Elizabeth
	16.7	Chatsworth		42.11	Mauricetown
	16.9	Friendship Bogs	Marmora	44.10	Petersburg
		Ocean City	45.2	Bargaintown	
		Woodbine	48.1	Woodbine	
			48.5	Dennisville	

Like hunting, agriculture is an old and culturally important activity in the Pinelands. It provides physiographic areas such as bogs and blueberry fields which are part of the residents' shared experiences and activities. Newly researched data supports the position that agriculture has been and continues to be of cultural importance in the Pinelands. The catalogue of historic sites prepared for the Pinelands Commission includes all known historic cranberry bogs, and shows that these bogs encompassed four times as much land as today's operations. The second data source is 19th century census schedules, which reveal that Pinelands residents, even in the darkest economic times during the last third of that century, continued to produce marketable quantities of agricultural items.

Today, the presence of agriculture remains a prominent aspect of the Pinelands' character, and is an important element of the rural lifestyle. Berry cultivation is compatible with, and in fact dependent on, the maintenance of large, unspoiled open spaces which characterize much of the Pinelands. Consequently, agricultural areas also have aesthetic appeal.

Areas of Aesthetic Interest

People in a given group or culture often share common aesthetic values. Sinton (1980) has defined a number of Pinelands residents' visual preferences, and has found that the most important aesthetic factor in general is diversity of forest types. Residents here are more partial to water, and the edges between land and water, than any other landscape types. All the rivers, lakes and bogs in the Pinelands should be considered to have the highest aesthetic quality and are of definite cultural significance. Pinelands residents also ranked sites with wildflowers high in quality. Most often mentioned were roadside areas, although many residents found upland areas with pyxie moss or turkey beard very beautiful. Sites with bog flowers are also greatly appreciated. These findings are consistent with those of a recent study of the Pinelands' scenic resources, which is discussed below.

Scenic Resources

The subdued quality of the Pinelands landscape is attributable largely to its location in the Outer Coastal Plain, a geological formation characterized by flat to gently rolling terrain. This formation affords the Pinelands neither the steep slopes nor mountain peaks which contribute to the scenic significance of areas such as Big Sur or the Adirondacks. Indeed, elevations in the Pinelands rarely exceed 150 feet, and generally the range is 50-150 feet. While topographic changes here are less than dramatic, the Pinelands exhibit a subtle beauty, the components of which are unmatched in the Northeast.

The relative flatness of the Pinelands actually contributes to the viewer's sensory experience. The region is known for its vast forests, producing an unbroken landscape rare in New Jersey. The predominantly flat terrain adds to the feeling of remoteness deep in the pine woods, and increases the exhilaration of viewing this expanse from the few high points such as Apple Pie Hill or ridges in the Plains.

Because of the unique interaction of features such as soils, water, fire, and human disturbance, the Pinelands are remarkably diverse. The region is a richly patterned mosaic of vegetative types, including pine and oak woodland, pigmy pine forests, tea-colored streams lined with cedar or maple, bogs, and marshes. A casual observer might attribute the sandy soil and scrub pine cover to an arid environment. However, below these droughty soils is a vast reservoir, which interacts with the gentle undulations of the land to produce changes in the landscape and pleasant surprises for the viewer.

Some of the region's most often-mentioned scenic qualities are associated with the presence of water. The many rivers and streams which meander through the Pines are sources of aesthetic and recreational enjoyment. The tall cedars lining many of these streams are considered special both for their soft beauty and their increasing scarcity. Bogs and marshes contain some of the rarest and most beautiful plants in the Pinelands, including crested yellow orchid, Boykin's lobelia, and Pine Barrens gentian. Even industries such as cranberry and blueberry cultivation are valued for their scenic qualities and are seen as integral elements of the Pinelands' natural landscape.

Recognizing that the Pinelands' scenic qualities contribute to their significance, both the state and federal legislation direct that the Comprehensive Management Plan identify those qualities and provide for their protection. The difficulty in achieving this objective lies in defining what constitutes scenic significance. Given the subtle, interactive beauty of the Pinelands and the fact that its sheer size is one of its most outstanding features, one is tempted to declare the total area scenically significant.

The definition and assessment of scenic resources is unlike most other planning tasks. Scenery exists as an idea in people's minds. The scenic value of different places or landscapes is therefore subjective and, within broad cultural limits, will vary from person to person. This subjectivity does not mean that it is not important to protect scenic areas, but it presents problems when attempting to choose those which are most significant.

The Commission has employed various approaches in an effort to pinpoint those areas of the Pinelands which exhibit the most noteworthy scenic qualities. Sources consulted during the preparation of the Plan included agencies whose programs dealt with scenic values, among other things, and one group whose specific purpose was to identify visual preferences in the Pinelands and to translate those preferences into acquisition priorities, management programs, and design standards.

At the federal level, the National Natural Landmarks Program is responsible for identifying areas which are the best examples of the country's natural heritage. Landmark status is ascribed to areas which best illustrate or interpret this natural history. These areas are evaluated according to criteria such as how well the nominated example typifies the ecological resource, the present condition of the example, the rarity of the type of resource, and the number of high quality examples which the area contains.

The National Natural Landmarks Program considers far more than the scenic value of a site, but the quality of the resource necessary to merit landmark status indicates that the example will contain important scenic features. The following areas within the Pinelands are being considered for inclusion on the register of the National Natural Landmarks: the Barnegat Bay system, the Delaware Bay mudflats (including a portion of Dennis Creek), the Great Bay estuary, Island Beach State Park, McDonald's Branch, Quaker Bridge, and the Wading River watershed. The Manahawkin bottomland hardwood forest in Ocean County is on the register.

The New Jersey Heritage Program is the umbrella organization charged with identifying and developing strategies to protect natural and cultural resources representative of the state's heritage. The Natural Areas System and the Natural Areas Register, elements of the heritage program, deal with management of noteworthy resources on public lands, and public and private lands, respectively. Scenic quality is a major factor in the nomination process. Several sites within the Pinelands were designated as part of the Natural Areas System when it was initiated two years ago. These sites include: a 100-acre cedar swamp in Lebanon State Forest; the 350-acre Batsto Natural Area and the 100-acre Oswego River Natural Area in Wharton State Forest; the 100-acre Absegami Trail in Bass River State Forest; 1,900 acres at Island Beach State Park; a 64-acre bottomland forest in Manahawkin Wildlife Management Area; the 395-acre Great Bay Natural Area in Great Bay Wildlife Management Area; and the 678-acre North Brigantine Natural Area.

While the designation of natural areas was initially limited to state-owned lands, the Heritage Program will soon direct its efforts to identifying private lands which will be considered for the Natural Areas Register. The Register will include all natural areas, public and private, which by virtue of scenic qualities, existence of threatened and endangered plants and wildlife, or other natural or cultural features warrant recognition as prime examples of the state's heritage. After developing the preliminary list for the Register, the Department of Environmental Protection's Green Acres office (the administering agency for the Heritage Program) will conduct further research and will then determine the respective boundaries for each designated area.

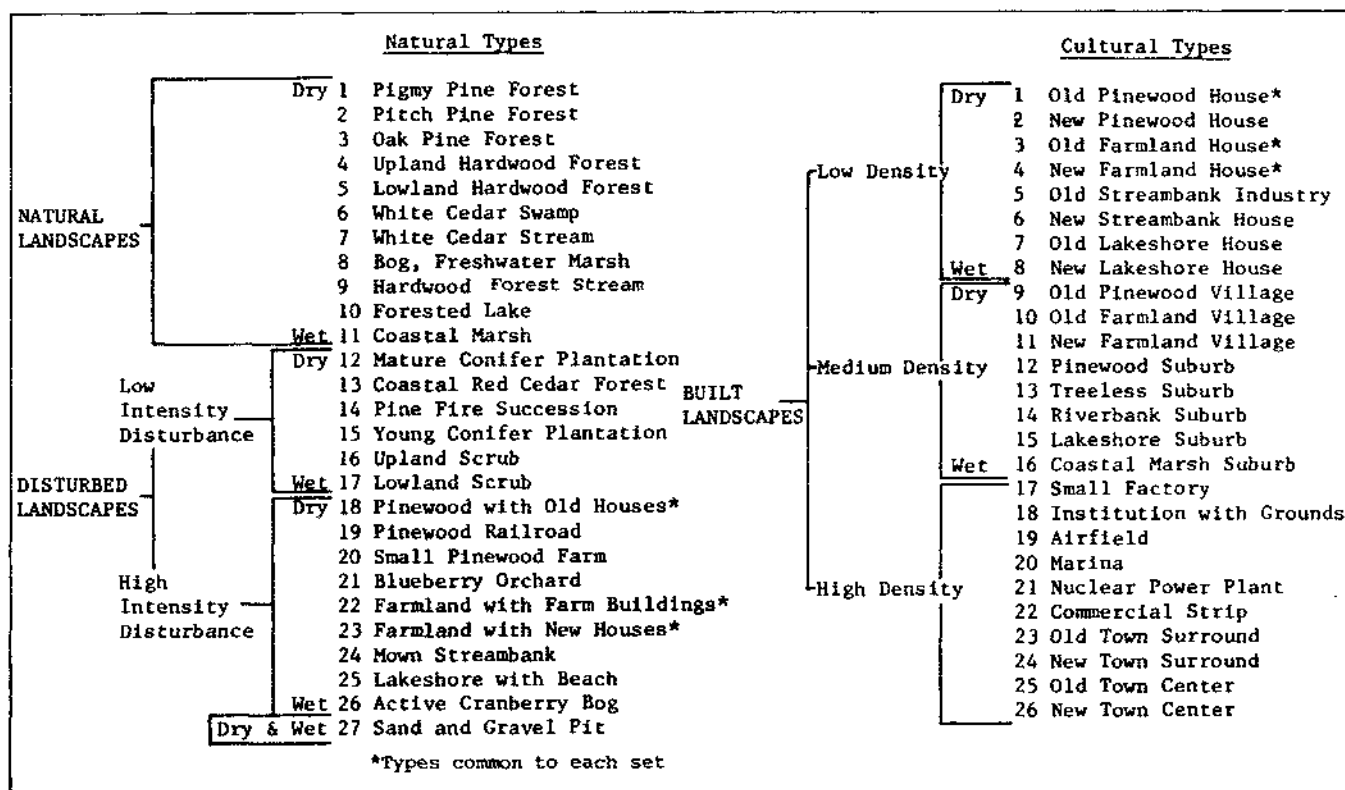
Pinelands Scenic Study

To refine the designation process, the State Heritage Program has cooperated in a study aimed at defining and assessing the relative value of scenic resources. Planned as a three-part study and spearheaded by the Northeast regional office of the federal Heritage Conservation and Recreation Service, the first stage concentrated on the Pinelands and involved coordination with the Pinelands Commission and the DEP's Division of Coastal Resources. The objectives and relevant findings of this first phase are summarized below. For further explanation, refer to the summary report, "The Pinelands Scenic Study," published by the Department of the Interior in 1980.

The study was divided into three main parts—measurement of scenic preference for types of Pinelands landscapes, measurement of scenic preferences for geographic places in the Pinelands, and the use of scenic preference measurements within the planning program. The measurement elements relied on the participation of Pinelands residents and users.

Measurement of scenic preference was achieved by asking a range of audiences to express their relative opinions on visual types present in the Pinelands. Of the many possible combinations of Pinelands features, 53 types were selected for voting. These types included 27 natural and 26 cultural types, grouped according to principles such as the intensity of human disturbance and the amount of water present. Figure 3.1 shows all visual types used and their respective groups.

Figure 3.1—Pinelands Visual Types



The visual types were illustrated with color slides, which were projected in pairs at public meetings to collect preference votes. Single composite scores were obtained by averaging the scores for each visual type given by the whole voting sample. Because of the time factor involved in showing every possible pair, cultural and natural types were voted separately, with the final preference score achieved through the use of three visual types common to each set. Figure 3.2 illustrates the distribution of these scores and represents the compilation of 155 natural and 146 cultural type questionnaires.

The distribution of scores, as well as an examination of the bar charts which were prepared for each type, leads to the following general conclusions. The most preferred scenic element is surface water in lakes and streams. Next preferred are undisturbed forests, such as cedar swamps and hardwoods along streams. Bogs are also a highly valued visual type. Generally, the lower the level of human disturbance, the higher the preference. Visual types without buildings are generally preferred to those with buildings. When buildings are present, lower densities and those in proximity to water are favored types. Sand and gravel pits, scattered new homes and suburbs in treeless areas, and commercial strips are among the least preferred scenic types. Since these are the most common types of new development in the Pinelands, one of the concerns that drove the protection effort is revealed.

The other element of the study which directly involved the public was the nomination process. Maps and nomination forms were distributed widely and individuals were asked to graphically indicate areas which were important for their scenic qualities. Figure 3.3 shows the results of all nominations received through the spring of 1980. Darker tones represent the most frequently mentioned areas. The darkest tones concentrate in the Preservation Area, particularly along the Mullica, Oswego, and Wading Rivers and in the vicinity of the Plains. Elsewhere, the Great Bay and Brigantine area, the upper reaches of the Mullica, and portions of the Rancocas Creek and Great Egg Harbor River watersheds receive the most support.

Figure 3.2—Final Scores and Order of Preference of Visual Types

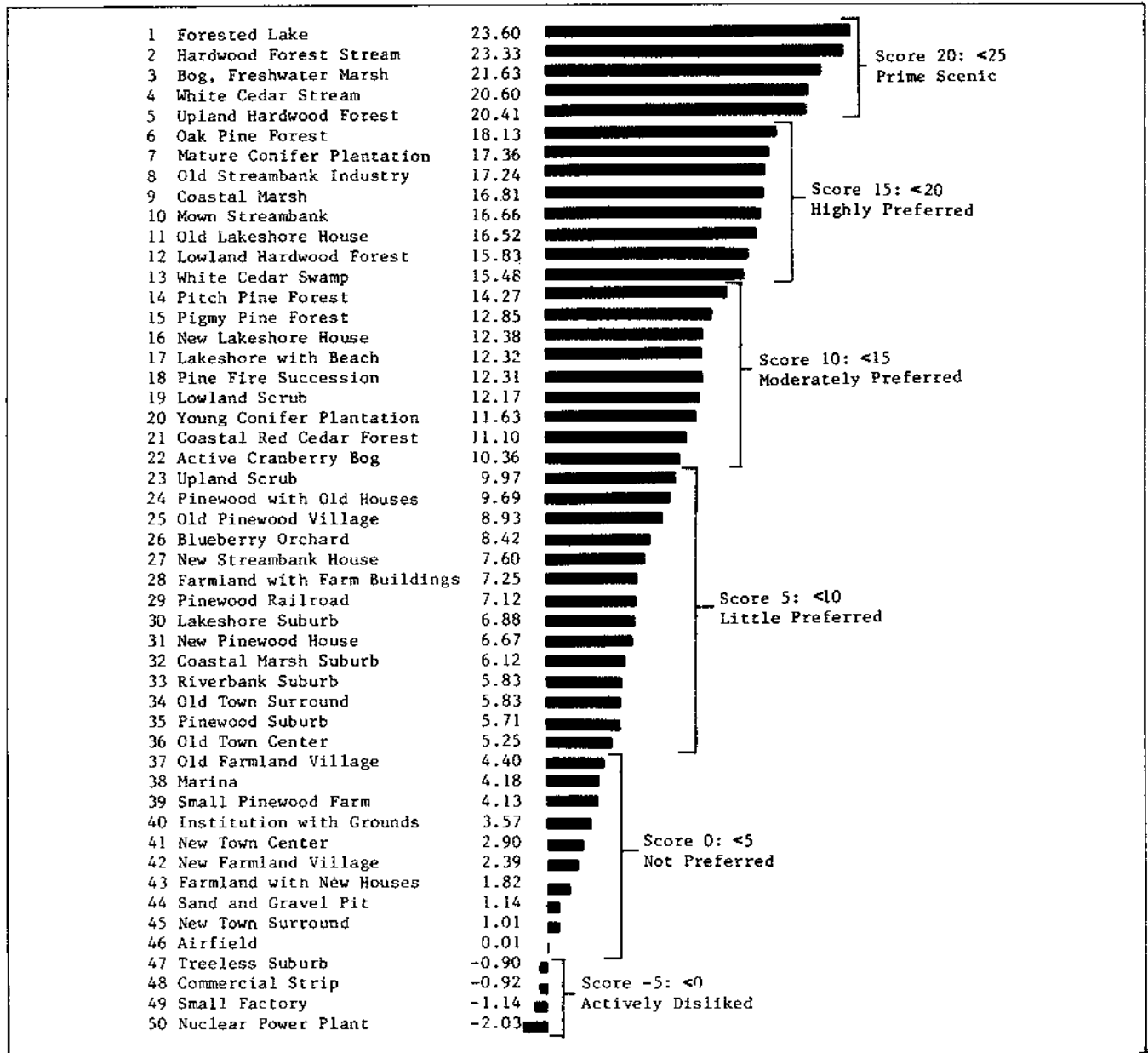
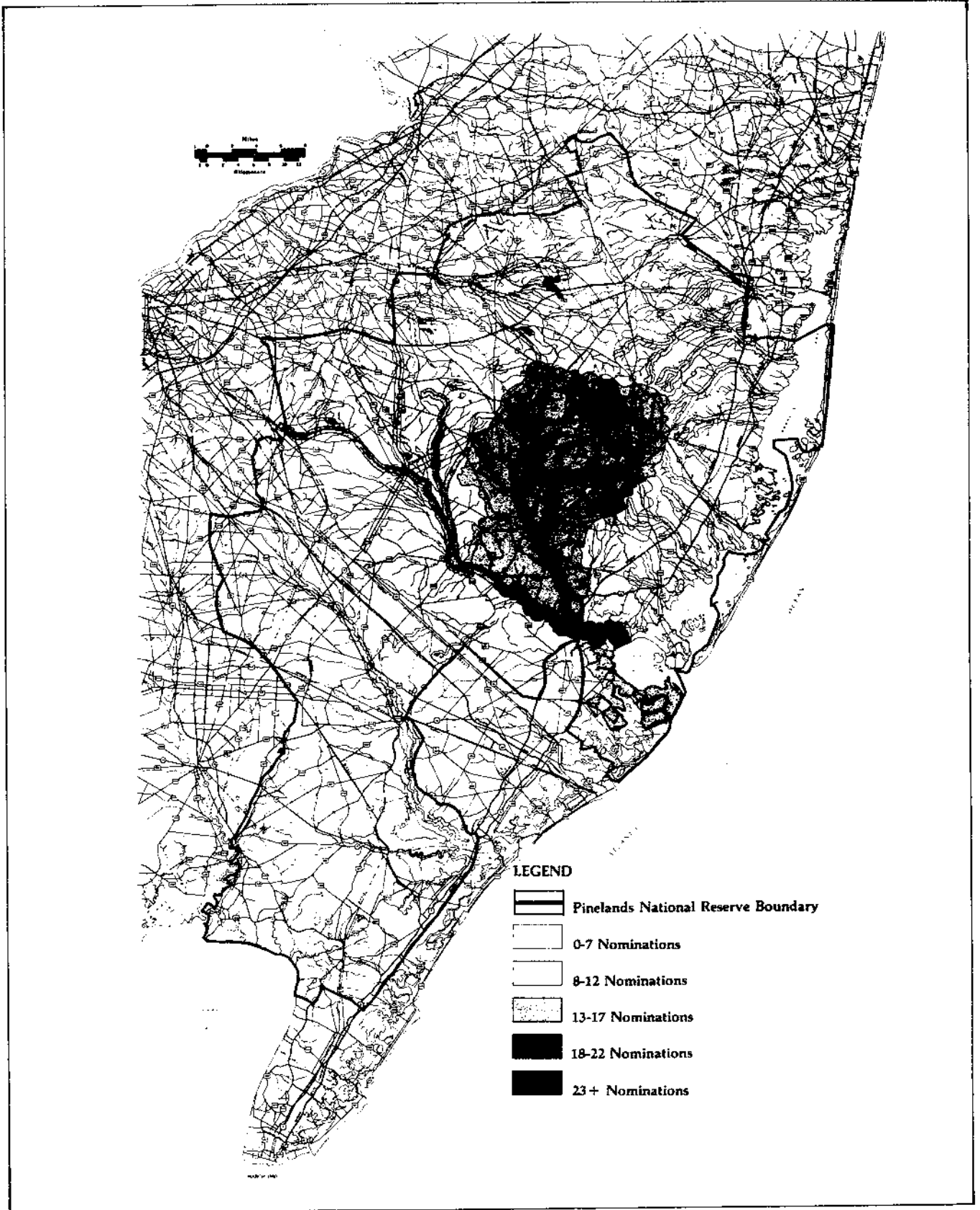


Figure 3.3—Scenic Area Nominations



Indicating preference for visual types is different from nominating scenic areas. Type preference measures liking for a landscape; nomination shows liking for a particular place. Nevertheless, a comparison between the results of the two methods shows them to be mutually supportive. The most preferred visual types, that is, the least disturbed sites with water present, are dominant elements in the nominated areas. The major exception in this comparison is the Plains. This disparity may be attributable to the fact that the Plains photograph poorly and lack noticeable water bodies. However, their uniqueness and the quality of their vistas clearly explain their frequent nomination.

The recurring theme in the scenic study's first phase was the important contribution of water to an area's scenic value. This comes as no great surprise, but helps to explain the individual nominations as well as those natural areas singled out in the state and federal programs. An undisturbed lakeshore, streambank, or bog will consistently contain scenic qualities leading to a pleasant viewing experience. The link between water areas and their associated recreational uses is undoubtedly another factor in this overwhelming support.

Wild and Scenic Rivers

The outstanding qualities associated with the Pinelands' water bodies led to the Legislature's designation of two Pinelands river segments as the first to be considered for inclusion in New Jersey's Wild and Scenic Rivers System. Under this system, rivers and their adjacent lands are to be studied, and the most valuable streams are to be delineated and analyzed for inclusion in the system. The two Pinelands rivers which were designated under the 1976 Wild and Scenic Rivers Act are the Lower Atsion segment of the Mullica River (from Route 206 at Atsion in Burlington County to Route 542 at Pleasant Mills in Atlantic County) and the Cedar Creek (from the headwaters to the Garden State Parkway, including its tributaries). The Department of Environmental Protection has completed the initial assessment of the Mullica River segment, and has proposed to declare it a wild river, to make it the initial component of the state system, and to protect it in accordance with the objectives of that system. A similar study of the Cedar Creek will take place before a recommendation for its inclusion in the state system is made.

In addition to the Pinelands rivers initially designated by the Legislature, many more are seen as potential candidates for inclusion in the State and National Wild and Scenic Rivers System. They include:

- Great Egg Harbor River
- Tuckahoe River
- Middle River
- Other portions of the Mullica River
- Wading River
- Maurice River
- Oswego River
- Batsto River
- Bass River
- Nescochague Creek
- Great Swamp Branch
- Tributaries of the Cedar Creek
- Rancocas Creek (North and South Branch and tributaries)
- West Creek
- Dennis Creek
- North Branch of the Forked River
- Toms River (and Davenport, Ridgeway and North Branches)
- Manumuskin River
- Mechesactauxin Creek
- Oyster Creek
- Westecunk Creek
- Menantico Creek

The Pinelands' scenery exists both as an important feature of the natural environment and as an image in the minds of people who live and visit here. Protection of the scenery will help ensure both that the region's natural qualities are protected, and that people's appreciation of those qualities is enhanced.

Varied Perceptions of the Future

The following attitude descriptions summarize approximately 300 interviews conducted during the winter of 1979-1980 for the Commission as part of its sociocultural factors study.

These varied perceptions of what the future should bring have been grouped into five categories which are referred to as: "Development with Technology", "Development with Sensitivity", "Leave Us Alone", "Resource Harvest and Extraction", and "The National Interest." These are composite descriptions drawn from field observations and analysis of conversations and historical data.

"Development with Technology"

In areas with pressing housing market demand, commercial and construction interests have long favored the maximum development allowed under the regulations. If the regulations have proven ineffective in protecting the people and the environment, then the merchant community and other concerned interests have successfully called on the state to provide a monetary and technological fix for the situation. As long as minimum standards pertaining to health and welfare are met, advocates of this scenario feel that development should be able to proceed into areas deemed accessible by the market. State and federal intervention is important because the same merchant community relies heavily on the quality of the environment to attract seasonal visitors and home buyers. Polluted bays, sewage in the streets, and sand-clogged inlets are not only unsafe but unprofitable. As long as technology can meet the problems and money exists to pay for the remedial work, this scenario represents a viable use pattern for the Pinelands in the minds of many.

"Development with Sensitivity"

Development with sensitivity represents a commonly held interpretation of the federal and state Pinelands legislation. Development should be allowed to take place, but the government should provide strict standards and guidelines for its location, construction, and performance. Science will provide the answers, for in the process of protecting unique, critical, or otherwise special areas from development, the guaranteed cleaner environment will attract both home buyers and more seasonal recreationalists. The state will make major purchases. There will be strict guidelines for the preservation of cultural, archaeological, historical, and aesthetic resources. These measures will protect "the character of the area" and at the same time allow the economy to function at an acceptable level. There may be some compromises between "Development with Technology" and this scenario, and thus not everyone will be satisfied. This scenario involves utilization of the state of the art of environmental planning.

"Leave Us Alone"

Many long-time residents of the Pinelands express this sentiment. They do not want development. They do not want sophisticated planning. They simply want nobody in the Pinelands except their families and their friends. A lot of this feeling stems from a perceived North Jersey-South Jersey split. It also relates to the desire on the part of many to live a rural lifestyle. Many of these people's relatives have moved out of the Pinelands because they believe municipal ordinances are restricting their rural ways. They cannot set up a trailer without paving a driveway, or keep animals as they did before. These people usually do not join in the debates over "growth or no growth," "conservation or preservation." They simply do not like what is going on around them. "Other people have messed up their places; now they covet ours," is the attitude. These people resent the people who build houses without taking care of the streams. Nor do they want to be told not to pick flowers, nor informed how clean the water is or should be. Their solution to the preservation of character problem is: "Keep it empty, keep it open." Like many others, they want clear streams, intact wetlands, and wooded swamps, open vistas from the few but significant hills, unpolluted bays, and views and memories of old buildings, both public and private. They want to use the land. Closely allied to these feelings is the importance of resource harvest and resource extraction, a discussion of which follows.

"Resource Harvest and Extraction"

To significant numbers of users, the Pinelands represent harvestable crops and renewable resources. Many of these people are engaged in the traditional pursuits of bog or blueberry agriculture; forestry, trapping, hunting, and gathering; crop agriculture; sand and gravel mining; and shellfishing. Their idea of use is heavy use, with management programs that allow for the fastest and most sustained regrowth

of the resource (where regrowth is possible). Because of the emphasis on use, and because many of these people do not want increased visitors, increased regulation, or increased urbanization, this scenario has many attributes of "Leave Us Alone." Resource harvesters look for state controls to curtail development and to put speculative land into production, but not to increase tourism, public multiple use, or total preservation areas. This point of view also includes allowance for small amounts of development that do not damage the environment or hinder its uses.

A surprisingly large number of people have a significant stake in this type of future. Their numbers include, but clearly are not limited to, the woods people who rely totally on the continuance of a diverse ecosystem for their livelihood; bog agriculturalists; and scientists and others who subscribe to the ideas associated with resource extraction because these entail an understanding of the interactive nature of Pinelands ecosystems. These people all accept heavy use, and assume that with an understanding of the ecosystem underlying the planning process, yield, income, and environmental quality can all benefit.

"The National Interest"

The interest in preservation of the region has a broad national base. The designation of the Pinelands as the prototype for the National Reserve concept offers both opportunities and challenges. What is going to be the New Jersey style in this first federal, state, and local cooperative effort to implement a management plan for a National Reserve? How will the Pinelands Commission protect and manage an area which has been recognized as being of national significance? What kind of plan can be developed which will meet the "burgeoning demand for the preservation of outstanding landscapes (while providing) a human living environment for an urban population"? (Florio, 1977).

Both within and outside the region, there has been a sufficiently high level of interest to bring about designation of the Pinelands as an area of national significance. These individuals and groups recognize the import of fulfilling the mandate set forth in the state and federal legislation. To them, the Pinelands are an area which must be preserved and protected for present and future generations. Their goal is to see that the stated objectives are fulfilled. The challenge is to carry out the preservation goals by means other than direct government acquisition.

Land Use Conflicts

These five perceptions of the future are drawn from many ideas that were expressed in the course of the interviews. It is apparent from the range of these opinions that they highlight many potential land use conflicts. The following is a list of major land use conflicts within the Pinelands as perceived by residents:

- Public ownership vs. lost municipal tax revenues
- Land-use restrictions (zoning, etc.) vs. private property rights
- State and federal regulatory power vs. home rule
- Extensive vs. intensive land uses
- Preservation of lifestyles indigenous to the Pines vs. wish for technological improvement.
- Preservation of traditional lifestyles vs. suburbanization
- Preservation of open space vs. need for housing of long-time residents
- Preservation of open space for residents vs. preservation of open space for non-residents
- Intensive recreational use vs. light recreational use
- Development of recreational fisheries vs. development of commercial fisheries
- Free and unlimited public access vs. access for wilderness needs and research
- Preservation of historic sites vs. development for recreation
- Preservation of present landscapes vs. needs for resource use and habitat restoration

The development of a Comprehensive Management Plan which would come to grips with these many conflicts has proven to be the Commission's greatest challenge.

CHAPTER FOUR

The Man-Made Environment

This chapter discusses the man-made resources or influences which affect the present landscape and future planning of the Pinelands. These factors indicate the extent and magnitude of human occupation and manipulation of the Pinelands' natural environment, while also providing insight into the region's capacity to accept continued human use and intrusion.

Throughout history, the natural environment of the Pinelands has dictated to a large degree the course and manner of human occupation, and hence the shape of the man-made environment. Indian populations, who used the land from the time of the Wisconsin glacier's retreat 10,000 to 12,000 years ago until their disenfranchisement in the 1700's, were originally thought to have been nomadic, due to the lack of natural resources, and to have occupied the area seasonally. More recent evidence indicates that prehistoric settlement may have been permanent in such resource-rich areas as the mouths of streams and headwaters of tidal activity, the fall line or shatter belt between the Inner and Outer Coastal Plains, marsh hummocks, and pingoes or bogs in the uplands (Regensburg, 1979; Cavallo, 1980). The low population densities and primitive cultures led to an overall level of non-exploitative use and a stable system.

Early European settlers and American colonists located in similar environments to take advantage of natural resources, but their societies encouraged higher levels of utilization and exploitation. Major rivers provided ship-building sites and transportation routes, and smaller streams provided energy sources and resource pools for fauna and minerals. The forest provided a primary energy source to fuel local economies and natural resources to supply them, and interior settlements served as transportation links between inland and coastal industries. The resource base proved tenuous and hazardous, however, and the settlement pattern was largely lost. The twin demons of progress, resource exploitation and economic competition, led to the destruction of the colonial industries and settlements.

Prior to, during, and after the demise of the early Pinelands industries in the middle and late 19th century, however, a relatively stable society did emerge. Rather than depending on industries, the society was based on an intimate knowledge and use of the natural environment, combined with strong familial, ethnic, and religious ties. The society's capability to use the resource base to respond to changing economies provided a measure of flexibility, and the extensive cultural ties provided stability (Sinton and Masino, 1979). These issues are discussed in greater detail in the previous chapter.

The link between earlier human occupation and the present is maintained not only by the historic sites and landscapes seen today, but also by certain cultural groups which have continued to exist in the Pinelands. Frequently characterized as "Pineys" and "Baymen," the groups share similar relationships with the natural environment. Their activities follow a seasonal cycle of hunting, fishing, trapping, collecting, forestry, and wage labor, and their settlement patterns and practices reflect this extensive use of the land. These cultures can exist because their resource usage is consistent with the capability of the land, and because the Pinelands are still largely undeveloped.

The features of the man-made Pinelands environment discussed in the remainder of this chapter represent a considerably different approach to use of the natural environment, an approach more typical of present-day society, involving greater manipulation of natural resources to suit man's needs. To sustain increased human use, man requires transportation links to activity centers, improved water and food supplies, and sewerage and solid waste facilities to protect the public health and welfare. Federal, state, and local facilities provide employment, and at the same time supply recreational opportunities and land for various uses. Resource production areas such as agricultural lands, mineral extraction areas, wetlands, and forest lands allow residents to earn their livings while contributing to the unique look of the different Pinelands regions.

To provide a quantitative framework for the discussion of the man-made environment, Table 4.1 relates the various boundary designations to areas within individual counties. The Pinelands National Reserve is generally the most encompassing boundary. It includes all of the Preservation Area and the greater part of the Protection Area, as defined in the state Pinelands Protection Act, with the exception of land in three municipalities which is within the Protection Area but not the Reserve. These three are Jackson Township (Ocean County), with 7,670 acres in the Protection Area not contained in the Reserve; Egg Harbor Township (Atlantic County), with 13,050 acres in the Protection Area but not in the Reserve; and the city of Vineland (Cumberland County), with 3,140 acres in the Protection Area but not in the Reserve. The acreage in the Preservation Area (368,750 acres) is included in the totals for both the Pinelands Area and National Reserve. Jurisdictional boundaries established by the federal and state Pinelands legislation are depicted in Plate 1.

Table 4.1—Acreage Totals for Various Jurisdictions, By County (In thousands of acres)

	Pinelands National Reserve	Pinelands Area	Preservation Area
Atlantic	243.6	246.4	21.3
Burlington	346.6	336.7	232.4
Camden	54.6	54.6	14.4
Cape May	85.6	34.2	0
Cumberland	55.7	45.6	0
Gloucester	33.2	33.2	0
Ocean	263.5	183.0	100.7
	<u>1,082.8</u>	<u>933.7</u>	<u>368.8</u>

LAND USES

Land use patterns reflect the interaction between the capabilities of the natural environment and the organization of human endeavors. As human populations occupy an area, they change the land to suit their cultural goals and requirements. Successive occupations by different groups produce a different look to the land, and in many cases the natural environment is changed forever by its past use. The Pinelands represent an area that, although extensively used, modified, and affected by man, resisted intensive and long-term human occupation until relatively recent times. The following section summarizes human use of the Pinelands. Many of the specific activities referred to are discussed in detail elsewhere in the document.

Historical Land Use

As alluded to in the introduction of this chapter, it is now believed that Indians of the Woodland period (1,000 B.C. to 1,650 A.D.) occupied the area on a permanent or semi-permanent basis (Regensburg, 1979). Evidence also suggests that occupation during the Paleo-Indian and Archaic times (10,000 to 6,000 B.C.) was probable (Cavallo, 1980). In the earlier period, favorable sites included coastal bays and estuaries, river mouths, and the fall line. The later period adds inland bog areas, which were lakes or ponds under the different environmental conditions

prevailing then. Because prehistoric research has not been undertaken on a systematic basis in the Pinelands, the extent and impact of the Indian occupation cannot be quantified, although the vast and relatively undisturbed nature of the Pinelands indicates a fruitful site for prehistoric archaeological investigation.

Written evidence places the earliest European explorations in 1624, with land grants for parts of the Pinelands dating to 1674 (Wacker, 1979). The land was classified early on as barren and sandy, covered by extensive pine forests. Some coastal regions were settled by 1695, predominantly fishing villages, and lumber harvesting of cedar was recorded in 1704. Prior to the mid-eighteenth century, however, the Pinelands were generally avoided as places of permanent European settlement. A map produced by Wacker (1975) is striking in its display of the Pinelands as almost entirely unsettled by European groups in 1765.

Even though the region was unsettled, accounts of the overexploitation of owned and unowned forests, particularly white cedar, date to the early eighteenth century. The pressure on the forest came primarily from the urban areas of colonial America. At the same time the iron industry brought settlements to the interior of the region, and further increased the demand on the forests. Although dotted by then with various industries related to the forest and coast, the Pinelands remained largely uninhabited. Using census data Wacker (1975) shows in map form that in 1784 the population density throughout the region was 0 to 9 persons per square mile, resulting in a maximum population of 15,000 people.

The demand for wood as lumber and as fuel for forges increased throughout the late eighteenth century. The impact of these practices cannot be underestimated. One estimate indicates that a medium-sized iron furnace required 12,000 acres of forest to be cut annually for charcoal, so that ten furnaces operating simultaneously could consume 120,000 acres per year (Sinton and Masino, 1979). Given a regrowth period of 15 years, a total of 1.8 million acres (40 percent of New Jersey) would have been needed to support the iron industry. It is highly improbable that such quantities could have been found within an economic hauling distance of the furnaces, and that was apparently part of the reason for the decline of the iron industry (although constant cutting is considered a management practice to favor the succession of pine). Historical accounts from the late eighteenth and early nineteenth century indicate many areas were already lumbered out and abandoned until regrowth occurred. A further demonstration of the extensive need for woodland is given by Wacker (1979), who notes that by the 1830's, the furnaces at Atsion, Batsto, and Weymouth had each grown to include from 50,000 to 85,000 acres. Secondary impacts of the iron industry included population growth, expansion of agricultural activities, and improvements of the transportation network by both land and sea.

Other historical land uses in the Pinelands included industries such as glass-making, attracted by sand, wood, and water power, and paper-making. Most industrial land uses flourished briefly and often experienced a progression of activities, such as sawmills, ironworks, and paper factories at one site, before declining in the face of competition from elsewhere (Pierce, 1957).

Agriculture came to the fringe areas of the Pinelands, most notably in Cape May and Cumberland Counties, early in the eighteenth century, and extensive agriculture in the form of grazing was noted in Atlantic County in the late eighteenth century. Traditional field agriculture occurred on a subsistence and part-time basis in the central Pinelands, generally on small plots of 2.5 to 5.0 acres (Sinton, 1976). With the widespread use in the early nineteenth century of greensand marl, which occurs extensively in the Inner Coastal Plain, agriculture expanded into a commercial enterprise in many parts of the region. Throughout the nineteenth century, efforts to promote agriculture, combined with more available rail service, resulted in larger areas coming under cultivation and the establishment of agricultural settlements. Most notable among these are the areas south of the Mullica River, including Egg Harbor City and Folsom, settled by Germans; Hammonton, settled first by New England Yankees and later by Italian immigrants; and Vineland, which followed a pattern similar to Hammonton's (Marsh, 1979).

No account of historical land use is complete without mention of the impact of fire. The Pinelands' distinctive landscape—along with California chaparral, one of the most hazardous fire

areas in the United States—is largely a product of its repeated burning. Fire provided benefits of local land users by favoring certain local industries and agricultural practices. Because the region was largely unsettled and titles unsure, there was little reason to contain the spread of fire. Given the flammable nature of the Pinelands vegetation, and the dependence on fire of forges, furnaces, and charcoal making, there is little wonder as to the cause of the many fires. The coming of the railroad exacerbated the problem. As Wacker (1979) notes, “The amount of widespread burning through time in a 1,000,000-acre region is astounding.” The loss of 100,000 acres per year to fire was not uncommon in the nineteenth century. The magnitude of this threat in the face of modern fire-fighting technology can be gauged by referring to McPhee’s account (1967) of the 125,000 acres burned in 1963, or to the records of the New Jersey Bureau of Forest Fire Management.

Current Land Use

When an area is settled and a community established, the developed resources of the area attract others to settle. The agricultural and seaward communities in the Pinelands experienced this phenomenon as immigrants entered the southern Pinelands and expanded those operations. The northern Pinelands experienced a loss of forest use as the iron industry left the area, but field agriculture in northwest Burlington County and the increase of cranberry cultivation maintained agronomic activities. Areas in the south experienced the development of idealized industrial communities, some of which remained viable until the 1940’s. The growth of the resort town of Atlantic City in the late nineteenth century spurred additional activities along the coast and in Atlantic County. Sand and gravel mining increased as more industrial uses were found for the material.

The current land use pattern became more distinct after World War II throughout the country. Population grew as returning soldiers established families. Roadways were improved, industries expanded, and society became more dependent on the family car. These trends had mixed effects on the Pinelands. Because of the region’s relative remoteness from the main urban corridor and the small population base, it was overlooked for industrial development. In turn, small local industries and industrial villages found it difficult to compete with more favorable locations. Agriculture expanded on the western borders of the Pinelands, but the industry was threatened by increased demand for residential development. The coastal communities experienced new pressure for vacation and year-round housing as improved roadways increased accessibility.

The Pinelands region had a population of approximately 110,000 in 1950 distributed over the 1,700 square mile area, or 65 people per square mile, for a housing density of 1 dwelling unit per 35 or 40 acres. About 60 percent of the population lived in the Atlantic and Burlington County portions of the region. Population densities in 1950 ranged by county from a low of 30 persons per square mile in Cumberland County to a high of 120 in Camden County. The forests remained largely unsettled, with the population concentrated in agricultural areas and along the coast, or where there was road access from the Pinelands to neighboring, more urbanized regions.

By 1970, the population in the region had more than doubled, with about half the residents located in the Philadelphia/New Jersey Standard Metropolitan Statistical Area, the same proportion as in 1950 (Mallach, 1980). Burlington and Ocean Counties accounted for about 65 percent of the population growth. Ocean County more than tripled its population. The opening of the Garden State Parkway in 1955 and the beginning of retirement home development accounted for much of the impact on Ocean County, while population increases in Burlington, Camden and Gloucester Counties resulted from suburbanization pressures along major roadways from the Philadelphia SMSA. In the latter counties development pressures were felt most strongly on the existing agricultural lands, which became prime building sites. With the purchase of the 100,000-acre Wharton Tract in 1955, the State of New Jersey became the major landholder in the Pinelands. The federal military facilities in the northern part of the region dominated land use in that area by virtue of primary and secondary impacts. The current population of the Pinelands National Reserve is approximately 323,000. Regional growth trends are discussed in more detail in Chapter Five of this document.

The dominant land cover in the Pinelands today is forest, in its many upland and lowland types, which gradually blends into forested and unforested wetlands and lowlands. These areas support a diversity of land uses related to primary resource extraction. Agricultural lands occupy the western border of the region near the Inner and Outer Coastal Plain boundary, the northern and western Atlantic County area, and the Burlington County cranberry region. Developed lands occur on the western, northern and southwestern edges, along peripheral highway corridors, and in established, historical communities in the central areas.

Table 4.2 presents an overview of the distribution of these land uses by political jurisdiction. There are three land use categories, which include the following aggregations: forest and wetland includes both upland and lowland forests and forested and unforested wetlands; agricultural land includes field crop areas, vegetable and fruit areas, and cranberry bogs with watershed lands excluded; and developed land includes the categories of residential, commercial, and industrial development, highways and rights-of-way, and local public uses. Table 4.2 gives ample evidence of the vast amount of vacant land occurring throughout the region. Plate 16, which was developed using large-scale aerial photographs, shows the distribution of 13 categories of land use, with the major categories including the following types:

- Agricultural land—Row, vegetable, and field crops; pasture and meadows
- Developed land—Low density residential (less than one unit per acre); medium to high density residential (more than one unit per acre); commercial and industrial; other urban uses (military, schools, cemeteries, parks, golf courses, etc.)
- Non-forest—Sand, gravel, and other mining; waste disposal; other non-forest
- Bog—Cranberry bog, other bog
- Forest—Pine/oak, oak/pine, and non-Pinelands forest
- Marsh—Hardwood swamp, cedar swamp, pitch pine lowlands, inland marsh, coastal marsh
- Water

Table 4.2—Estimated Land Uses in the Pinelands
(in thousands of acres)

(Pinelands National Reserve total acres = 1,082,816)

County	Land Area in National Reserve	Forest and Wetland	Agricultural Land	Developed Land
Atlantic	243.6	201.7	16.5	25.4
Burlington	346.6	295.6	24.8	26.2
Camden	54.6	39.5	6.5	8.6
Cape May	85.6	78.7	2.3	4.6
Cumberland	55.7	52.4	1.0	2.3
Gloucester	33.2	23.5	5.9	3.8
Ocean	263.5	235.3	1.0	27.2

The following sections discuss each of the major categories in Table 4.2 in greater detail, by land use, type and subregion.

Forest and Wetland

The category includes pine-oak, oak-pine, and hardwood forest types and the wetland types of pitch pine lowlands, cedar swamps, hardwood swamps, and inland coastal marshes. Camden and Gloucester Counties have the smallest percentage in this category, but in no county is it less than 75 percent of the area. In the principal Pinelands counties of Atlantic, Burlington, and Ocean, which account for 80 percent of the region's total land area, this category accounts for about 83 percent of the land. McCormick and Jones (1973), and the information from Plate 16, indicate that about 15 to 20 percent of the area falls into the inland wetland classes, and the coastal marshes include tens of thousands of acres.

The forest and wetland category supports a wide variety of land uses. Timber and mineral extraction, hunting and gathering, and all types of recreational activities occur in the forest land classification. The forests are an area of extreme fire hazard, and this factor combines with their general inaccessibility to limit the opportunity for intensive development. The inland wetlands support fishing, trapping, hunting, gathering, and recreational activities. The occurrence of high water tables and the threat to water quality limit development opportunities. Coastal wetlands provide many of the same opportunities as the inland areas, with the addition of shell and salt water fishing. Prior to recognition through the state Wetlands Act of the extreme importance of these areas in the functioning of natural systems, coastal wetlands were often drained and filled for lagoon developments.

Another major user in this category is the public, in the form of lands held by state and federal land management agencies. Table 4.3 shows the amount of land held in parks, forests, and wildlife areas by county and by level of public ownership. This table excludes the 48,000 acres of federal land in military and aviation facilities, although much of this is a forest type.

Table 4.3—State and Federal Parks, Forests, and Wildlife Areas
(in acres)

County	State	Federal
Atlantic	22,740	19,885
Burlington	105,714	119
Camden	16,003	—
Cape May	24,571	—
Cumberland	14,805	—
Gloucester	2,027	—
Ocean	51,810	7,577
Totals	237,670	27,581

Agricultural Land

Agricultural lands in the Pinelands (see Table 4.2 and Plate 16) are concentrated in three general areas: the field crop and fruit and vegetable regions in western Burlington, Camden, and Gloucester Counties; the vegetable and fruit areas of western and central Atlantic County; and the cranberry region, predominantly in Burlington County. Agricultural land uses in the western region are threatened by development pressure from the Philadelphia SMSA, and have been the site of several experiments in farmland preservation. The Atlantic County area is a relatively stable agricultural region, with a history of agricultural activities dating back 100 years, but development pressure is expected to increase. The 3,000 acres of cultivated cranberries, about 75 percent of which are in Burlington County, are a high-value use and extremely important to the culture, landscape, and environmental quality of the central Pinelands. In addition, cranberry growers commonly maintain seven to ten times the cultivated acreage for watershed protection. Blueberry cultivation, which occupies about 7,800 acres of high water table soils in Atlantic and Burlington Counties, is an agricultural use of high value which is compatible with the Pinelands environment.

Developed Land

Developed land, as categorized in Table 4.2, is almost exclusively devoted to residential uses and the attendant roadways and municipal services. Nowhere in the Pinelands does commercial and industrial land account for more than 20 percent of the total developed land, and in most areas it is 1 to 2 percent of total land. There are only 16 major industrial employers of more than 100 workers in the region, compared to nearly 4,000 in New Jersey or 29 in Cherry Hill Township alone. Only three municipalities, Galloway Township (Atlantic County) and Winslow and Waterford Townships (Camden County), have more than one such employer. Military facilities

dominate employment in the northern Pinelands, but it is a stabilized or declining activity. There are no major retail centers in the Pinelands. Only two shopping centers, in Evesham (Burlington County) and Hammonton (Atlantic County), serve a population equivalent of more than 20,000; the region is primarily served by adjacent retail areas. What commercial development does exist is primarily small businesses, services, and retail trades along roadways. Industrial development is confined to highly localized or specialized activities.

Residential development, which together with attendant services occupies 90 percent of the developed land listed in Table 4.2, varies greatly in its distribution and diversity. Population density averages about 200 people per square mile across the entire region, with county averages ranging between 50 and 300, or approximately one dwelling unit per 40 acres to one dwelling unit per seven acres. Housing densities in some central Pinelands communities average less than one dwelling unit per 100 acres, while in developed areas like suburban communities, housing densities of three to four units per acre are common. The latter densities are only feasible in areas which have sewerage for the disposal of wastewater. Table 4.4 illustrates the population density variation in certain Pinelands communities entirely within the regional boundary.

Table 4.4—Population Densities in Pinelands Communities

County	Municipality	Population Density (people per sq. mile)
Atlantic	Estell Manor*	17
	Hamilton	83
	Hammonton	289
Burlington	Bass River*	16
	Woodland*	34
	Pemberton*	490
	Medford Lakes	5,471
Cape May	Dennis*	70
	Woodbine	358
Cumberland	Maurice River*	68
Ocean	Eagleswood	62
	Little Egg Harbor	148
	Manchester*	354
	Lakehurst	4,058

*Publicly owned land excluded from the calculations

Retirement communities are a special, relatively high-density residential use. The Pinelands' remoteness and large amount of fairly inexpensive available land are especially attractive for these developments, since they are not tied to conventional growth stimulators such as jobs or markets. Within the Ocean County portion of the Pinelands there are about 16,500 retirement units, with many thousands more in some stage of planning or approval. These are predominantly self-contained villages, although the full range of shopping facilities are not provided locally, and hospital services are in high demand. In the search for cheap, available land, many developers have located in the most hazardous forest fire areas in the region. Most retirement communities are served by sewers, permitting the higher gross densities of three to four dwelling units per acre.

Residential development elsewhere in the region is basically of two types: housing densities of greater than one unit per acre in existing sewerred areas and agricultural villages, such as Hammonton, Egg Harbor City, Evesham, Waterford, Medford, Hamilton, and Williamstown; and building lots or small subdivisions of one to three acres per unit scattered along roadways and on the developing fringes of the region. Multi-family housing is virtually non-existent, as are buildings of greater than three stories. Total land consumption per dwelling unit averages about one acre across the region.

Airola (1979) analyzed 12 zoning ordinances of Pinelands communities in four counties. The 12 townships occupy 400,000 acres and have a total population of about 85,000. If built up to the zoning code, these townships would produce over 400,000 dwelling units and more than one million people. About 65,000 acres are zoned for housing densities of greater than three dwelling units per acre on sewerage systems, even though much of the area is unsewered, and an additional 85,000 acres are zoned for housing on 0.5 to 1.0 acre lots with on-site disposal of wastewater. The latter category would seriously degrade the high quality water in the Pinelands and would threaten potable water supplies.

AGRICULTURE

The descriptive name "Pine Barrens" is said to have originated with some long-forgotten colonist who attempted to farm the soils of the region and found them "barren" of fertility. Although a majority of the soils in the core area of the Pinelands will not support field crops, orchards, or vegetable-type agriculture, the area has a monopoly on the blueberry and cranberry agriculture of New Jersey. Other areas in and along the western fringe of the Pinelands contain soils better suited for field and vegetable crops. The distribution of agricultural soils in the Pinelands is shown in Plate 6. In all, the Pinelands provided 24 percent of New Jersey's 1978 agricultural income.

In 1978, the Pinelands Area encompassed 26,800 acres of field crops, 3,300 acres of ornamentals, 15,500 acres of berries and fruit, and 12,160 acres of vegetables. These 57,823 acres were 9.4 percent of the 611,620 acres of land utilized in 1978 by New Jersey agriculture, and they produced \$61.0 million worth of crops.

During the same year, the Pinelands supported 2.5 million head of livestock and poultry valued at \$5.7 million. Table 4.5 summarizes the acreage and income levels for the major agricultural activities of the Pinelands area. Dashes indicate data which is either not available or not applicable.

Cranberries and Blueberries

Berry agriculture can be considered part of the overall culture and character of the Pinelands. These native plants thrive on the soil conditions which forestall the development of traditional field crops and vegetables: sandy soils which are moistened by high water tables, which have low fertility, and which are strongly acid. Berry cultivation is restricted to Atsion, Berryland, St. Johns and Muck soils. The latter three are identified as Unique Soils by the U.S. Department of Agriculture, Soil Conservation Service.

Cranberry cultivation was first recorded in the vicinity of Pemberton about 1825. Early growers improved the wild meadows and savannahs by removing the competitive plants and controlling water levels rather than by preparing and planting sites. As knowledge and cultivation techniques improved, cranberry production expanded. By 1910 it had become the principal industry of the Pinelands. Cultivation peaked at about 13,000 acres in 1921. The late 1920's however, saw an infestation of false blossom disease and the cranberry girdler. This misfortune was compounded by the economic depression of the 1930's, and cranberry acreage decreased to 2,500 acres in 1958.

Today, cranberry agriculture is located in regions which are climatically suited, have large supplies of clean, unpolluted water, and have expansive, low-lying level sites with acid soils. The New Jersey cranberry acreage is found in the North Branch Rancocas Creek sub-basin and the Wading River, Batsto River, and Atsion-Sleeper Branch sub-basins of the Mullica River Basin. With 3,000 acres, New Jersey has 13 percent of the nation's cranberry acreage, and in 1978 it produced 9 percent of the national harvest, third behind Massachusetts and Wisconsin. The 1978 crop had a market value of \$4.8 million.

Table 4.5—Pinelands Agriculture

CROP	Pinelands Area		Seven Counties		New Jersey	
	Acres (100)	Income (1,000 \$)	Acres (100)	Income (1,000 \$)	Acres (100)	Income (1,000 \$)
TOTAL	578.2	61,041.82	—	—	6,116.2*	359,590
Field Crops	268.2	3,859.61	1,369	—	5,290	102,720
Corn & grain	55.3	764.18	236	5,084.8	950	19,884
Hay	58.2	478.35	210	5,190.0	1,119	23,250
Soybeans	123.4	2,484.95	715	14,527.5	2,060	42,333
Others	31.3	132.13	208	—	1,090	17,253
Ornamentals	32.9	9,863.31	—	—	—	—
Nursery	—	—	37	—	111	—
Sod	17.9	3,131.09	—	—	—	—
Trees & shrubs	9.9	2,413.98	—	—	—	—
Others	5.0	4,318.24	—	—	—	—
Fruits & Berries	152.2	27,350.60	—	—	257	48,779
Apples	14.5	2,645.25	33	6,022.9	56	10,170
Blueberry	77.0	13,897.49	78	14,074.0	78	14,074
Cranberries	28.8	4,643.45	30	4,839.0	30	4,839
Peaches	27.7	5,523.79	73	14,561.2	83	16,520
Strawberries & grapes	4.2	640.62	7	1,270.5	10	1,768
Vegetables	121.6	13,477.03	—	—	711	78,762
Asparagus	1.8	172.49	11	1,103.6	19	1,789
Corn (sweet)	29.9	1,785.63	66	3,946.8	100	5,978
Peppers	8.4	914.17	39	4,128.1	60	5,709
Potatoes (white)	8.9	886.10	26	2,519.4	82	8,155
Potatoes (sweet)	17.1	2,749.47	24	3,825.2	26	4,176
Tomatoes	12.4	1,479.70	77	8,717.9	138	16,384
Others	43.0	5,489.47	—	—	286	36,562
Livestock (head)	—	—	—	—	—	—
Cattle (dairy)	13.2	1,796.07	79	10,721.3	470	60,998
Chicken (layers)	2,251.7	2,425.97	—	6,604.2	17,160	18,488
Swine	71.3	701.16	630	5,982.4	760	6,592
Turkeys	308.8	389.15	—	—	580	762

*Total agricultural land in New Jersey is 1,058,600 acres.

Blueberry cultivation is more widespread. It covers 7,800 acres in the North Branch Rancocas drainage basin, in the Hammonton Creek sub-basin and near Chatsworth in the Wading River sub-basin of the Mullica River drainage basin, and near Mays Landing in the Great Egg Harbor River basin. The 1978 blueberry crop was valued at \$15.5 million.

Berry crops are dependent on high-quality acidic water. In addition, cranberries require large volumes of high-quality water for frost protection and harvest. The importance of water has led growers to protect the quality and quantity of their water sources by purchase. Typically, ten acres of watershed protection land are owned for each one acre of producing bog.

Environmentally, berry agriculture is more compatible with the character of the Pinelands than more conventional agricultural activities. These native plants depend on the maintenance and preservation of the surrounding area in a relatively undisturbed manner. Reliance on strongly acid soil conditions (pH between 4.0 and 5.0) minimizes the need for liming of the bogs and fields. Also, due to the plants' low fertility requirements, excessive fertilizer is not applied.

Production studies show that increased levels of nutrients, specifically nitrogen, result in more prolific plant growth and reduced berry production. Recommended nitrogen fertilizer

application rates are 40 to 80 pounds per acre for blueberries and 20 to 30 pounds per acre for cranberries.

Fruit Production

Apple and peach production is located in the "upland" areas of the Pinelands. Fruit production favors soils with deeper water tables such as Aura, Downer, Hammonton, Nixonton, Sassafras and Woodstown soils. These are all classified as Prime Agricultural Soils by the USDA, Soil Conservation Service.

The tree fruit industry of the Pinelands was valued at \$8.1 million in 1978. It is located primarily in Gloucester and Atlantic Counties, along the Route 30 corridor between Berlin, Hammonton and Egg Harbor City. It is also located along the western Pinelands boundary from Williamstown to an area east of Vineland. Together, apples and peaches utilize 4,200 acres of Pinelands soils.

In contrast to berry production, tree fruit production requires a slightly acid soil (pH between 6.0 and 6.5). Since the normal range of soil pH is 3.6 to 5.5, a substantial quantity of lime is necessary to initially "sweeten" the soil. Thereafter, the liming rate is reduced to just maintain a favorable pH level. To raise the pH of a Pinelands loamy sand to 6.0 would require 2,000 to 5,000 pounds of limestone per acre. A sandy loam soil would require 3,000 to 6,000 pounds per acre to produce the same shift in pH.

Nitrogen fertilizer requirements for fruit production are 0.5 to 1.5 pounds per tree per year for apples and 0.5 to 1.0 pound per tree per year for peaches. Assuming an average of 140 trees per acre, the nitrogen fertilizer requirement for apple and peach orchards ranges from 70 to 210 pounds per acre per year.

Vegetable Crops

The same soils that support fruit production will also support vegetable agriculture, primarily in Cumberland and Gloucester Counties around Vineland and in Atlantic and Camden Counties along the Route 30 corridor. The 12,100 acres of vegetables in the Pinelands in 1978 brought in \$13.5 million in cash receipts. These numbers represent 17.1 percent of both the state acreage and income values.

The major vegetables produced on Pinelands soils are shown in Table 4.6 along with preferred pH range and recommended levels of lime and fertilizer.

Table 4.6—Production Recommendations for Pinelands Vegetable Crops

Crop	Recommended pH	Lime (tons/acre)		Nitrogen Fertilizer pounds/acre/yr
		Loamy Sand	Sandy Loam	
Asparagus	6.0—6.5	1.0—2.5	1.5—3.0	50— 75
Snap beans	6.0—6.5	1.0—2.5	1.5—3.0	40— 80
Cabbage	6.0—6.5	1.0—2.5	1.5—3.0	100—150
Sweet corn	6.0—6.5	1.0—2.5	1.5—3.0	125—150
Cucumbers	6.0—6.5	1.0—2.5	1.5—3.0	100—125
Lettuce	6.0—6.5	1.0—2.5	1.5—3.0	80—125
Onions	6.0—6.5	1.0—2.5	1.5—3.0	75—100
Peppers	6.0—6.5	1.0—2.5	1.5—3.0	100—130
Sweet potatoes	4.8—5.5	0.5—1.0	1.0—2.0	50— 75
White potatoes	4.8—5.5	0.5—1.0	1.0—2.0	125—150
Spinach	6.0—6.5	1.0—2.5	1.5—3.0	100—125
Squash	6.0—6.5	1.0—2.5	1.5—3.0	75—100
Tomatoes	6.0—6.5	1.0—2.5	1.5—3.0	80—130

Source: Adapted from Bulletin 406-G, Cooperative Extension Service, Cook College, Rutgers University, 1980

Field Crops

Field crops include grain and hay. They also include soy beans, which account for 46 percent of the Pinelands field crop acreage and 64 percent of their \$3.8 million value. Field crop production is located primarily on the upland soils in Burlington County in the vicinity of Columbus, New Egypt, Mount Holly, and Pemberton. As with other upland crops, field crops do best in "sweeter" soil (pH between 6.3 and 6.5). Therefore, one to three tons of limestone per acre are needed to raise the pH to suitable level.

Field crop fertilizer requirements range from 20 to 120 pounds of nitrogen per acre. Soy beans and leguminous hay (alfalfa or trefoil) are at the low end of this range, while corn is at the high end and the others fall in between.

Ornamentals

This category includes flowers, sod, nurseries, Christmas trees, and greenhouses. It was valued at \$9.8 million in 1978, which is 16 percent of the economic activity of Pinelands agriculture. As with the other types of non-berry cultivation, ornamentals require a slightly acid to neutral soil and the addition of fertilizer. This activity in southern New Jersey is located primarily in Cumberland and Gloucester Counties.

Agricultural Water Quality

Pinelands agriculture is dominated by berry, tree fruit, and vegetable production, which are considered high risk and capital intensive enterprises. Farmers' economic survival in the most densely populated state relies on proximity to markets and a high rate of return on investment, which is used to offset the cost of land and taxes. In 1977, the value of New Jersey farmland per acre was the highest in the country and taxes per acre were third highest.

Costs of the production of selected vegetables in South Jersey have been estimated by Dhillon (1979):

Crop	Cost/Acre (1979)	Return/Acre Average (1974 - 1978)
Cucumbers (fresh)	\$2,099	\$3,234
Snap beans	\$ 659	\$ 806
Lettuce (iceberg)	\$1,734 - \$2,144	\$2,310
Onions	\$1,144	\$1,876
Peppers	\$2,333	\$2,405
Tomatoes (fresh)	\$3,038	\$3,907
Squash (spring crop)	\$1,934	\$2,542

The profit margin for fresh vegetables, as seen above, can be substantial. Economically viable agriculture, however, requires intensive management of growing conditions by use of lime, fertilizer, and pesticides. In turn, agricultural activity appears to influence change in water chemistry.

A study of the Mullica River Basin (Durand and Zimmer, 1979) has shown the following water quality patterns:

Parameter	Land Use		
	Undeveloped	Agricultural	Residential-Agricultural†
pH	4.0—4.9	5.0—6.9	5.0—6.9
Total Phosphorous*	0.19—1.02 (0.006—0.03 ppm)	0.83—1.33 (0.026—0.042 ppm)	0.63—11.89, 46.4 (0.02—0.37, 1.45 ppm)
Nitrate*	3.7—24.6 (0.53—0.351 ppm)	28.9—72.2 (0.413—1.03 ppm)	27.8—76.6, 92.9 (0.397—1.09, 1.33 ppm)
Total Organic Nitrogen*	11.0—32.9 (0.157—0.47 ppm)	24.7—38.2 (0.353—0.546 ppm)	38.4—51.1, 179.4 (0.548—0.73, 2.56 ppm)

*In microgram atoms per liter

†Third values are means for sewage treatment plant discharge

Except for pH, the above table shows the range of mean values for different streams characteristic of each land use. There are six streams in the undeveloped category and four in the agricultural (vegetable and fruit). Four streams are represented in the residential-agricultural group. The third value shown in this category is the mean for a sewage treatment plant discharge.

Although surface waters in the agricultural areas are affected, their assimilative capacity downstream appears to keep the impact localized. This assimilative capacity, however, has not been quantified. It may exist only because of the small area of agricultural and residential land use relative to the expanse of undeveloped land in the basin. The impacts associated with residential land use are more significant because they are continuous, whereas agricultural impacts are seasonal. They occur during the non-growing season, corresponding to the period of low biological productivity in Pinelands streams.

Overall, agricultural activity is part of the character of the Pinelands. It contributes significantly to the economic base of the region, and certain types, such as cranberry production, contribute to the maintenance of the ecosystem. The current level of agricultural activity is relatively low but intense. Continued economic productivity of fruits, vegetables and berries as well as field crops and ornamentals requires intensive management and has localized impacts on water quality. These impacts, however, could be minimized by following a program of Recommended Management Practices, including fertilizer and pesticide application recommendations of the New Jersey Agricultural Experiment Station.

SEWERAGE SYSTEMS AND WASTEWATER DISPOSAL

Other than on-site disposal techniques, which are discussed elsewhere, sewerage systems are the only method for collecting, cleansing and disposing of home and business liquid wastes. Originally developed as a public health measure for dense urban settlements, the use of sewerage systems expanded as the potential hazards from untreated wastewater became more evident. Historically, sewerage systems were provided in localized areas, generally when housing densities reached one to two dwelling units per acre. More recently, the trend has been to large regional systems to increase operating efficiency. The latter type of system has been shown to have major secondary impacts on growth patterns and local costs. Current thinking is to reach an accommodation between the two extremes.

Much of the current impetus behind sewerage construction came from the Federal Water Pollution Control Act Amendments of 1972 which, among other wide-ranging impacts, established the Construction Grants Program under Section 201. Federal funding for 75 percent of capital costs, now 85 percent for innovative systems under recent amendments, is provided to local sewer authorities for construction of sewerage systems. The systems generally consist of the following components: the wastewater, called sewage before treatment; the collection system, including lateral, collector, and interceptor pipes, and pumping stations; the treatment plant, to which sewage is directed for physical, biological, or chemical treatment; effluent, which is the treated wastewater discharged from the plant; and sludge, the material removed from wastewater requiring later disposal.

Treatment plants are usually built in a modular fashion so that additional capacity or treatment processes can be supplied without disrupting plant operation. The piping system, on the other hand, requires considerable excavation, and is usually at least 60 to 70 percent of total cost. Therefore, pipes are usually oversized relative to plant capacity, so that they don't have to be

replaced when a plant expands. Pipe capacity is frequently the overriding consideration in establishing a region's capacity for sewerage.

The Pinelands include parts of five areawide planning regions (Section 208), encompassing the active facility planning areas shown in Table 4.7.

Table 4.7—Areawide Planning Regions and Facility Planning Areas in the Pinelands

Areawide Planning Regions	Facility Planning Areas
Tri-County 208 Area	Northern Burlington County Regional Sewerage Authority Evesham Municipal Utilities Authority Pemberton Township Municipal Utilities Authority Camden County Municipal Utilities Authority Gloucester County Municipal Utilities Authority
Ocean County 208 Area	Central District Southern District Northern District
Atlantic County 208 Area	Atlantic Coastal Lower Great Egg Harbor River Basin Upper Great Egg Harbor and Mullica Rivers
Cape May County 208 Area	Cape May County Municipal Utilities Authority
Lower Delaware 208 Area	Undesignated region

Existing Sewerage Systems

Since the enactment of the Clean Water Act in 1972, the location and construction of sewage treatment plants have become a leading planning issue. Because of the difficulties with on-site disposal, particularly in the Pinelands' sandy soils, sewerage systems represent the only feasible alternative for regional growth. Environmental factors in the Pinelands make sewerage system planning a complex issue. For example, the unique vegetative communities are dependent on high water tables which may be lowered by export of water or wastewater, and high quality surface and groundwater may be degraded by sewage effluent discharge.

The problem becomes even more complicated because of the institutional arrangement arising from areawide planning (Section 208) and facilities planning (Section 201) under the Clean Water Act. Ideally, facility plans are based on the areawide plans, allocations, and population projections, with the areawide plans completed first. In reality, this has not been the case. The two planning efforts have occurred simultaneously, or in some cases facility plans have predated areawide plans, and the coordination of the two is not always ensured. In addition, facility plans are developed by a designated utilities authority for a large geographical region, often in areas where local utilities authorities already have operating sewage treatment facilities. Disputes arise when the local authorities are directed to comply with the regional authority, often at a significantly increased cost to the local customers, and often where existing treatment at a local plant is already adequate.

Existing sewerage areas are shown on Plate 17 (Division of Planning, 1979). The areas shown are those where sewage collection and treatment are actually in place, with certain regional pipe connections also shown. The areas are further coded to indicate whether the average flow of the treatment plant is exceeding capacity, operating at 80 to 100 percent of capacity, or operating at less than 80 percent of capacity. From the map, it is clear that the only areas with excess sewage capacity occur on the periphery of the region.

In general, the Pinelands are poorly served by sewers, primarily because of the low population. The only areas with sewerage within the central part of the region are older,

agricultural communities, and the condition of the service reflects its age. A complete analysis of sewerage systems is given in Table 4.8. The table includes a listing by county of treatment plants and operating authorities. The data categories include the following: design capacity and average flow, in million gallons per day, with summer peak flow in parentheses; primary, secondary, or advanced treatment level; population served; and remaining capacity with average or peak flow subtracted.

Table 4.8—Existing Sewerage Systems in the Pinelands

County/Authority	Design Capacity (mgd)	Average Flow ¹ (mgd)	Treatment Level ²	Estimated Population Served	Remaining Capacity (mgd)
Atlantic					
Atlantic Co.	40.0	23(28)	S	152,000	12.0
Buena Boro	.4	.41	S	2,900	0
Egg Harbor City	.34	.52	S	4,000	0
Hamilton Twp.	.63	.58	S	4,400	.05
Hammonton	1.6	1.2	S	8,400	.4
FAA Tech. Center	.21	.19	NA	NA	.02
Burlington					
Evesham (Elmwood)	1.5	.86	A(T)	3,500	.64
Fort Dix	3.0	2.0	S	26,000	1.0
McGuire AFB	1.25	1.37	S	12,000	0
Medford Lakes	.55	.40	A	5,200	0
Medford Twp.	1.3	1.1	S	10,000	.2
Pemberton Twp.	2.5	1.27	S	14,000	1.2
Southampton Twp.	.5	.19	A(T)	3,500	.30
Wrightstown	.2	.14	S	1,000	.07
* Pemberton Boro	.18	.14	S	1,350	.04
Camden					
* Berlin Boro	.6	.54	S	4,200	.06
Waterford	.42	.36	A(SI)	3,600	.06
	(.75) ³				(.39)
* Winslow	.7	.35	A(T)	5,000	.35
Cape May	No sewerage service in Pinelands Area				
Cumberland	No sewerage service in Pinelands Area				
Gloucester					
* Gloucester Co.	16.0	14.6	S	102,000	1.4
Ocean					
* Dover Twp.	12.0	7.1 (7.5)	S	60,000	4.5
* Ocean Co.-Northern ⁴	28.0	9.0	S	NA	19.0
Ocean Co.-Central	24.0	6.0	S	NA	18.0
Ocean Co.-South	20.0	3.5 (7)	S	NA	13.0

Source: New Jersey Division of Planning

Notes: 1—Values in parentheses are peak summer flows.

2—S = Secondary

A = Advanced

T = Tertiary

SI = Spray Irrigation

3—Plant can expand to .75 mgd.

4—Plant serves small part of region.

NA = Not available.

*Systems not in the Pinelands but adjacent to the region and serving parts of it.

mgd = million gallons per day.

Certain treatment plants (asterisked in Table 4.8) are not actually within the Pinelands, but are included in the table because the currently sewered area either abuts or extends over the Pinelands boundary. These are Pemberton Borough in Burlington County; Berlin Borough and

Winslow Township in Camden County; the Gloucester County plant, serving 5 percent of Monroe Township in the region; the Dover Township plant, which serves 5 percent of Jackson Township in the region; and the Ocean County Northern plant, serving 10 percent of Berkeley Township in the region. The three federal facilities on the list, Fort Dix and McGuire Air Force Base in Burlington County and the Federal Aviation Administration Technical Center in Atlantic, cannot be classified as public, available systems, but are included for completeness.

The evidence in Table 4.8 indicates the limited options for development of sewerage systems in the Pinelands. In Atlantic County, other than the county plant, only the Hammonton plant has excess capacity, and it has other problems, discussed later. In Burlington County, significant excess capacity exists only in Pemberton Township, with some capability in Southampton. The Waterford plant in Camden County will have excess capacity when the full design capacity of .75 million gallons per day (mgd) is reached. Gloucester County has already committed a sewage flow in excess of the design capacity, and current peak flows exceed design capacity by 3 mgd.

The two most significant areas in the region in terms of available capacity are Atlantic and Ocean Counties. The Atlantic County plant, while situated in Atlantic City, has interceptor pipes extending into Galloway and Egg Harbor Townships in the Pinelands. The Ocean County Central plant, in Berkeley Township, serves that township and four others in the Pinelands—Manchester, Lacey, Ocean and Barnegat. The Ocean County Southern plant serves the Pinelands communities of Little Egg Harbor, Eagleswood, Stafford and Tuckerton.

Excess sewage capacity represents a significant development potential in terms of growth stimulation and accommodation. Based on the above analysis, some preliminary estimates for the region are possible. The 12 mgd capacity in the Atlantic County plant is destined to shrink, owing to the volatile nature of the Atlantic City casino impact. Twelve casinos in operation by 1985 would consume 2.4 mgd (Division of Water Resources, 1978), and development in coastal communities and the city could consume another 5 mgd, resulting in 4.6 mgd available for Pinelands communities served by the Atlantic County plant. This plant could be expanded rapidly by 15 mgd capacity. To convert the capacity, and the capacity in other Pinelands counties, into the population estimate in Table 4.9, the following assumptions are used: 80 percent of excess capacity will go to residential use, and residential users produce 100 gallons per person per day. The population figure in parentheses for Atlantic County is computed with the additional 15 mgd potential capacity added. Based on this analysis, with the additional Atlantic County capacity, 70 percent of the sewered population would reside in Ocean County, and approximately 575,000 people would be served in the Pinelands, or 190,000 to 200,000 housing units.

Table 4.9—Estimates of Potential Additional Sewered Population

County	Population
Atlantic	41,000 (161,000)
Burlington	12,000
Camden	3,200
Ocean	400,000

Sewage Sludge and Septage Disposal

Sewage sludge is the residual material removed from sewage during wastewater treatment. It contains whatever materials were in the wastewater, generally in a concentrated form. Septage is the material which accumulates in septic tanks during on-site wastewater treatment. Both materials, when disposed, can have adverse environmental impacts, and disposal options are limited. Sewage sludge disposal, once exclusively practiced via the ocean and landfills, is currently prohibited in the oceans, and landfill disposal is severely restricted. Septage has generally been sent to landfills, or to the nearest concealed culvert. It is now being directed to sewage treatment plants, or to adequately protected landfills.

Sewage sludge generated in the Pinelands is landfilled with the single exception of the small

Pinelands contribution to the Atlantic County plant, which is incinerated and the ash then landfilled. Septage is also predominantly landfilled, with the exception of some material which is directed to sewage treatment plants. The quantities of each material generated in the Pinelands are developed from the treatment plant data in Table 4.10, and from figures of total population in the Pinelands in relation to that proportion with on-site waste disposal systems.

Table 4.10—Estimated Sewage Sludge and Septage Generation in the Pinelands

County	Sludge Generation (dry tons/year)	Septage Generation (gallons/year)
Atlantic	1,300	5,280,000
Burlington	1,530	3,300,000
Camden	150	1,250,000
Cape May	—	1,320,000
Cumberland	—	600,000
Gloucester	N/A	1,000,000
Ocean	1,800	6,000,000

Problem Areas, Proposals, and Prospects

The New Jersey Division of Planning (1979) has developed a comprehensive review of problem areas and proposals relative to sewerage facilities, based on an extensive review of federal Office of Management and Budget project review files, Section 201 facilities' plans, Section 208 plans, and communications with local authorities. The preceding and following analyses are based in part on these data.

Table 4.11—Potential Sewerage Expansion Projects by County

County	Project Description
Atlantic	<p>Facilities Plan for Lower Great Egg Harbor River serving parts of Hamilton and Egg Harbor Townships.</p> <p>Facilities Plans to replace sewers in Weymouth, replace existing plant with package plant in Egg Harbor City, and extend sewers in Hammonton to alleviate septic problems.</p> <p>Prospect of expanding Atlantic County plant from 40 to 55 mgd capacity.</p>
Burlington	<p>Plan to expand Hamilton Township plant to 1.5 mgd.</p> <p>Facilities Plan to create sewerage authority in New Hanover and Plumsted (Ocean County) Townships.</p> <p>Facilities Plan to provide sewerage service to Southeast Rancocas and Mullica (Atlantic) drainage areas.</p> <p>Facilities Plan to expand lines into a State Development Guide Plan limited growth area.</p>
Camden	<p>Facilities Plan for lower county sewage plant in Berlin, outside Pinelands.</p>
Gloucester	<p>Facilities Plan to expand county plant from 16 to 25 mgd capacity.</p>
Ocean	<p>Facilities Plan for Jackson collection systems to Northern county plant.</p> <p>Facilities Plans for collection systems in five townships, including a State Development Guide Plan area designated as open space.</p> <p>Numerous negotiations to phase out ten small treatment systems to send to Central and Southern county plants.</p>

Source: New Jersey Division of Planning, 1979.

There are numerous problem areas related to on-site and off-site wastewater disposal in the region, probably owing to the high water table and the age of systems, respectively. Septic system failures abound throughout the Pinelands, occurring in virtually every county. The Atlantic County 208 Water Quality Management Agency (1979) identified problems in Galloway, Egg Harbor, Mullica, Folsom, and Hamilton, and other sources mentioned Burlington and Gloucester Counties. The major problems with sewerage systems are excessive infiltration and inflow from high water tables and surface runoff. This overloads treatment plants and sacrifice treatment capacity. Areas experiencing this problem include the Gloucester County plant, several in Burlington County, numerous plants in Atlantic County, and one in Ocean. Facilities currently or recently under a sewer connection ban include Wrightstown, Evesham, Egg Harbor City, and Hammonton.

Current proposals and possibilities for Pinelands sewage treatment relate to both the alleviation of existing problems and the provision of new facilities. Applications for federal and state aid in the former category have been made in Gloucester and Atlantic Counties. Programs in the latter category include facilities' plans to construct or expand treatment plants, and longstanding goals of individual authorities. Table 4.11 summaries some of these prospects.

WATER SUPPLY SYSTEMS AND WATER USE

The water used to supply domestic, irrigation, and industrial needs in the Pinelands is pumped exclusively from the underlying aquifers. The deepest system, the Potomac-Magothy-Raritan, is heavily and incautiously used along the Delaware River, resulting in severe pollution problems, but is not utilized in the Pinelands. The next two strata, the Englishtown and Mt. Laurel-Wenonah, are also not used in the region, but have been overutilized in coastal Ocean and Monmouth Counties. As discussed in Chapter Two, the aquifers of principal interest in Pinelands water use are the Kirkwood overlain by the Cohansey. The Kirkwood is connected to the Cohansey in some places, and is used by the coastal counties of Atlantic, Cape May, and Ocean at a rate of 25 million gallons per day (mgd) in areas predominantly outside the Pinelands. The Cohansey Sand is used at a rate of 98 mgd within and outside the region (Division of Water Resources, 1979).

Due to a number of factors, accurate estimates of water usage are extremely difficult to develop. The actual volume of water pumped is only reported if a diversion permit is required, and diversion permits are generally required only if the quantity of water pumped is in excess of 100,000 gallons per day. Diversion permits are often granted in excess of the amount actually withdrawn. Therefore, not all groundwater pumpage is reported, and the amount reported is frequently far less than what might be permitted. Additionally, holders of grandfather rights, which were granted to an area as diversions came under state control, are not required to report their pumpage as long as pump capacity and well depth are not altered. The combination of factors makes problematic any quantitative estimate of water usage.

Table 4.12 illustrates the variations that can occur. For the three categories discussed above, the quantitative allocations in the seven counties are shown. It should be noted that these quantities are for the entire seven-county area, not just the Pinelands portion of each. From the table, it is apparent that actual water use (reported pumpage and grandfather rights) could approach 600 mgd in the seven counties. In addition, if all grandfather rights and approved diversions were used to their limits, pumpage would approach 950 mgd. From these data, two observations are clear: the current system does not adequately monitor the quantity of groundwater used; and water usage approvals already granted, if fully utilized, could have an impact on the Pinelands ecosystem.

There are no large water purveyors within the Pinelands. Existing public water supply systems serve only municipal or sub-municipal areas. With groundwater so easily available and population densities low, there is little need for expensive infrastructural hook-ups. There are 26

Table 4.12—Reported Pumpage, Diversion Permits, and Grandfather Rights for the Seven Pinelands Counties in 1976

(in million gallons per day)

County	Reported Pumpage	Groundwater Diversions	Grandfather Rights
Atlantic	28.7	71.3	85.2
Burlington	38.8	121.6	24.4
Camden	75.1	132.8	51.1
Cape May	12.5	38.9	6.3
Cumberland	21.5	73.2	103.6
Gloucester	28.4	78.4	57.2
Ocean	33.5	69.9	27.7
Total	238.5	586.1	355.5

Source: New Jersey Division of Water Resources, 1979.

such water purveyors entirely within the region, with 75 percent of them split evenly between Burlington and Ocean Counties. The Fort Dix Water System in Pemberton Township is the largest purveyor, with pumpage of 3.12 mgd in 1977. Elsewhere, only the Hammonton and Evesham water systems, and the interconnected Berlin systems on the edge of the region, use more than 1 mgd. The areas experiencing over-pumpage problems are in coastal areas of Atlantic, Cape May, and Ocean Counties. The areas with public water supply are largely coincident with those having sewerage systems, as might be expected. Areas served by public water systems are shown on Plate 18.

Water usage for the Pinelands is given in Table 4.13. The estimated quantities are aggregated with data from the Bureau of Water Quantity Allocation, the Statewide Water Supply Master Plan, and Department of Labor and Industry population figures. Matching up the various factors is not a precise process, but the figures in the table should be representative. Not accounted for are the potentially large amounts of grandfather rights, particularly in Atlantic and Camden Counties. The data on approved diversions for public systems is incomplete, but the figure is around 40 mgd.

Domestic usage accounts for 60 percent of total reported usage, and in no county but Atlantic does the category include less than half the total. Public systems provide 40 percent of domestic usage. Irrigation usage is high only in Atlantic County, although little is known of the use or impact of grandfather rights in agricultural areas. Industrial usage, given a liberal interpretation, is uniformly low. The reported pumpage rates are in no area excessive, but the potential impact of a water level drop on agriculture, vegetative patterns, and stream flow requires that careful attention and more accurate monitoring be instituted.

Table 4.13—Estimated Water Usage in the Pinelands, By County and Type
(in million gallons per day)

County	Domestic (Public System)	Individual Well	Irrigation	Industry
Atlantic	3.7	4.4	10.0	.5
Burlington	7.1*	6.0	3.0	1.0
Camden	1.2**	1.5	1.2	1.0
Cape May	.2	1.0	.4	.5
Cumberland	—	.5	—	.5
Gloucester	.7**	1.7	.6	1.0
Ocean	2.8	8.0	.3	.5
Totals	15.7	23.1	15.5	5.0

*Includes Fort Dix population and water supply.

** Includes systems located just on western border.

Sources: New Jersey Division of Water Resources, 1979 and 1980

SOLID WASTE GENERATION AND DISPOSAL

The generation and disposal of solid waste, including hazardous waste and some forms of liquid or semi-solid waste, is an increasingly difficult and complex management problem. Recognition of the problem by federal and state governments, in the form of the Resource Conservation and Recovery Act of 1976 (P.L. 94-580) and the New Jersey Solid Waste Management Act (L. 1976, Chap. 326), respectively, has finally brought widespread attention to an unpopular topic. The attempts to resolve solid waste problems which were initiated by this legislation are for the most part in preliminary stages, with few major issues settled. Many of the inherent problems, both institutional and environmental, cannot be remedied without extraordinary amounts of technical and financial assistance. The solid waste management districts established under Chapter 326, in combination with state and federal agencies, are attempting to address this situation.

The Pinelands are in an especially dangerous position regarding solid waste disposal. Because of its relative emptiness and its network of sandy roads combined with close proximity to major urban areas, the region is a likely destination for those disposing wastes illegally. The extremely porous soils have a double effect: any liquid dumped will be absorbed quickly, thereby making detection difficult, and the rapid permeability means any waste liquid will have direct negative impacts on groundwater and surface water quality. As regulations become more severe on the disposal of solid, liquid, and hazardous wastes elsewhere, but no new alternatives are offered, the pressure for illegal dumping in the Pinelands can become even greater.

Solid Waste Sources

The New Jersey Solid Waste Administration identifies nine categories of solid waste, including municipal, dry sewage sludge, bulky waste, dry hazardous waste, dry non-hazardous chemical waste, vegetative waste, animal and food processing wastes, oil spill clean-up wastes, and non-chemical industrial waste. The wastes produced in the Pinelands are primarily of the municipal, bulky, and vegetative types, although some areas produce dry sewage sludge, animal and food processing wastes, and non-chemical industrial waste. Hazardous and chemical waste generation is virtually nonexistent here. The Solid Waste Administration categorizes six types of liquid waste, including waste oil and sludge, bulk liquid and semi-liquids, septic tank clean-out wastes, liquid sewage sludge, liquid hazardous waste, and liquid chemical waste. The only two liquid wastes produced here in substantial quantities are septic tank clean-out (septage) and liquid sewage sludge. They are covered in other sections and in Table 4.10.

Of the three main categories of Pinelands solid waste, by far the largest amount of the total generated is municipal waste, which includes household, commercial, and institutional waste types. Up to 20 percent of the total solid waste generated in some areas is bulky waste, which includes appliances, building and demolition debris, and whole trees and stumps. Vegetative waste, which includes waste from nurseries, crop residues, and wood chips, is produced in agricultural areas, but the material is frequently used at the production site, and the quantity disposed is negligible.

The generation of municipal waste is dependent on a number of local characteristics, including lifestyle and age of population, degree of commercial development, and population distribution and density. These and other factors result in a range of per person production from four to seven pounds per day across the region, or approximately 0.7 to 1.3 tons per person per year. The average is very close to one ton per person per year, which is often used as a rule of thumb. The quantity of solid waste generated by county on an annual basis is given in Table 4.14.

Under the New Jersey Solid Waste Management Act, each of the counties in Table 4.14 were designated as districts responsible for producing a district plan by July 1, 1980. The plans are submitted to the New Jersey Department of Environmental Protection for certification and approval, after approval by each county's Board of Chosen Freeholders. Four districts have state certified plans, all with significant modifications required before final approval, while Atlantic, Cape May, and Cumberland have completed plans and are awaiting freeholder and state action.

Table 4.14—Estimated Annual Solid Waste Generation, by County for 1980 and 2000

County	Solid Waste Produced (tons/year)	
	1980	2000
Atlantic	64,500	200,000
Burlington	69,000	130,000
Camden	5,500	11,300
Cape May	11,400	27,000
Cumberland*	10,000	—
Gloucester*	10,000	—
Ocean	83,000	270,000
Total	252,400	638,300

*Quantities estimated on basis of population and average waste production. All other quantities from District Soil Waste Management Plans.

Table 4.15—Active Landfills within the Pinelands Area

	Location and Name	Acres	Refuse Disposal (tons/year)	Sludge (S) and Septic Cleanout (C) (gallons/year)	Waste Category Accepted*
1	Buena Boro	18.5	2,800		10,12,13, 23,73,74
2	Buena Vista	16.0	1,645		10,13,23
3	Egg Harbor City	15.3	5,200		10,13,23
4	Egg Harbor Twp (Lee's gravel pit)	85.0	60,600		10,12,23, 25,73,74
5	Estell Manor City	22.3	1,140		10
6	Folsom Boro	14.0	220		10,13,23, 27
7	Galloway Twp (Hershel St. sanitary landfill)	10.0	5,000		10,13,23
8	Galloway Twp (Oak St. site)	10.0	7,500		10,12,23
9	Galloway Twp (Stockton State College)	—	—		13,23
10	Hamilton Twp (Somers Point Rd. site)	13.3	3,600		10,13,23, 25,27
11	Hammonton Town	80.0	9,000		10,12,13, 23,25,27, 73,74
12	Mullica Twp	16.0	3,500		10,13,23, 25,27
13	Port Republic City	2.0	830		10,13,23, 27
14	Weymouth Twp	25.0	1,380		10,13
15	Bass River Twp	10.0	900		10,13,23
16	Evesham Twp	56.0	12,900	1,300,000(S)	10
17	Medford Twp	11.0	12,900	76,000(C)	10,13,23
18	Pemberton Twp	27.0	21,200	4,400,000(S + C)	10,13,23

*Numbered codes refer to the following waste types:

- 10-Municipal (household, commercial, and institutional)
- 12-Dry sewage sludge
- 13-Bulky waste
- 23-Vegetative waste
- 25-Animal and food processing wastes
- 27-Non-chemical industrial waste
- 73-Septic tank clean-out wastes
- 74-Liquid sewage sludge

Sources: Atlantic County, 1979
 Burlington County, 1979
 Camden County, 1979
 Cape May County, 1979
 Ocean County, 1979
 New Jersey Solid Waste Administration, 1978

Table 4.15—Active Landfills within the Pinelands Area (continued)

	Location and Name	Acres	Refuse Disposal (tons/year)	Sludge (S) and Septic Cleanout (C) (gallons/year)	Waste Category Accepted*
19	Pemberton Twp (Ft. Dix)	—	21,900	73,000(S)	10,13,23, 27
20	Southampton Twp (Big Hill-Burlington Environmental Manage- ment Services)	55.0	136,000	3,800,000(S + C)	10,12,13, 23,25,27, 73,74
21	Tabernacle Twp	26.0	3,100		10,13,23, 73
22	Woodland Twp	33.0	1,760	230,000(C)	10,13,23
23	Woodland Twp (New Lisbon State School)	2.0	185		10,13,23
24	Winslow Twp	20.0	12,600		10,13,23, 25
25	Winslow Twp (Ancora Psych. Hospital)	—	—		10
26	Dennis Twp (Belle- plain site)	27.0	108		10,13,23, 25
27	Dennis Twp (South Seaville site)	50.0	985		10,13,23, 25,73,74
28	Upper Twp	9.0	1,740		10,13,23
29	Woodbine Boro (William Saduk)	20.0	0	1,000,000(S + C)	73
30	Woodbine Boro (Founda- tion and Structures)	61.0	7,100	5,000,000(C)	10,12,13, 23,73,74
31	Maurice River Twp	—	—		10,13,23
32	Maurice River Twp	20.0	4,000		10,13,23
33	Berkeley Twp	145.0	12,800		10,12,13, 23,74
34	Eagleswood Twp (Tuckerton/Eagleswood)	27.0	4,000	156,000(C)	10,13,23, 73
35	Jackson Twp	120.0	26,000		10,12,13, 23,25,73, 74
36	Lacey Twp	11.0	5,000		25
37	Pemberton Twp (Federal)	130.0			10,13,23
38	Little Egg Harbor Twp	10.0	4,600	100,000(C)	10,13,23, 25,27
39	Manchester Twp (Whiting site)	200.0	1,000		10,12,13, 23,25,27, 73,74
40	Ocean Twp (Southern Ocean Landfill Inc.)	283.0	19,200	23,800,000(S) 11,000,000(C)	10,12,13, 73,74
41	South Toms River Boro	10.0	2,500		10,13,23
42	Stafford Twp	145.0	101,000	1,000,000(S) 250,000(C)	10,13,23, 73,74
43	Barnegat Twp (Frances Tanner)	30.0	2,500		13,23
TOTALS		1,718.0	520,000	52,185,000(S + C)	

Solid Waste Disposal

The disposal of solid waste in the Pinelands is exclusively by landfill. Most of the solid waste produced in the region is disposed of here, with some going outside the boundary in Atlantic, Ocean and Camden Counties. Far more pronounced is the discrepancy between the amount produced in the region and the amount disposed. Comparing the figures of quantity produced in Table 4.14 to those on quantity disposed in Table 4.15 indicates a net inflow of 267,500 tons annually, or an approximate doubling. The largest net increases are in the Burlington, Ocean and Atlantic districts.

Table 4.15 identifies the currently active landfills in the Pinelands, and for each provides the following: location and name; acres currently utilized; quantity of solid waste disposed in tons per year; and liquid sludge and septage disposed in gallons per year. Plate 19 shows the uneven distribution of the landfill sites in the region, with concentrations on the periphery in all compass directions, and a scattering in Atlantic County, where many municipalities operate local landfills. Compost facilities for vegetative waste and terminated landfills are not shown on the plate.

Fourteen of the landfills are in Atlantic, eleven in Ocean, and nine in Burlington Counties, comprising 80 percent of the total. These 34 landfills handle 95 percent of the volume disposed in the region, or 492,000 tons. Each of these counties have one landfill which handles 60 to 65 percent of the county total. The total land devoted to the landfills is approximately 1,700 acres, with 57 percent of the total in Ocean County, and 95 percent of the remainder in Atlantic, Burlington, and Cape May Counties. The total acreage can produce over one billion gallons of leachate and runoff, which can seriously affect local groundwater and surface water conditions. To give some sense of the volume involved in 520,000 tons of solid waste, the quantity would cover 700 acres of land to a depth of one foot annually.

The specific sites of the landfills in the region are also a matter of interest. The entire Pinelands is an area of groundwater recharge, and therefore any landfill site is linked to the water system. In addition, most of the landfills are located in areas of marginal utility, such as wetlands, abandoned gravel pits, and floodplains, which have direct hydrologic linkage to the surface and groundwater systems. No landfill in the region has a leachate collection system or liner to protect water resources.

This is particularly important with regard to the large quantity of liquid septage and sewage sludge disposed of in the region. The 52 million gallons of liquid disposal is concentrated in half a dozen landfills. Many of the facilities which accepted the liquids are not licensed to do so, according to records filed with the state. The materials are generally high in soluble nutrients, which can result in water quality problems. All of the sewage sludge produced in the region is landfilled, either here or elsewhere, with the exception of sludge from portions of Galloway and Egg Harbor Townships, which is sent to the Atlantic County Sewerage Authority treatment plant. Many areas are currently preparing sludge management plans to cease landfill use, as more stringent regulations are developed. Comparing Table 4.15 to Table 4.10, it is evident that most septage is also landfilled within the region of production.

Hazardous and Industrial Wastes and Illegal Dumping

Hazardous wastes include materials which are toxic, corrosive, irritating, biologically infectious, explosive, or flammable. There are some 8,000 to 10,000 hazardous waste producers in New Jersey. Since 1976, there have been no approved disposal sites in the state for these materials. The state has promulgated a manifest tracking system to trace hazardous wastes from place of production to place of disposal, with the idea of establishing legal liability with the waste producer. But because there are no legal hazardous waste disposal sites in New Jersey, and because other states do not have comparable programs, it is difficult to evaluate the systems' operation. No producers have been prosecuted under this program.

The actual extent of hazardous waste dumping in the Pinelands, past or present, is unknown. Reasons include the large and vacant land area, the lack of systematic inventories, the porous soils, and the lack of monitoring information. Recent investigations by the Burlington County Health Department have uncovered two toxic waste dump sites in Woodland Township and three in Pemberton Township, and others are suspected. The United States Senate Committee on Interstate and Foreign Commerce, Subcommittee on Oversight and Investigations, is inventorying abandoned toxic sites and suggesting measures for cleanup. Four sites were identified just outside the region in Franklin Township, Gloucester County. A recent case in Jackson Township, Ocean County, in which a municipal landfill has been charged with illegally accepting hazardous and carcinogenic industrial wastes, resulting in the contamination of over 100 home wells and major health problems, has dramatized the potential hazards that may exist in many areas.

The Jackson landfill is located inside the northern border of the Pinelands National Reserve. It opened in 1972, and dumping continued until recently, with reported peak deliveries of 300,000 gallons of waste fluids per day. The Department of Environmental Protection has filed suit to permanently close the landfill. Nearby residents were supplied with drinking water trucked in from a distant deep well, and the township has borrowed \$1.2 million from the state for a water treatment plant and a pipeline system.

Industrial waste producers are not widespread in the Pinelands, but at least seven industrial lagoons are located here. These sites are poorly regulated, and have a large potential for leakage, in the range of 140 million gallons per year for the seven (Geraghty & Miller, Inc., 1980). Several are strongly suspected of causing severe groundwater contamination. Home wells were closed in Winslow Township from lagoon leakage, observation wells at another lagoon site detected organic solvents far above standards, and two wells in the Monroe Township public water supply system were closed because of mercury contamination probably emanating from a lagoon filled with washwater containing pesticides.

Accidental spills and deliberate illegal dumping may also affect large areas. The Jackson case represents an extreme in long-term, high-volume, improper dumping, while at the other extreme is night-time disposal of one truckload. The New Jersey Office of Hazardous Substances Control recorded 41 spills in the region from 1976 through 1979. Spilled products included acids, paint, ink, herbicides, pesticides, benzene, coal tar, solvents, asphalt, fuel oil, and unidentified chemicals. The total reported spill volume during the four-year period was about 60,000 gallons. Exact amounts spilled are often unknown, however. Seven of the spills were prosecuted as illegal dumping violations.

The locations of the spills could not be determined precisely from the records required to be filed. In many cases, only the municipality was given, and it is possible that some of the 41 spills occurred outside the official Pinelands boundary. Also, the inventory is not complete because many spills are not reported.

Governor Byrne established a task force in 1979 to investigate the hazardous waste problem. Initial recommendations on siting and administrative structures were presented in January, 1980. The state Department of Law and Public Safety operates an investigative unit to prosecute hazardous waste violators, and has obtained convictions of many individuals and companies. The U.S. Attorney for New Jersey has a strike force engaged in similar work. The demand for a solution is increasing, but it is certain to be costly.

Environmental Impacts

Many of the environmental impacts of solid and liquid waste disposal have been mentioned in preceding sections. Given the Pinelands' soil and hydrologic structure, any type of spill will have some local water quality impact. The extent of the impact will vary as a function of volume and duration of dumping, type of material, and local groundwater connection. Effects when large volumes are involved, as in Jackson, are usually extensive, persistent, and have no simple mitigation measures. Groundwater degradation also occurs when local landfills accept sludge or septage, resulting in violation of standards for iron, dissolved solids, phenols, and biological and

chemical oxygen demands (Atlantic County 208 Water Quality Management Program, 1979). Besides leaching, water runs off directly from the surface in rainy periods, carrying with it ponded liquids and semi-solids. Landfills present another hazard in the form of fire resulting from methane gas generation.

The reasons for the extreme environmental impacts are not difficult to assess. The entire region is an aquifer recharge area, and the soils are unsuitable for landfill siting because they don't adsorb contaminants in the leachate. In the Burlington County Solid Waste Management Plan (Weston and Alaimo Associates, 1979), an assessment of Pinelands landfills revealed that all were in environmentally sensitive areas, all were in recharge areas, all had potable water supplies in the area, none had a geologic restriction on leachate generation, none had monitoring wells, and five had received a Department of Environmental Protection notice of prosecution and/or a county health department violation notice. Similar conditions exist in most parts of the region. With these impacts in mind, it is clear that the Pinelands are inappropriate as a site for waste disposal.

TRANSPORTATION FACILITIES

The transportation network in the Pinelands, as it relates to highways, is striking in several regards. The region is bounded by interstate and limited-access highways, but only one limited-access route, the Atlantic City Expressway, travels completely through the region. The other principal federal and state highways are either four-lane undivided or two-lane with relatively narrow rights of way. Parts of the interior are honeycombed with sand roads, often of indeterminate public or private maintenance, and undeveloped subdivision streets. The combination of these factors contributes not only to the use of various subregions, but also to their distinctive character.

Plate 20 categorizes the region's internal and peripheral roadways as follows: limited access, four or six-lane highways, U.S. and state highways; divided into two and four-lane segments; County Series 500, inter-county roads which serve as major collectors; and County Series 600, which serve local transport needs. Railways are delineated as to whether they are active or abandoned.

Limited Access and Interstate Highways

Interstate highways come within approximately three miles of the western boundary of the region (I-295), and two miles of the northern border (I-195). Interstate 295 parallels and nearly abuts the New Jersey Turnpike, and the two roads serve as similar linkages in the Eastern megalopolis. Both roads are foci for development on the fringe of the region. Interstate 195 is envisioned as the Central Jersey Expressway linking Trenton on the west to Ocean and Monmouth County shore communities in the east. When opened for its complete length the road is certain to serve as a growth stimulator at its termini and interchanges.

The Garden State Parkway, completed in the late 1950's and early 1960's and running north-south, provides a 35-mile eastern boundary of the Pinelands in Atlantic and Cape May Counties, and transects the region for 30 miles in Ocean County. The completion of the 175-mile road stimulated an already active resort market, and the link provided access to employment areas and resulting year-round residences. The Atlantic City casinos have recently resulted in increased usage of the roadway. There is a current plan to improve the road at its northern exit point in the region, and there are some requests for additional exits.

The Atlantic City Expressway crosses the region in a northwest-southeast direction for 30 miles through Atlantic and Camden Counties, connecting the Philadelphia and Atlantic City urban areas. The tollroad has eight access points, and toward the west is used for commutation to Philadelphia. Toward the east the attraction of Atlantic City is taxing the roadway's capacity. Although average traffic in summer is less than 50 percent of capacity (Department of Community

Affairs, 1980), severe traffic congestion occurs at the eastern terminus. Projections indicate that this and other highway into Atlantic City may reach capacity before 12 casinos are built, which can occur in less time than the necessary improvements would take. The Expressway Authority is considering an expansion of the roadway from four to six lanes. The land around both expressways is primarily vacant woodland and wetland.

Federal and State Highways

Federal highways in the region include Route 206 serving Burlington and Atlantic Counties, Route 9 in Cape May and Ocean Counties, Route 30 in Atlantic and Camden Counties, Route 40 in Atlantic County, and Route 322 in Atlantic and Gloucester Counties. The U.S. highway network in the Pinelands is notable on two counts. Half of the approximately 140 miles of the system is in Atlantic County, and only 30 miles of it is more than two lanes, none outside of Atlantic. Most of the roads have relatively sparse commercial development, with some strip development in populated area and at road intersections; the coastal Route 9 is considerably more developed. Functionally, the roads range from minor to principal arterials, connecting widely separated areas. Routes 30 and 40 carry 14,000 and 11,000 cars daily, respectively, or approximately 60 to 70 percent of capacity (DCA, 1980).

The state highway system in the region is composed of 150 miles of roadway on ten principal routes. Most of the state highways connect at least two Pinelands counties, and also connect non-Pinelands parts of the seven counties. These roadways supply access to many of the distinctive areas in the region and link many of the smaller settlements. The character of the roadways vary greatly depending on the subregion. In the southern Pinelands Routes 47, 49, and 50 follow historical paths, link older villages, and provide access and mobility to residents. The regions they pass through reflect the woodland and wetland orientation. In the northern Pinelands Routes 70 and 72 are predominantly unsettled, pass through distinctive woodland and bog areas, and are mainly used for access to other areas. Wider rights of way provide an open, unsettled view. A notable feature of the state system, similar to the federal, is that only 11 of the 150 miles of roadway are greater than two-lane, and this only on the western fringe. Route 73 in this area had the highest traffic count in the region of 23,000 cars daily (Camden County Planning Department, 1978), while an earlier count indicated 12,000 cars on Route 70 in Evesham (Burlington County Planning Board, 1970).

County Roads, Local Streets, and Sand Roads

County roads provide the basic internal transportation system in the Pinelands. The length of county roads exceeds the combined total of the previous categories. County highways are divided into two principal types: the County 500 Series, which are usually inter-county routes; and the County 600 Series, which are mainly intra-county connections. The 500 Series are the major collectors in the region, providing access between areas and mobility within. Most 500 Series roads have local names, which usually include the place names of the principal termini on the route. The routes are often on the same alignment as historical roads, and each road has a distinctive character depending on the subregion. The County 600 Series of roads are minor collectors, primarily serving intra-county movement, and providing mobility and some access principally to residents.

The developed areas in the region have fairly typical patterns of local streets, with rights of way between 33 and 66 feet. Their condition varies across the region and by age, and in some areas water problems develop. Sand and dirt roads also comprise a significant portion of local streets. Many of them dead end or are interrupted by wetlands. In many areas, particularly the Preservation Area, there are relatively few paved roads, and access depends on the complex network of sand roads. The sand roads are variously public and private, often indeterminate, and are used extensively by residents, recreationists, and woodsmen alike. The sand roads lead to the region's historical sites and areas and natural views, and are often all that remain of the Pinelands' past.

Railroads and Other Transport Modes

Railroads are a part of the region's past, are little used in the present, but offer prospects for the future. Railroads came early to the region to serve the coastal and woodland towns. They then suffered the fate of most U.S. railroads in the face of highway competition and fell into disuse. Population densities were not great enough to support continued passenger service. Among the railroads in existence are the old Central Railroad of New Jersey, running through the entire region from Ocean to Burlington, Atlantic, and Cumberland Counties; the Pennsylvania Reading Seashore Line, running from Philadelphia to Camden County, with branches from there through Atlantic County to Atlantic City and through southern Atlantic to Cape May; and several branch lines in Ocean and Atlantic Counties. The railroad system is now owned and operated through the state Department of Transportation by Conrail.

With development intensity increasing in the region, there are several proposals for new or extended service. The Pennsylvania Reading Seashore Line, currently operated with three weekday passenger trips between Lindenwold and Atlantic City, is being considered for purchase, electrification, and upgrading, with the possibility of several stations in the Pinelands. The Atlantic County Planning Board is recommending the reactivation of existing unused rail lines to serve county needs generated by growth in Atlantic City. The Lindenwold High Speed line, providing rail service from the Camden County suburbs to center-city Philadelphia, may be extended to the region's western edge to serve the developing areas.

The region's abandoned railroads represent a different potential, in that they can serve many recreational uses. Railroad rights of way provide habitats for some of the region's many endangered flora and fauna, and they act as pathways for recreational users. They can act as useful links in an open space network because the rights of way are established and cleared.

The region currently has no major civilian airports, but is served by several small airfields, including a terminal operated by Atlantic City at the Federal Aviation Administration Technical Center. This site may be expanded to accommodate the increased demand generated by casino development in Atlantic City. The other airfields in the region, at Berkeley, Hammonton, Stafford, and Woodbine, primarily serve private planes and small charter flights. There are several similar airfields outside the region's border, and there are a few fields used for crop-dusting purposes.

FEDERAL, STATE, AND LOCAL FACILITIES

The first major federal facility in the Pinelands was the Fort Dix army training base in Burlington and Ocean Counties, established in 1917. Major state facilities preceded Fort Dix, with the establishment of the Leesburg State Prison in Cumberland County in 1913 and the New Lisbon State School in Burlington County in 1916. Since then other state and federal facilities have been located in the region, chiefly near the northern and southern edges. The facilities are primarily large and have significant effects on local economies. The local facilities of greatest importance are schools, municipal buildings, and firehouses, all serving multiple purposes in the Pinelands communities.

Plate 21 identifies by location and type the region's major federal and state facilities. It also shows federal and state open space areas, such as forests, parks, and wildlife refuges, which are discussed later in this chapter.

Federal Facilities

There are four major federal facilities in the Pinelands, with smaller facilities such as Coast Guard stations and post offices excluded. The four installations are listed in Table 4.16, which shows size, location, and numbers of employees. Other than the Federal Aviation Administration Technical Center in eastern Atlantic County, all are located near the northern rim of the region.

These four facilities are the largest employers in the Pinelands, and have considerable

Table 4.16—Major Federal Facilities in the Pinelands

Facility	Total Acreage	Counties	Communities with Acreage	Total Employees	
Fort Dix	31,992	Burlington	New Hanover	10,216	7,000
			Pemberton	4,643	
			Springfield	410	
		Ocean	Wrightstown	753	
			Manchester	4,031	
			Plumsted	11,940	
McGuire Air Force Base	3,490	Burlington	New Hanover	3,002	7,000
			North Hanover	419	
			Wrightstown	70	
Lakehurst Naval Air Station	7,412	Ocean	Jackson	6,330	4,840
			Manchester	1,083	
Federal Aviation Administration Technical Center	5,055	Atlantic	Egg Harbor	3,575	2,100
			Galloway	805	
			Hamilton	675	

Sources: New Jersey Department of Community Affairs, 1972
Pinelands Review Committee, 1979

regional impact. The total annual payroll of the federal installations is approximately \$350 million, and the combined employment of 21,000 is a significant percentage of the regional share. In addition, the facilities generate over 20,000 support jobs for local residents (Pinelands Review Committee, 1979). When dependents are considered, the total population economically dependent on federal activities in the Pinelands increases substantially.

The oldest and largest facility is Fort Dix, situated in Burlington and Ocean Counties. The fort has been the subject of many proposals in recent years, some recommending an expansion and change in function, and others a change in function accompanied by a reduced operation. Most recently it was threatened by a proposed transfer and consolidation of its basic training activities to South Carolina. Efforts of New Jersey officials to demonstrate Fort Dix's regional importance have resulted in a delay of the proposed move and a reexamination of the situation.

In Atlantic County, the Federal Aviation Administration Technical Center occupies a 5,000-acre site in Egg Harbor, Galloway, and Hamilton Townships. Until the first casino opened in Atlantic City, the center was the county's largest employer. It is now undergoing a large construction program to expand and modernize its operation. Atlantic City is also seeking to expand its municipal terminal at the center to a major airport. The incompatibility of the facility and nearby residential use caused by noise has led the FAA to commission two master plans for the area. They recommend that residential development in close proximity to the center be minimized.

A similar noise study is being conducted at McGuire Air Force Base in Burlington County. The facility is the largest Military Airlift Command port of aerial personnel transport on the East Coast. East of McGuire and Fort Dix in Ocean County is the Lakehurst Naval Air Station, a Navy facility for research and development of aeronautical systems. The two air facilities represent over one billion dollars in assets and \$250 million in annual operating expenditures.

The Air National Guard also operates a practice bombing site on leased acres near Warren Grove, on the border of southern Ocean and Burlington Counties. The Department of Defense is considering plans to expand the buffer around the target area through purchase or lease so that the facility would total up to 40,000 acres. The proposed enlargement would cover some existing state forest lands.

State Facilities

Major state facilities in the Pinelands, excluding parks, forests, and wildlife areas, include a

state college, schools, a hospital, and a prison. The facilities are generally large in area, and represent a significant source of local employment. Stockton State College, in Galloway Township, Atlantic County, occupies nearly 1,500 acres. Founded in 1968, Stockton is one of the newest additions to the state college system. It specializes in environmental affairs.

There are two state schools in the region, the largest of which is the New Lisbon State School in Woodland Township, Burlington County. It occupies 1,854 acres, with over 1,200 retarded male residents and over 1,100 employees. The school has its own sewage treatment plant and solid waste dump, both of which have operating difficulties, and includes fields and woodlands. A similar facility, founded five years after New Lisbon in 1921, is the Woodbine State School in Woodbine, Cape May County. The school houses similar residents but is smaller, occupying 206 acres.

The oldest major state facility in the Pinelands is Leesburg State Prison, in Maurice River Township, Cumberland County, founded in 1913. The site occupies 1,094 acres and serves as a combined minimum and medium security prison for men. The Ancora Psychiatric Hospital in Winslow Township, Camden County, was founded in 1955, and serves patients of all ages from southern New Jersey counties on a 785-acre site. Most of these facilities are the major employers in their respective subregions. Other state facilities include transportation yards, state police stations, and motor vehicle inspection stations.

County and Local Facilities

The region contains two county-run colleges, Burlington County College in Pemberton Township and Atlantic Community College in Mays Landing. These relatively new facilities provide general higher education opportunities and specialized schools for professional development. The Pinelands is home to only one county seat, Mays Landing, an unincorporated municipality in Hamilton Township, Atlantic County. Most of the county's administrative offices are actually located in Atlantic City, but the county has plans to centralize the functions in a new headquarters at the county seat.

Local facilities in the Pinelands serve dual purposes: the functional one for which they were developed, and a cultural one as gathering places where people of the communities share common social experiences. Among the types of facilities used in this manner are schools, churches, municipal buildings, and volunteer fire companies. Besides their basic function, schools are used for adult education, and as social and political meeting places. The churches play their traditional roles and also provide historical links. Fire companies help protect public safety, while also contributing to the community's social framework.

Primary education in the Pinelands is generally provided in local schools operated by local school boards, with secondary education conducted in a mix of local and regional high schools. The regional schools, necessitated by the low population density, frequently operate on split shifts because of overcrowding, and their dispersed nature requires a considerable transportation effort. In more heavily developed areas secondary education is generally provided by local school districts.

RESOURCE EXTRACTION

The sedimentary deposits which comprise the Pinelands' surface geology are the basis for the region's extractive industries. The occurrence of the Cohansey Sand throughout the area, and the Bridgeton and Cape May Formations locally, provide an ample supply of many grades of sand and gravel. Mineral production (extraction) has different environmental impacts in comparison to a resource use such as forestry. It differs not only in that the resource is nonrenewable, but also in that whatever soils have developed are destroyed and the landscape is significantly altered. Extractive industries occur throughout the region, and have so since the development of the glass industry in the southern Pinelands in the late 1700's (see Plate 22). They are an important

economic activity, especially in Cumberland and parts of Ocean Counties. Uses for the materials include industrial activities and construction. The sand varies from fine-grained, high-silica sands to coarse sand and gravels in the different formations.

Feasibility Considerations

Although the basic formations in the region lend themselves to extractive industries, certain factors establish the limits to use. In order to be economically feasible for development, the thickness of the strata should be at least three feet. Excavation below the water table level not only alters the type of mining equipment needed, but also exposes the aquifer to possible surface contamination. Depth to seasonal high water table is therefore an important industry criterion, and one which indicates the environmental suitability of a given area for extraction activities. An excessive amount of silt and clay, or fine material, also indicates an unusable or infeasible site, and is a primary factor in determining a site's utility. Based on the latter criterion eight of the sixteen soil units occurring in the region have excessive fine particles. The remaining eight are considered potentially usable. Additional criteria include the availability and distance to markets, equipment availability, and the width of the deposit.

The mineral extraction industry is constrained by a high volume and weight to price ratio, and therefore must locate close to the market. Major extractive regions in the Pinelands are located near manufacturing industries, such as glass in Cumberland County, or where construction of roads and development is prevalent, as in Ocean County. A land distance of 20 to 30 miles to market is considered a maximum for most extractive operations, although certain industrial products are shipped much greater distances. The sand and gravel industry also requires large amounts of land, usually at least 25 acres, and the nature of the operation can create conflicts with neighboring landowners. The activity is therefore not usually compatible with developed areas, due to noise and other impacts, but its need to locate near available markets requires a balancing of objectives.

Extent of Activities

Sand and gravel mining occurs in every county in the Pinelands, but is most prevalent in the extreme northern and southern sections. A precise estimate of the acreage and tonnage involved is difficult to develop, as a variety of accounting procedures are utilized. The Department of Labor and Industry, which regulates the industry for safety purposes, estimated that there were 7,800 acres of sand and gravel extraction operations in Ocean County in 1977, and 7,100 acres in eastern Cumberland County (Pinelands Review Committee, 1979). These estimates do not reflect the actual acreage mined, but rather the amount registered, and are therefore somewhat high. They do give an indication, however, of the potentially large commitment of land to mining.

The state Bureau of Geology and Topography is compiling data on extraction activities for display on its Atlas Sheet series. The data is in rough form and is currently incomplete, and does not distinguish between active and registered areas. This source estimates that there are 4,800 acres producing over 2 million tons annually in the Atlantic, Camden, Cape May, and Cumberland portions of the region (Geraghty & Miller, Inc., 1980). A detailed but dated source (Cumberland County Planning Board, 1966) identified 31 abandoned sites and 53 operating or recently used in the Cumberland section of the Pinelands, occupying over 1,500 acres. More than 1,100 acres were in Maurice River Township. The annual production from these areas was 1.5 million tons.

An analysis of 1979 aerial photographs provided the data in Table 4.17. The acreage figure for Ocean County includes two operations with greater than 1,000 active acres, and three townships, Jackson, Lacey, and Manchester, with greater than 1,000 acres each. Maurice River Township also has more than 1,000 active or recently abandoned acres. In each of these areas extraction companies own several thousand additional acres not currently in use. An acre of sand and gravel mine, dug out to a three-foot depth, can produce about 6,000 tons of raw material before processing.

**Table 4.17—Acreage of Active or Recently
Abandoned Extraction Sites in the Pinelands**

County	Excavation Acreage
Atlantic	1,480
Burlington	370
Camden	440
Cape May	745
Cumberland	1,200
Gloucester	100
Ocean	5,100

Summary of Impacts

Resource extraction strips the land of vegetation and upper soil layers, and is not consistent with preservation of natural areas. When the water table is exposed during mining activities, a direct hydrologic link to the aquifer is established, which results in aquifer mining and disturbance of groundwater flow. If the operation is directly linked to a surface water body, considerable contamination from suspended solids can result. In addition, streams and wetlands are often affected by extraction industries, resulting in further disruption of drainage patterns.

An excavated extraction site can be restored and redeveloped for a different purpose. But if restoration is not carried out, the site can become a nuisance to the community. Abandoned sites in the Pinelands are frequently converted to landfills. In fact, 18 of the 43 currently active landfills are located in abandoned pits, and several dozen other registered and unregistered dump sites are coincident with abandoned pits. This is a poor management practice as it exposes the aquifer to direct contamination from landfill leachate.

THE RECREATIONAL LANDSCAPE

The recreational landscape of the Pinelands is composed of two principal components, vegetative communities and surface water resources, which contribute to the overall quality and quantity of the area's recreational resources. Combined, the two provide attractive locations within the Pinelands for such recreational activities as photography, sightseeing, driving for pleasure, canoeing, hiking, nature study, hunting, and camping.

The most unusual aspect of the vegetative communities of the Pinelands is embodied in their expansiveness and the extent of their undisturbed range. These communities include the bay and shore ecosystem, coastal marsh, wetlands, and uplands. They are conducive to hunting and birdwatching, in addition to other recreational uses such as photography, sightseeing, driving for pleasure, camping, and trailbiking.

The vegetative communities, however, are also extremely fragile. This should limit participation in certain recreational activities in selected areas of the Pinelands, such as the habitats of endangered and threatened plant species. Similarly, the forest fire hazard potential of particular types of Pinelands vegetation precludes indiscriminate recreational use.

The surface water resources of the Pinelands and the overall aesthetic quality of the visual landscape in proximity to surface waters are attractive to a variety of water-based recreational activities such as boating and fishing. The popularity of canoeing is testimony to this. The acidic nature of the Pinelands fresh waters do not, however, provide a suitable habitat for many sport fish species. Primary contact activities such as swimming, diving, and water skiing are not that highly developed in the Pinelands, particularly as they relate to fresh water resources. Salt water facilities are more attractive to primary-contact recreation activity. Water skiing and diving are popular on the bays and lower reaches of the Mullica and Great Egg Harbor Rivers. Swimming is

generally confined to shore locations within the Pinelands, particularly at the Island Beach State Park. Other activities, such as camping, are enhanced by the areas' surface water resources.

The bay areas of the Pinelands are generally most used for secondary-contact activities such as salt water boating, fishing, shellfishing and crabbing, birdwatching, and hunting and trapping. The bay ecosystem is extremely sensitive to water pollution and its continued use for recreational activity is dependent upon the maintenance and enhancement of existing water quality.

Conflicts

The Pinelands include a wide assortment of public open space areas. Plate 21 shows the region's national wildlife refuges, state-owned parks, forests, and wildlife management areas, and county parks. These open spaces combine with the vegetative communities and water resources discussed above to generate a network of recreational activities ranging from those in intensively used and developed areas to those which cover large land areas in remote subregions. With this mix of opportunities, the Pinelands represent a recreational resource of high potential, but one which is not without conflicts.

The conflicts are basically of three types: those which relate to overuse of a particularly sensitive natural system, those which occur between different groups of recreational users, and those which occur between recreational and other land uses. In the first case the example of canoeing rivers is frequently cited, where high-volume use could degrade the environment and also reduce the quality of the canoeing experience. A common example of conflicts among user groups is the demand for trail space by day and wilderness hikers, horseback riders, and off-road vehicle drivers. Examples of conflicts between recreational and other land uses occur where agricultural lands, particularly bogs, are utilized for access to recreational areas, with the attendant potential for vandalism, and where certain types of recreational uses occur in close proximity to developed lands.

Federal Open Space Areas

The federal government operates two national wildlife refuges in the Pinelands: the Brigantine refuge in Atlantic County and the Barnegat and Holgate site in Ocean County. The former was established in 1939, and now totals over 20,000 acres in three townships. The latter area was first established in 1968 and has grown rapidly to its present size of approximately 7,600 acres in several townships. The Fish and Wildlife Service, U.S. Department of the Interior, has jurisdiction over both areas. The refuges have been created to preserve the natural habitat, which ranges from coastal marsh to upland woods, for the management and protection of waterfowl along the Atlantic Flyway. The two refuges provide opportunities for hiking and nature study on marked trails. The military installations mentioned earlier permit limited access for hiking and hunting during special time periods. The Warren Grove bombing area, leased by the federal government, also provides limited access.

State Open Space Areas

State land in the Pinelands consists of wildlife management areas, administered by the Division of Fish, Game and Wildlife, and state parks and forest, administered by the Division of Parks and Forestry, both in the Department of Environmental Protection (DEP). The wildlife areas are concentrated in Ocean County along Route 539, and in the southern Pinelands in the area where Atlantic, Cape May, and Cumberland Counties meet. The state forests are located in Burlington County, with the exception of Belleplain in Cape May and Cumberland Counties and parts of Bass River in Ocean County. The only state parks in the region are along the bay or ocean coast in Ocean County.

Table 4.18 summarizes the state parks and forests in the Pinelands. The table includes data on acreage and county of location, and a brief summary of available activities. The list does not include the designated state natural or recreational areas, which are included within the state forest category and which account for less than 1,000 acres in the region. Wildlife management areas are listed in Table 2.38.

Table 4.18—State Forests and Parks in the Pinelands

Area	Acres	Camping Sites	Attendance (Fiscal 1979)	Activities				
				Picnicking	Playground	Swimming	Boating	Fishing
Forests								
Bass River	9,100	178	105,438	•	•	•	•	•
Belleplain	11,270	203	74,500	•	•	•	•	•
Lebanon	29,413	90	34,496	•				
Penn	3,366	—	15,103	•		•	•	
Wharton	99,672	55	355,359	•	•	•	•	•
TOTAL	152,821							
Preservation Area Subtotal								
	141,551							
Parks								
Island Beach	3,002	—	624,224	•		•		•
Barnegat	31	—	60,137			•		•
Double Trouble	1,677	—	12,928					•
TOTAL	4,710							

Sources: New Jersey SCORP, 1977
 New Jersey Division of Parks and Forestry, 1978
 Comitta/Frederick Associates, 1980

The three categories of state land amount to 235,000 acres in the Pinelands, with 176,000 acres of the total in the Preservation Area. Adding military facilities and national wildlife refuges, the open space totals are 300,000 acres and 219,000 acres, respectively. Approximately 65 percent of the state lands are state forests, a figure which rises to 80 percent in the Preservation Area. About two-thirds of the Pinelands' total forests are in Burlington County. Bass River, Belleplain, Lebanon, and Wharton State Forests provide for swimming, fishing, boating, picnicking, hunting, and canoeing. The same four maintain all the 526 campsites at state-owned facilities in the Pinelands. The forests serve nearly 600,000 visitors annually. They are briefly characterized as having a wide range of upland and lowland habitats and physiographic types; slowly moving, meandering streams; a network of sand roads; and an occasional ghost town.

Also operated by the Division of Parks and Forestry are the region's three parks. Island Beach State Park is a ten-mile stretch of barrier island which is among the most popular of New Jersey's recreation areas. Over 500,000 people come to the park annually, attracted by the combination of shore activities in a natural setting. Barnegat Lighthouse is an historical landmark located on a 31-acre site at the northern tip of Long Beach Island; the park there provides swimming and a scenic overlook. Double Trouble State Park is a relatively recent park acquisition located in Ocean County. The state has plans to expand the area in the near future.

Wildlife management areas in the Pinelands total 77,000 acres, with about half in Ocean County and equal shares of the remainder in Atlantic, Cape May, and Cumberland Counties. Wildlife areas provide waterfowl, upland game, and deer hunting; saltwater fishing in coastal areas and freshwater fishing inland; and nature study and photography. These areas provide over-wintering sites and nesting places for many bird populations, and breeding areas for all types of wildlife. The facilities generate economic benefits by their attraction to hunters.

As discussed in Chapter Three, New Jersey has a Natural Areas Program for special designation of natural and ecological resources. State and private lands are studied for their possible inclusion in the program. The areas now designated in the region are all within state lands. The state is also currently developing a Wild and Scenic Rivers System to complement the similar national system. Designation studies for two Pinelands rivers, Cedar Creek and a 12-mile stretch of the Mullica, have been prepared and are under review. The State Comprehensive Outdoor Recreation Plan (SCORP) indicated in 1977 that eight Pinelands streams, including the Mullica, Maurice, Bass, Batsto, and Wading Rivers and their tributaries, the downstream portion of the Great Egg Harbor River, and Rancocas and Nescochague Creeks, should be studied as potential state rivers. Over the past several years a Recreation Rivers study co-sponsored by the federal Heritage Conservation and Recreation Service identified a number of other Pinelands streams and tributaries that meet or appear to meet the criteria for inclusion on the National River Inventory Lists. Additionally, the DEP and the Commission are in the process of a statewide assessment of rivers for potential study, and other Pinelands rivers may be recognized as a result of this investigation.

County Parks

Because of the large amounts of state-owned public open space and remote private open space in the Pinelands, the county park systems are relatively underdeveloped. This is also partly due to their environmental sensitivity. The county facilities represent a potential resource for future recreation needs. There are five county parks here, occurring in three counties, as shown in Table 4.19.

Table 4.19—County Parks in the Pinelands

County	Park	Acreage	Activities				
			Picnicking	Playground	Swimming	Boating	Fishing
Atlantic	Estell Manor	1,652	•		•	•	•
Camden	New Brooklyn	600	•			•	•
Ocean	Miller Airpark	850	•	•			
	A. Paul King	60	•	•	•	•	•
	Tuckerton	17		•	•	•	•

The first three parks listed are relatively undeveloped and of sufficient size to provide a wide range of activities. The various existing sites would require certain actions and facilities, such as restoration, walkways, bikeways, and other improvements, to increase their recreation use. Some of the counties have plans to acquire and/or develop other properties to increase recreational opportunities for county residents.

Non-Profit and Quasi-Public Facilities

Non-profit and quasi-public organizations also provide recreational opportunities and services. The Batona Hiking Club maintains the 39-mile Batona Trail. It crosses both private and public land in Burlington County. The Conservation and Environmental Studies Center at Whitesbog maintains 63 acres for hiking and nature walks, and two private wildlife management refuges provide nearly 20,000 acres. The Boy Scouts and Girl Scouts, church organizations, and the YMCA offer camping programs at 13 locations. Private, non-profit clubs include the East Coast Enduro Association, which maintains over 650 miles of motorcycle enduro trails throughout the Pinelands, canoeing clubs, and over 200 sportsmen's clubs.

Proprietary Facilities

The two most conspicuous examples of proprietary recreational facilities in the region are canoe liveries and campgrounds. Canoe rentals are provided by 14 liveries equipped with approximately 1,200 canoes. The liveries are a long-established business in the Pinelands, and in fact one has been operating for over 100 years. Most liveries are in the vicinity of Wharton State

Forest, and all are located in the northern part of the Pinelands. Canoeing opportunities include lazy trips through cedar swamps on meandering streams, overnight trips on wild and scenic rivers, and leisurely paddling and fishing. Two of the principal canoe rental shops provide an estimated total of 7,000 trips per season.

Private campgrounds are numerous in the Pinelands, particularly in the area from southern Burlington County southward. Table 4.20 provides a breakdown by county, including the number

Table 4.20—Private Camping Facilities in the Pinelands

County	Number of Campgrounds	Camping Sites
Atlantic	19	2,595
Burlington	9	1,491
Camden	1	100
Cape May	24	6,525
Cumberland	2	165
Gloucester	6	450
Ocean	10	1,538

Sources: New Jersey Division of Travel and Tourism, 1979
 Cape May County Planning Board, 1980
 South Jersey Resource Conservation and Development Council, 1979
 Comitta/Frederick Associates, 1980

of campgrounds, and campsites. The total for the Pinelands is 71 campgrounds, containing 12,700 campsites. Atlantic, Burlington, Cape May, and Ocean Counties account for about 90 percent of the total, and Cape May has an additional 6,000 sites within the county. Campground activities are oriented to the Pinelands' streams and lakes, and to the coastal bays and beaches. More than two-thirds of the sites are for trailer camping, not tents, with wastewater, potable water, and electrical hook-ups. A few provide telephone and cable television service. Some of the campgrounds occupy over 100 acres with close to 800 sites, indicating a potential summer weekend population of over 3,000 in a single campground. The private campgrounds afford a less expensive overnight opportunity for summer visitors than motels and hotels near recreation areas, and are important to the local economy.

Trails

There are many opportunities within the Pinelands area for hiking, bicycling, horseback riding, and organized enduro events. A good deal of present trail use is undertaken on the countless unmarked sand roads and trails which are found throughout the Pinelands. Some of these routes are well-known and lead to scenic vistas, such as the views from Apple Pie Hill or the Forked River Mountains, or to the several state fire towers. Others may lead to historic sites. However, many of the roads and trails go nowhere in particular. Unless the user knows the route, it may produce more of an experience than was anticipated.

Table 4.21 summarizes for each activity and by county the number of miles for each category of trail use. As the table shows, the number of miles of motorcycle enduro trails far exceeds the number of other trail activities. The enduro trails are used seasonally by chartered member groups of the East Coast Enduro Association. These trails are on both private and public land and are concentrated within the Preservation Area. They are marked only on the day of the enduro event, and the markers are removed the same day.

The most visited trail in the Pinelands is the 39-mile Batona Trail, maintained by the Batona Hiking Club. This trail runs between Org's Hat and the Route 563 crossing of the West Branch of the Wading River in Burlington County. The trail connects the Lebanon State Forest with the Wharton State Forest, the Pinelands' two largest state forests. There are active plans to extend the Batona Trail to Bass River State Forest in Burlington County and eventually to the bay in Ocean County.

Table 4.21—Pinelands Trail Categories
(in miles)

	Atlantic	Burlington	Camden	Cape May	Cumberland	Gloucester	Ocean	Pinelands Total
Bicycle Route	65	92	18	31	4	1		211
Bicycle Route to Seashore	41	54	7	41	8	12	4	163
Hiking Trail	15	105	23.5	6	—	—	17	149.5
Hiking—Nature Trail	9	7	—	—	—	—	—	16
Hiking—Batona Trail	—	39	—	—	—	—	—	39
Hiking/Horse Trail	—	16	—	—	—	—	—	16
Enduro Trail	—	239	—	7	169	—	236	651

Source: Comitta/Frederick Associates, 1980

An important element in future trail development in the Pinelands is the New Jersey Trails Council. The Council is preparing a statewide trails master plan, to be completed by the end of 1980. It will establish a framework for a Pinelands trails system for such uses as hiking, horseback riding, and bicycling.

Characteristics of Recreational Use

A profile of recreational users adopted from a 1975 survey of New Jersey residents conducted for the 1977 New Jersey Statewide Comprehensive Outdoor Recreation Plan (SCORP) revealed that among 26 activities which may be classified as "Pinelands activities," bicycling, driving for pleasure, and swimming were the most popular. Other highly rated activities were canoeing, trail hiking, trailer and camper camping, hunting, and saltwater boat fishing. Sailboating and trail biking were among the least popular (see Table 4.22).

Participation estimates for 1980 prepared by a consultant to the Commission indicates that out-of-state participation in recreational activity in the Pinelands is close to 14 percent. Data from the SCORP reported that an average of 60 percent of the out-of-state recreation participants in New Jersey traveled from adjacent counties in New York and Pennsylvania. Canoeing, saltwater swimming, and trailer camping were most popular among out-of-state participants. Other activities with high rates of out-of-state participation include sailboating, tent camping (car access), and fresh and saltwater fishing. Activities less likely to involve out-of-state participants include bicycling, driving for pleasure, hunting, and trail biking.

Although recreational activity is generally reduced during the winter months, outdoor recreation in the Pinelands is a year-round phenomenon. Campgrounds at all state parks and a few private facilities remain open all year, and even the canoeing rivers maintain adequate flows and remain ice-free throughout most of the year. An analysis of the peak use data reported in the SCORP revealed that bicycling and trail biking participation did not concentrate on a particular day or weekend. Trail hiking, nature walks, camping, horseback riding, and historic site visiting are among activities that exhibited a moderate amount of peak day or weekend use, while swimming was found to be concentrated at peak periods. Hunting, which takes place during a controlled season, is an extreme example of a seasonal and/or peak use activity. Overall, the New Jersey survey found that 90 percent of the respondents participated in their favorite activities during the weekend and 60 percent during the weekdays.

The popularity of recreational activities which attract visitors to the Pinelands is reflected in Table 4.22. The first column ranks the 26 activities according to the number of activity occasions estimated to have occurred during 1980 in the Pinelands. The second column ranks the same activities for total estimated occasions in the seven Pinelands counties. The third column ranks the activities according to the 1975 survey conducted as part of the SCORP.

As can be seen from the table, bicycling, the first-ranked Pinelands activity, is also highly

Table 4.22—Popularity Rank of Pinelands Recreational Activities

Activity	Pinelands Activity Occasions	Pinelands Counties Activity Occasions	New Jersey Survey Respondents
Bicycling	1	2	2
Camping, trailer	2	14	23
Driving for Pleasure	3	3	1
Hunting	4	6	24
Fishing, saltwater, boat	5	7	9
Swimming, freshwater	6	4	5
Sunbathing	7	5	6
Swimming, saltwater	8	1	3
Fishing, saltwater, shore	9	11	14
Camping, tent, by car	10	18	17
Hiking, nature walk	11	8	11
Hiking, trail	12	17	15
Birdwatching	13	9	19
Boating, sail	14	16	25
Boating, saltwater, motor	15	10	12
Canoeing	16	21	22
Horseback riding	17	15	13
Picnicking with family	18	13	4
Historic site visiting	19	12	7
Wading	20	19	16
Harvesting/Picking	21	23	10
Trail biking	22	24	24
Boating, freshwater, motor	23	25	25
Fishing, freshwater, boat	24	26	26
Picnicking with group	25	20	20
Fishing, freshwater, shore	26	22	22

Sources: New Jersey Department of Environmental Protection, "New Jersey Outdoor Recreation Demand Study," Volume 1, 1976
Comitta/Frederick Associates, 1980

ranked for the counties and the state as a whole. However, this figure is probably grossly overstated as the result is likely to include neighborhood as well as tour biking. Camping by trailer or camper, the second ranked activity, is therefore probably the most predominant Pinelands recreation activity. Interestingly, however, camping ranked quite low according to survey respondents and as a proportion of the total Pinelands counties activities. Similar results are reported for sailboating, bird watching, and canoeing.

Other activities which appear popular in the state or the seven Pineland counties are not so in the Pinelands, as illustrated by saltwater swimming and picnicking.

Supply and Demand

The interaction of recreational supply and demand defines the open space and recreational needs of an area. The New Jersey SCORP has extensive information on the supply of recreational areas and facilities at various levels of government, some of which has been abstracted in this section. The SCORP report also developed information on recreational demand by defining socioeconomic characteristics and recreation participation, eliciting residents' preferences from

a questionnaire, and converting the data into demands for various activities. Open space needs were examined using two methods: balanced land use guidelines, which describe the need for open space provided by various levels of government as fixed percentages of developed and developable lands; and acres per population standards, which relate the need for open space at various levels of government to fixed open space standards based on population estimates. The balanced land use calculations serve as federal, state, and local goals. Because they represent future goals, they generally produce higher need figures than the acres per population standards, which reflect the present need for open space at municipal and county levels.

Applying the balanced land use guidelines to the Pinelands counties results in total municipal and county open space deficits ranging from 8,000 to 37,000 acres per county, and a state and federal deficit of 45,500 acres in southern New Jersey. As the guidelines call for 3 percent and 7 percent of the developed and developable land areas of municipalities and counties to be dedicated to open space areas to serve local residents' needs, these open space requirements will need to be re-examined by municipal and county governments. As local open space recreation deficits will probably change, decreasing in areas of low residential densities and increasing in growth areas, the amount of public open space to be provided in the region should be carefully reviewed in light of the extent to which present and future state areas and facilities will satisfy local recreation needs.

The acres per population standards used by the SCORP are a way to measure the intensity of the present need for open space. These standards (8 acres per thousand for municipal areas and 12 acres per thousand for county areas) indicate that all counties except Cape May exhibit a shortage of total open space to meet present needs. The most severe shortages are noted in the more heavily populated Pinelands counties such as Camden and are mainly the result of development outside of the Pinelands. In combination with the balanced land use guidelines, the acres per population standards will represent an important tool in assessing the region's present and future total open space needs.

The New Jersey SCORP identified similar deficits in facility needs based on the demand for a wide set of activities by users who were surveyed. The four most popular outdoor recreation activities are bicycling, swimming, and walking or driving for pleasure. The former two, which can require facilities, have shortages in each of the seven counties. Similar deficits exist for other popular activities such as nature walks, boating, and general outdoor open space pursuits.

With its rich diversity of natural resources, and the increases in demand for all types of recreational and open space activities, the Pinelands offer a rare opportunity for continued recreational development. Much land is currently in public ownership, and there are detailed plans at the county and state level for additional areas and activities. Of particular importance is the accommodation of the many activities, users, and providers in a manner which utilizes the various resources while minimizing adverse impacts and conflicts.

The Pinelands also exhibit several imbalances in available recreational resources. Certain subregions have large holdings in some categories of state recreational land, but are lacking many necessary facilities at the local level, while other subregions are lacking in the full range of recreational lands, activities, and facilities. Other imbalances occur in the provision of activity types by the private and public sectors. For example, the great majority of campsites are offered by private operators, and most of the sites are for trailer camping as opposed to tents. The state's development of intensive recreation areas such as Atsion Lake, while not without controversy, demonstrates an attempt to broaden the type of recreational experiences provided.

CHAPTER FIVE

Regional Growth Factors

The pressure of growth around and within the Pinelands during the past decade was a primary reason for the enactment of national and state legislation mandating the development of this Comprehensive Management Plan. The region's growth reflects not only the traditional suburbanization emanating from more urbanized adjacent areas, but also two unique growth-shaping phenomena: casino gambling in Atlantic City, and large-scale retirement community development in Ocean County.

The character of development in the Pinelands, although not nearly as advanced, is typical of that found in other areas of the state, where a steady spread of single family dwellings consumes large land areas in an inefficient and costly manner. If allowed to continue unchecked in a scattered and piecemeal fashion, the future development of the Pinelands would be overwhelming in its impact on water quantity and quality, and on the preservation of the region's existing character.

The Commission's studies indicate a continuance, and indeed an acceleration of the growth pressures affecting the Pinelands National Reserve. Accommodating future growth in a manner which protects the unique environmental resources of the Pinelands is a key component in the successful implementation of the Comprehensive Management Plan.

Population Trends

In 1978 the population of the municipalities which have a majority of their land area in the Pinelands National Reserve was estimated to be 394,154 persons, or slightly more than 5 percent of the total population of New Jersey. Because the Reserve includes only portions of several municipalities, and because development concentrations in these municipalities often exist outside the Pinelands boundary, the Commission estimates the population of the Reserve itself to be approximately 323,000. As shown in Table 5.1, the population has been rising steadily since 1950. While the most recent period studied, 1970-1978, shows the greatest numerical increase, it represents in most cases the continuation and extension of a gradual long-term trend, rather than a departure from previous historical patterns.

Table 5.1—Pinelands Population and Population Increase 1950 to 1978

	Pinelands population	Population change	Population change (percent)	Average annual change (percent)
1950	118,400			
1950-1960		+ 72,731	+ 61.4%	+ 4.9%
1960	191,131			
1960-1970		+ 77,613	+ 40.6%	+ 3.5%
1970	268,744			
1970-1978		+ 125,410	+ 46.7%	+ 4.9%
1978	394,154			

Source: 1950, 1960, and 1970 from U.S. Census. 1978 estimate from New Jersey Department of Labor and Industry

Table 5.2 compares the population growth in the Pinelands portion of each county with the non-Pinelands portion as well as the New Jersey portion of the Philadelphia Standard Metropolitan Statistical Area (Burlington, Camden, and Gloucester Counties). Although the increase in the 1970-1978 period is greater than in the 1960-1970 period for Pinelands communities in each county except Burlington, of primary significance is the population increase relative to non-Pinelands areas of the counties. As growth in nearly all parts of New Jersey has slowed in the past decade, the Pinelands communities have been largely immune from this trend. (Burlington County's relative population growth slowdown in the 1970-1978 period is entirely the result of a drop of some 13,000 in population associated with the reduction in activity at Fort Dix.)

Table 5.2—Historical Population Trends in the Pinelands and Surrounding Areas by County

County	Area	1950	1960	1970	1978	1960-1970 change	1970-1978 change
Atlantic	Pinelands	35,055	48,415	62,173	78,718	13,758	16,545
	Balance	89,768	111,475	112,870	111,266	1,395	(1,604)
	Pines %	28.1	30.3	35.5	41.4		
Burlington	Pinelands	36,401	68,111	88,367	108,189	20,256	19,822
	Balance	99,509	156,388	234,765	255,355	78,377	20,590
	Pines %	26.8	30.3	27.3	29.8		
Camden	Pinelands	8,413	13,335	16,076	26,373	2,741	10,297
	Balance	293,330	378,700	440,215	445,249	61,515	5,034
	Pines %	2.8	3.4	3.5	5.6		
Cape May	Pinelands	6,320	7,689	8,673	12,093	984	3,420
	Balance	30,811	40,866	50,881	64,887	10,015	14,006
	Pines %	17.0	15.8	14.6	15.7		
Cumberland	Pinelands	2,834	3,105	3,743	4,670	638	927
	Balance	85,763	103,745	117,631	125,526	13,886	7,895
	Pines %	3.2	2.9	3.1	3.6		
Gloucester	Pinelands	10,597	16,847	23,061	31,476	6,214	8,415
	Balance	81,130	117,993	149,620	168,521	31,627	18,901
	Pines %	11.6	12.5	13.4	15.7		
Ocean	Pinelands	18,780	33,629	66,651	132,635	33,022	65,984
	Balance	37,842	74,612	141,819	198,894	67,207	57,075
	Pines %	33.2	31.1	32.0	40.0		
Phila/NJ SMSA (NJ portion)	Pinelands	55,411	98,293	127,504	166,038	29,211	38,534
	Balance	473,969	653,081	824,600	869,125	171,519	44,525
	Pines %	10.5	13.1	13.4	16.0		

Source: 1950, 1960, and 1970 from U.S. Census. 1978 estimates from New Jersey Department of Labor and Industry

While the Pinelands communities increased in population by 125,410 between 1970 and 1978, the balance of southern New Jersey (non-Pinelands municipalities of the seven counties and Salem County) increased by 121,897 persons. Pinelands municipalities, therefore, accounted for just over 50 percent of all population growth in southern New Jersey during that period. This compares to 29 percent of the total southern New Jersey growth during the 1960's. The result is a shift in development toward the Pinelands in a number of counties, particularly in Atlantic and Ocean. This is most significant in Ocean County, since, unlike Atlantic, the non-Pinelands municipalities of Ocean County were also subjected to growth during the 1950 to 1978 period.

As Table 5.3 indicates, Pinelands municipalities in Ocean County accounted for over half of all growth in the county between 1970 and 1978. They also represent over half of the entire population increase in the Pinelands during the same period. Since 1950, the percentage of total Pinelands population living in Ocean County has increased from 15 percent to 33 percent.

There have also been noticeable changes in the trends affecting other parts of the Pinelands, as shown in Table 5.4. This table presents population by subarea for Atlantic, Burlington, and Ocean Counties. Again, the contrast between Pinelands and non-Pinelands areas is clear. The

Table 5.3—Growth in Pinelands and non-Pinelands Areas of Ocean County, 1950 to 1978

	Pinelands municipalities	non-Pinelands municipalities	Pinelands growth
1950-1960	14,849	36,770	28.8%
1960-1970	33,022	67,207	32.9%
1970-1978	65,984	57,075	53.6%

population increase for all Pinelands subareas, with the exception of the Fort Dix area in Burlington County, was greater in 1970-1978 than in 1960-1970. The opposite was true of most non-Pinelands subareas, the only exceptions being those along the shore which experienced only moderate growth in both periods (Ocean) or declined in population over both periods (Atlantic). Finally, certain key areas, which experienced only moderate growth prior to 1970, showed a significant increase during the 1970's. The central Pinelands subarea in Burlington County, which had increased in population by only 2,417 over the 20-year period from 1950 to 1970, increased population by nearly double that amount from 1970 to 1978. A similar pattern took effect in the central and southern subareas of Ocean County, where in both cases the 1970-1978 increase was substantially larger than the 1950-1970 increase. These are three areas within the Pinelands where recent (post-1970) growth does represent a departure from previous historical patterns, and where settlement patterns have begun to change significantly.

Table 5.4—Historical Population Trends by Subarea for Atlantic, Burlington, and Ocean Counties

County	Area	1950	1960	1970	1978	1960-1970 change	1970-1978 change
Atlantic	Shore	76,415	82,984	76,786	74,152	(6,198)	(2,634)
	Suburban	22,196	33,692	42,845	45,602	9,153	2,757
	Middle	13,392	16,204	23,048	31,648	6,844	8,600
	Western	19,027	26,455	30,589	36,259	4,134	5,670
	Southern	1,369	1,555	1,795	2,323	240	528
Burlington	Central	4,524	5,577	6,941	11,378	1,364	4,437
	North	27,653	51,516	56,209	56,925	4,693	716
	West	5,418	12,268	26,561	41,368	14,293	14,807
	Northeast	6,644	9,355	17,889	18,109	8,534	220
	Southwest	15,549	27,140	35,833	42,253	8,693	6,420
Ocean	Shore	9,243	12,573	17,947	24,259	5,374	6,312
	Northeast	27,639	61,065	121,396	171,562	60,331	50,166
	Northwest	8,882	15,779	32,580	56,641	16,801	24,061
	Central	6,899	14,462	27,142	57,568	12,680	30,426
	South	3,946	5,079	9,405	21,499	4,326	12,094

Economic Activity

Based upon an analysis of employment centers within the region surrounding the Pinelands, it is apparent that a substantial part of past residential development in the National Reserve is linked to economic activity taking place outside of its boundaries.

The analysis conducted during the development of the Comprehensive Management Plan indicates that only 16 employers or facilities employ 100 or more workers within the Pinelands. It is important to stress that this does not mean that there is not valuable economic activity in the Pinelands. Rather, it means that this valuable activity, which is heavily agricultural, is not linked to the generation of development pressure in the manner that is typical of large-scale manufacturing employment. Within the New Jersey context, 16 major employers is a trivial number. In 1978, there were a total of 3,956 separate employers reporting 100 or more jobs covered by the unemployment insurance system of the New Jersey Department of Labor and Industry.

With the exception of Fort Dix in the northern end of the region, it would appear that no employers in the Pinelands National Reserve are so large as to act as present or potential nodes

of development. The development impact of Fort Dix, although clearly significant in the past, is less so at present, since its level of operations has been steadily reduced in recent years.

Table 5.5 indicates the growth in employment covered by the state unemployment insurance system in the seven counties in which the Pinelands are located, and the share of increases experienced by municipalities which form the portions of those counties within the Pinelands.

Table 5.5—Growth in Covered Employment in the Pinelands Counties, 1972 to 1978

	Pinelands portion	Balance of county	Total	Pinelands share
Atlantic	5,572	883	6,455	86.3%
Burlington	3,712	5,835	9,547	38.9%
Camden	2,869	11,459	14,328	20.0%
Cape May	131	6,655	6,786	1.9%
Cumberland	(42)	3,018	2,976	0%
Gloucester	1,597	10,501	12,098	13.2%
Ocean	7,199	10,866	18,065	39.9%
TOTAL	21,038	49,217	70,255	29.9%

Source: New Jersey Department of Labor and Industry

Within the seven counties approximately 30 percent of the covered employment increase between 1972 and 1978 occurred within the communities which contain the Pinelands. Communities with increases of 1,000 or more jobs were all located on the fringe of the region's boundaries with the single exception of Hammonton in Atlantic County. It is sharply apparent that through 1978 residential growth within the Pinelands was not linked to internal employment growth.

The pattern of major retailing centers serving Pinelands municipalities is consistent with and even more dramatic than the patterns of employment. There are no major regional retail centers located within the Pinelands. Only two centers in Evesham and Hammonton can be considered minor regional shopping centers with as much as \$50 million in annual retail sales in 1977. Although \$50 million has a large ring to it, it is roughly the amount spent annually on shopping by 6,000 to 7,000 moderate income families, or some 20,000 people. For practical purposes, all major shopping by Pinelands residents is done outside of the region. The perimeter of the Pinelands is well served by shopping facilities, generally oriented to automobile traffic.

With regard to Ocean County, it is worth noting that although the population distribution of the county has been moving into the Pinelands, to the west and south of the initial population centers, the same has not been true of retail shopping activity. Dover Township today is responsible for a larger share of total countywide retail trade than was true five years ago. The same is true of the northeastern part of the county generally.

It may be concluded from the foregoing that no significant center of economic activity, either in terms of employment or retail trade, has yet developed in the Pinelands. As a result, residential development within the region has been perimeter development closely linked to areas outside the Pinelands offering employment and shopping. There is no evidence, at least in terms of data assembled in 1977 and 1978, of any shift in that pattern. Indeed, the concentration of retail trade in northeastern Ocean County, and more importantly, the resurgence of Atlantic City as a center of economic activity, should strengthen this pattern in the years to come. This would argue that there is little economic necessity or justification for extensive development in the interior of the Pinelands, leaving aside the attractions of inexpensive vacant land. Indeed, it can be argued that large-scale "leapfrogging" into the interior areas could trigger either substantial commuting and energy costs, or alternatively, the need for major additional investment for commercial and other infrastructures linked to residential development.

Development Activity

With the exception of some townships in Ocean County, the most active Southern New Jersey

municipalities in terms of building permit issuing are outside the Pinelands. Many Pinelands communities did show significant levels of growth during the last decade, but this development tends to be located largely around the region's perimeter. The relatively few developments away from the perimeter tend to be modest in scale, with a handful of exceptions such as Crestwood Village, the large senior citizen development in Ocean County. Most of the recent developments in Shamong and Tabernacle Townships in Burlington County, for example, are quite small, being subdivisions of under 100 homes. Because these developments have tended to be scattered, however, their impact in terms of land consumption and transformation of community character is likely to be substantial.

The cumulative effect of development around a perimeter of open land such as the Pinelands is to shrink that perimeter. This is taking place in many areas of the Pinelands today. The pattern of development, however, strongly suggests that it is possible to place bounds on the current trends in order to move toward a more systematic balancing of environmental and development objectives.

Land Transaction Analysis

Based upon an analysis of vacant land transactions, as annually assembled by the New Jersey Division of Taxation for 1965, 1969, and 1972 through 1980, the Commission has determined major trends in the land market affecting the Pinelands region. The following are the principal findings of this analysis:

Land market activity in the Pinelands peaked in 1973, dropped significantly during the 1974-75 recession, and had not recovered to the 1973 level through 1978. This is shown in Table 5.6, which compares the total value of transactions in Pinelands municipalities, in both current and constant (1967) dollars.

Table 5.6—Total Value of Vacant Land Transactions in the Pinelands

Year	Current Dollars	Constant Dollars*
1965	2,355,000	2,492,000
1969	4,933,000	4,492,700
1972	14,279,000	11,395,800
1973	22,552,500	16,944,000
1974	21,050,000	14,251,900
1975	15,415,000	9,562,700
1976	17,599,000	10,322,000
1977	24,130,000	13,294,800
1978	28,111,000	14,408,500

* 1967 value (adjusted according to Consumer Price Index)

Source: New Jersey Division of Taxation. Analysis by Alan Mallach Associates

There are significant variations by area within the Pinelands in terms of land market activity, both in terms of overall level and recent trends. As Table 5.7 shows, the different counties in the Pinelands show significant differences in their growth patterns. While the general pattern of decline from the 1973 peak (1974 in Ocean County) is apparent across the region, subsequent developments vary widely. The most significant recent increase has been in Atlantic County. As will be shown later, the increase in land market activity in the Pinelands municipalities of that county is significantly less than that which has been taking place in the shore area. Ocean County continues to be the principal area of land market activity in the Pinelands, accounting for roughly half of the value of transactions from year to year.

As will be discussed below, there are significant variations, as well as shifts over time, between different areas within each county. An example is the significant increase in the

southern Ocean County area's share of total countywide transactions. This share went from less than 2-percent of the dollar value of county transactions in 1969 to 26 percent of the total by 1978, largely attributable to activity in one municipality, Stafford Township (see Table 5.8).

Table 5.7—Dollar Value of Land Transactions in Pinelands Region By County (Values in Current Dollars only)

	Atlantic	Burlington	Camden	Cape May	Cumberland ¹	Gloucester	Ocean ²	TOTAL
1965	594,000	350,000	147,000	218,500	48,000	150,000	737,000	2,244,500
1969	836,000	1,270,000	182,000	479,500	28,000	271,000	1,866,500	4,933,000
1972	1,313,500	3,317,500	461,000	1,512,000	77,000	499,000	7,099,000	14,279,000
1973	2,787,500	5,342,500	732,500	2,830,000	110,000	987,500	9,762,500	22,552,500
1974	2,955,000	3,442,500	470,000	1,195,000	95,000	1,055,000	11,837,500	21,050,000
1975	2,327,500	4,615,000	725,000	1,732,500	227,500	635,000	5,152,500	15,415,000
1976	2,651,500	3,950,000	390,000	1,647,500	20,000	1,117,500	7,822,500	17,599,000
1977	3,885,000	3,692,500	515,000	2,152,500	37,500	837,500	13,010,000	24,130,000
1978	5,940,000	5,495,000	345,000	3,197,500	95,000	902,500	12,136,000	28,111,000

(1) Includes Maurice River Township only

(2) Does not include any transactions in Dover Township

Source: New Jersey Division of Taxation. Analysis by Alan Mallach Associates

Table 5.8—Dollar Value of Vacant Land Transactions in Active Municipalities in Pinelands Region, 1973-1978

	1973	1974	1975	1976	1977	1978	TOTAL	Percent increase 1977-1978
Atlantic								
Egg Harbor	455,000	605,000	262,500	272,500	547,500	977,500	3,120,000	78.4
Galloway	595,000	400,000	325,000	580,000	682,500	1,312,500	3,895,000	92.3
Hamilton	422,500	312,500	535,000	602,500	590,000	1,325,000	3,787,500	94.1
Burlington								
Evesham	1,027,500	480,000	1,382,500	490,000	932,500	1,525,000	5,837,500	63.5
Medford	1,407,500	990,000	627,500	1,345,000	635,000	2,257,500	7,262,500	255
Pemberton	1,330,000	200,000	572,500	792,500	580,000	322,500	3,797,500	(44.4)
Tabernacle	432,500	387,500	540,000	585,000	390,000	735,000	3,070,000	88.5
Cape May								
Upper	607,500	577,500	1,130,000	792,500	1,075,000	1,920,000	6,102,500	78.6
Ocean								
Beachwood	392,500	660,000	487,500	750,000	592,500	225,000	3,107,500	(62)
Berkeley	570,000	1,262,500	720,000	962,500	1,135,000	930,000	5,580,000	(18)
Jackson	1,697,500	2,305,000	875,000	737,500	1,627,500	1,251,500	8,494,000	(23.1)
Lacey	2,917,500	625,000	1,335,000	1,672,500	1,612,500	1,310,000	9,472,500	(18.8)
Little Egg Harbor	515,000	1,212,500	592,500	542,500	655,000	602,500	4,120,000	(8)
Manchester	137,500	870,000	497,500	702,500	3,147,500	1,322,500	6,677,500	(58.2)
Stafford	1,435,000	2,127,500	912,500	1,977,500	3,557,500	5,624,500	15,634,500	58.1

Source: New Jersey Division of Taxation. Analysis by Alan Mallach Associates

A disproportionate share of all land transactions take place in a small number of highly active municipalities. As indicated by Table 5.7 and Table 5.8, four municipalities (Stafford, Manchester, Jackson, and Lacey Townships) accounted in 1978 for 78 percent of the dollar value of land transactions in the Pinelands municipalities of Ocean County. Three municipalities (Evesham, Medford, and Tabernacle Townships) represented 82 percent of the value of land transactions for Pinelands municipalities in Burlington County.

The actual volume of vacant land activity in the Pinelands is modest, relative to the availability of land, or the image of land activity widely held. Outside a handful of "active" Pinelands communities, the amount of land involved in vacant land transactions is generally modest, and appears to be significantly less than the amount of land available for sale. This has been confirmed by discussions with knowledgeable persons in the region.

Table 5.9—Characterized Land Transactions in Central Burlington County Pinelands Municipalities, 1978

	LOTS		ACREAGE		LARGE ACREAGE	
	No.	\$ value	No.	\$ value	No.	\$ value
Bass River	3	22,500	1	25,000		
Shamong	6	60,000				
Tabernacle	22	275,000	10	260,000*	1	200,000**
Washington	6	25,000	1	25,000		
Woodland	17	102,500				
TOTAL	54	485,000	11	310,000	1	200,000

*This total includes 9 transactions in the range from \$20,000-\$29,999. Given the increasingly suburban character of parts of Tabernacle Township, some of these may be "lot" sales rather than "acreage."

**Value given only as "over \$100,000" in data. This analysis gives a consistent value of \$200,000 to all such transactions. Source: New Jersey Division of Taxation. Analysis by Alan Mallach Associates.

As an illustration, Table 5.9 indicates land transactions in central Burlington County Pinelands communities. Three levels of transactions are characterized as lots, acreage, and large acreage. Transactions involving less than \$20,000 are considered to be lots, between \$20,000 and \$99,000 to be acreage, and over \$100,000 to be large acreage.

It is apparent from the analysis that there is very little large-scale land activity taking place in an area where the inventory of privately owned land is immense. It is likely that in the entire area only a few hundred acres were involved in transactions of raw land during the year.

Overall, there is no evidence of a major shift of land activity into the inner Pinelands and away from the edges. One question of particular importance in terms of future growth pressures is whether the more suburbanized areas on the edges of the Pinelands, which have absorbed a large part of the region's growth during recent years, are becoming more fully developed, causing development pressures in the inner reaches of the Pinelands to increase. The evidence strongly suggests that this has not taken place. The vacant land market in border areas inside the Pinelands such as Evesham and Medford, or outside such as Dover (Ocean County) and Washington (Gloucester County), continues to dominate the region. Not only do these townships continue to be growth centers, but more significantly, their rebound from the mid-1970's decline in many cases exceeds that of the central Pinelands communities.

From 1977 to 1978, Evesham and Medford increased their share of total dollar value of land transactions in the Burlington County Pinelands from 42 percent to 69 percent. Both vacant land activity and housing construction remain consistently strong in these communities. Another indicator is major land sales (total transaction value over \$50,000). In Camden County between 1976 and 1978, there were 19 such transactions in Cherry Hill, outside the Pinelands, but only four major transactions in the five Pinelands municipalities of lower Camden County.

Major Land Transactions

An analysis of major land transactions suggests pressure areas for future development activity. The increase in vacant land transactions in Evesham and Medford, for example, increases the likelihood that the development activity in those communities will continue to be sustained. It should be noted that with the exception of Burlington County, the amount of large-scale purchase activity has been consistently greater in the fringe areas immediately outside of the Pinelands than in the Pinelands proper. In Burlington County, the Pinelands communities of Evesham and Medford share the development features of fringe areas in other counties.

Within the Pinelands, the pattern of large-scale land acquisition suggests future development interest in the following areas:

- Galloway Township in Atlantic County
- Evesham and Medford Townships in Burlington County
- Upper Township in Cape May County
- Jackson, Manchester, and Stafford Townships in Ocean County

During the past two years, these seven townships are responsible for 62 of the 90 large-scale land transactions taking place in the Pinelands, or 69 percent of the total. These seven municipalities, which include some of the largest in the region, nonetheless contain only 21 percent of the vacant land inventory in the Pinelands.

County Analysis

The following is a county-by-county assessment of land market trends, in which the particular features or trends affecting areas within each county are discussed.

Atlantic County

Atlantic is the one county in the Pinelands where the volume of vacant land transactions in 1978 significantly exceeded any previous year. Although this pattern is particularly noticeable in Atlantic City and its immediate environs, the increase in land transactions (presumably attributable to the effects of casino gambling) is affecting the Pinelands as well.

To date, the impact of casino development has been greatest in closest proximity to Atlantic City. Land transactions on Absecon Island, for example, increased by 1978 to nearly 900 percent of their 1975 level. The increase is significant as well in the largely developed suburban communities facing the bay. On the mainland, Hamilton, Galloway, and Egg Harbor Townships (communities containing areas of the Pinelands) tend to dominate the land market.

Burlington County

In contrast to Atlantic County, land market activity in Burlington County presents a picture of little significant investment in recent years. In all areas, except for Medford and Evesham, 1978 vacant land transaction dollar values are substantially below peak years in the early and middle 1970's. This reflects to a large degree a general decline in development activity in most of the county, and limited recovery from the housing market collapse of 1974.

The most notable inconsistencies are found in Shamong and Tabernacle Townships, where there has been a steady and significant increase in the number of building permits issued in each of the past five years, without any parallel increase in the volume of land market activity. The increase in permit issuing is fairly directly attributable to the recent inclusion of these two townships within the Philadelphia suburban ring. In other words, houses are now being constructed in those townships for affluent households in the Philadelphia SMSA. At the same time, it would appear that the inventory of vacant land held for development or investment, presumably resulting from transactions which took place for the most part in the early 1970's, is adequate to sustain the current growth.

As noted previously, the peak years of land market activity were the early 1970's. Not only were there substantial land transactions during this period, but also many submissions of large-scale developments for approval throughout the Pinelands. Actual construction, however, tended to decline with the collapse of the housing market in 1974-1975. In recent years, as housing production has risen once again, a large part of the development activity represents continuation of construction in developments approved in the early 1970's. Examples of this in Burlington County include Kings Grant in Evesham and Larchmont in Mount Laurel Township. The same pattern is noticeable in a number of Ocean County communities.

The development taking place in Evesham, Medford, Shamong and Tabernacle Townships, and in Mount Laurel outside the Pinelands, represents the only evidence of growth in the area under study. The balance of the Burlington County Pinelands fringe has shown little activity in recent years. A pattern of sporadic developer and investor interest in some of the municipalities in the Mount Holly area in the early 1970's does not appear to have been sustained. Similarly, the northeastern fringe appears too remote from existing population centers or economic activity to generate any widespread development interest at this time. Within the Pinelands, there has been a significant decline in activity in the north, an area which is heavily influenced by Fort Dix. Again, after considerable activity in the early 1970's, particularly in Pemberton Township, both

land and building activity have declined here, largely as a result of the gradual decline in the scale of operations at Fort Dix.

Camden and Gloucester Counties

The Pinelands areas of these two counties show similar development and land market activity patterns. Both are within the perimeter of suburban development, but remain outside the principal centers of that development in each county. In Camden County, the principal areas for land activity tend to be in Gloucester Township (Blackwood) and Cherry Hill. In Gloucester County, Washington Township (Turnersville) and townships to the north are the most active.

Lower Camden County, Winslow Township in particular, is an extreme example of an area where housing construction has taken place at increased levels with little parallel activity in vacant land transactions. Despite the generally modest and declining level of land transactions, building permit issuance in Winslow was sustained at a level of nearly 300 permits per year during the five years since 1974. It is suspected that this relationship (high volume of building permits to low land transactions) is found in communities where a large part of current building activity is made up of "building out" previously obtained approvals.

The picture is not dramatically different in Gloucester County. Activity is principally in Monroe Township, which can be considered one of the active Pinelands municipalities in terms of land transactions, although not at a scale comparable to the major growth centers of Ocean County.

Cape May County

The Pinelands area in Cape May County presents the opposite picture from that in lower Camden County: a large and increasing volume in land sales activity which has not, at least to this point, been well reflected in housing production. This situation is principally concentrated in Upper Township, where land transactions have averaged over \$1 million per year for the past five years. During the same period, building permits in Upper Township have typically run at a modest level of 100-200 permits per year.

Table 5.10—Dollar Volume of Vacant Land Transactions in Pinelands Municipalities in Cape May County

	Upper, Dennis, and Woodbine	Middle
1965	113,000	105,000
1969	269,500	210,000
1972	742,500	769,500
1973	1,322,500	1,507,500
1974	820,000	375,000
1975	1,187,500	545,000
1976	1,310,000	337,500
1977	1,422,500	730,000
1978	2,465,000	732,500

An interesting additional aspect, illustrated in Table 5.10, is that there has been a significant shift in the focus of land transaction activity within the area. It will be noted that from 1965 to 1973, the value of land transactions in the two clusters of municipalities was almost precisely comparable. Since 1974, however, while Middle Township has experienced a pattern of gradual decline, the increase in the value of transactions in Upper Township and vicinity has been dramatic. Within the three municipalities, Upper Township accounts for the great majority of transactions (78 percent in 1978). The land market in Woodbine is negligible.

The evidence strongly suggests that the observed land market shift is attributable at least in part to the growing importance of Atlantic City as a center of economic activity, as a result of casino development. Outside Atlantic County, Upper Township is the most readily accessible municipality to Atlantic City (via the Garden State Parkway and Atlantic City Expressway). It

contains substantial resources of vacant land, well over 8,000 acres either vacant or being farmed. The large overall volume of vacant land transactions, particularly with regard to the level of current building activity, plus the large number of major transactions that have taken place (15 vacant land sales over \$100,000 during the past four years, including nine in 1978), indicate that Upper Township is a major center of land investment or speculation in anticipation of future development prospects.

Ocean County

Ocean County represents by a substantial margin the largest land market in the Pinelands, as well as the largest center of housing development activity. In addition, it has exhibited a development pattern in recent years that is far more idiosyncratic and irregular, particularly in terms of geographic spread, than is found in any other part of the Pinelands. As was described, most of the development activity in the Pinelands portions of Burlington, Camden, and Gloucester Counties is readily explicable in terms of the gradual spread of suburbanization outward from the center of the Philadelphia SMSA. In a similar vein, development pressures in Atlantic and Cape May Counties are linked generally to Atlantic City, and specifically to the economic activity surrounding casino development. Ocean County shows no such pattern. The municipality with the largest volume of land activity in recent years, Stafford Township, is located at a considerable distance from other centers of development activity. The key to understanding development activity in Ocean County's Pinelands municipalities is found in the nature of the leading development types—retirement communities and second home communities. The locations of these developments are far less predetermined than are the locations of suburban developments characteristic of the Camden and Burlington County Pinelands. Indeed, it is arguable that the economics of large-scale development may even work against proximity to existing development, in view of the lower land costs available in more remote locations.

During the 1960's, land market activity was largely concentrated in the shore and northeastern subareas of Ocean County, outside the Pinelands. The movement of market activity into the Pinelands took place largely in the late 1960's and early 1970's. With the exception of a modest increase in the market share into the southern area, there has been no significant change in the distribution of land market activity since then. The same has largely been true with regard to permit issuing activity, although the decline of the share in the more heavily developed northeastern area is more pronounced.

One significant trend, however, has been the shifting centers of development activity within the county, particularly since the early 1970's. Many of the townships where development was particularly active then have not resumed large-scale growth since the recent (post-1977) upturn in the housing market. At least three municipalities which were highly active growth centers in the earlier period—Lacey, Little Egg Harbor, and Barnegat (Union) Townships—have experienced only modest recent development activity. These three municipalities are also experiencing only modest interest in terms of vacant land activity, although the continuing number of small lot sales in the first two townships cited tends to obscure the land market decline. Each of these municipalities, and particularly Barnegat, appears to be experiencing the "building out" phenomenon, or construction resulting from earlier approvals on which implementation was deferred. This is corroborated by a recent, unrelated study, which attempted to inventory current and planned development activity within the potential housing market area of Atlantic City (Economic Research Associates, 1979). This study identified no "planned/proposed" projects (those in which no construction had yet taken place) in either Lacey or Little Egg Harbor Townships, and only one, a senior citizen community, in Barnegat Township. The study also noted that of nearly 2,000 units in developments under construction in Barnegat Township, only 550 remained to be built. In any event, these three municipalities, which accounted for 23 percent of the building permits issued in the county in 1973, accounted for only 9 percent of the total in 1978.

At the same time, Berkeley and Manchester Townships, by virtue of either more central location or other factors, have been able to maintain a level of housing production in recent years

equivalent to the highest levels of the early 1970's. As a result, they have come to dominate the countywide housing market, issuing 39 percent of all 1978 building permits. Indeed, this represents a modest decline, resulting from the increasing market in other municipalities. Berkeley and Manchester accounted for 54 percent of county permits in 1976 and 42 percent in 1977. These two municipalities, in conjunction with Stafford Township, accounted for 75 percent of all permits issued in the Pinelands municipalities of Ocean County during 1978.

Land market trends vary somewhat in these three key municipalities, although the patterns are obscured by the large number of individual lot sales taking place in all three, particularly Stafford. These sales tend to blur the picture of land acquisition for development or for investment. Still, it is important that Manchester and Stafford Townships each has had 11 transactions at over \$50,000 in the past two years. Berkeley Township has had only two. Generally speaking, it has not experienced a level of land market activity comparable to that in the other two municipalities, particularly Stafford, where there have been 27 such transactions since 1972.

It should be noted as well that a number of Ocean County municipalities, apparently as suited or unsuited for development as those discussed above, have experienced little development activity in recent years. These include Ocean, Eagleswood, and Plumsted Townships. Jackson Township, which has experienced modest development and land activity, appears to have shown a significant increase in land market activity in 1977 and 1978, both in terms of total volume and the number of large transactions (nine transactions over \$50,000 during the two-year period).

The implications of these patterns for future development in Ocean County are uncertain, particularly since the historic pattern of development has not followed a consistent thread in relationship to metropolitan centers or prior development nodes. Although there is no evidence of significant new activity, there is no reason, given past experience, for further development not to happen in communities such as Lacey or Little Egg Harbor in the absence of regulatory constraints. The proximity of Little Egg Harbor to Atlantic City would increase its development potential. It is also apparent that the proximity of at least three municipalities—Jackson, Berkeley, and Manchester—to existing heavily developed areas on the north and east would make them particularly attractive areas for sustained development. It is more difficult to project the future of development in Stafford Township, since the underlying reasons for the development taking place there recently are less well understood.

Development Regions

From a development perspective, different parts of the Pinelands fit into different regions, and fill different roles relative to their region. Parts of the Pinelands in **Burlington, Camden, and Gloucester Counties** are an integral, although still secondary, part of the suburban ring of the Philadelphia SMSA. Most of Evesham and Medford Townships are clearly within the band of suburban development. Other municipalities, such as Shamong, Tabernacle, Winslow, and Monroe Townships, are on the perimeter of suburban development, and are still largely undeveloped.

There is no question that in theory, future development likely to take place in this part of the Pinelands (with the possible exception of Evesham and Medford) could be accommodated in non-Pinelands parts of the SMSA. The number of units produced in these municipalities is not proportionately a major factor in the region, although it is likely that their share would increase in the absence of regulatory constraints. If, however, growth were diverted to other parts of the SMSA outside the Pinelands, the implications could be problematical. First, a large part of that developable area, particularly in Gloucester County, is outstanding farmland which could easily be lost. Second, since the Pinelands Commission has no leverage over the land use policies of non-Pinelands municipalities, the effects could be worse, taken as a whole, than those of carefully controlled and clustered growth within selected parts of the Pinelands.

Although only modest development has taken place up to now in Pinelands municipalities in **Atlantic and Cape May Counties**, these areas appear central to future growth of the region surrounding Atlantic City. It is not possible to conceive of a reasonable solution to the housing

needs that will be probably generated in the coming decade as a result of casino development which does not utilize at least some land area in the Pinelands, most likely parts of Egg Harbor, Galloway, and Hamilton Townships in Atlantic County, and Upper Township in Cape May County. Their importance is exemplified by the increased pace of land transactions in these municipalities, as well as their growing number of planned or proposed land developments.

In the only **Cumberland County** municipality with significant area in the Pinelands, Maurice River Township, there is no evidence of development pressure now or in the near future.

Pinelands municipalities in **Ocean County** continue to represent the principal resource for housing development, particularly but not exclusively for senior citizens, in the county and perhaps in central New Jersey. It is hard to imagine how development could be significantly diverted from these communities without reducing the housing supply, significantly increasing its cost or both. Land in the rapid growth communities of the early 1970's to the north—Dover and Brick Townships—appears to be less readily available and more expensive. Areas in Monmouth County are significantly more expensive, are currently subject to highly restrictive land use regulations, and in any event are largely prime farmland. In short, it would appear unlikely that there will be an alternative to continued but controlled development in the Pinelands communities of Ocean County.

Retirement Communities

Two development phenomena in New Jersey have special consequences for the Pinelands: the proliferation of retirement communities, predominantly in Ocean County, and the advent of casino gambling in Atlantic City. Before proceeding to discuss population projection for the overall Pinelands region, it is necessary to examine these phenomena individually in terms of their impact on the Pinelands National Reserve.

Although there are retirement communities located throughout New Jersey, for a variety of reasons they have come to be a significant factor, both economically and demographically, in Ocean County alone. According to one study, 80 percent of all retirement communities in New Jersey are in Ocean County. Based on official records, the Commission has identified only three such communities in the balance of the Pinelands. Only one, Leisure Towne in Southampton Township, is of significant size. Since the initial development of these communities in the middle 1960's, over 23,000 retirement units have been constructed and occupied in Ocean County. The distribution of retirement community units is shown in Table 5.11 below. The table illustrates one significant shift that has taken place since the early or middle 1970's. Prior to then, a significant part of the development activity took place in the northeastern area, particularly in Dover and Lakewood Townships. With the completion of many of the initial developments, including Leisure Village and Leisure Village East (Lakewood), and Holiday City (Dover), retirement community construction largely ceased in that area. At present, the center of gravity is firmly lodged in the two central communities of Manchester and Berkeley, where nearly all the recent construction as well as the outstanding site plan approvals are to be found.

Table 5.11—Retirement Community Units in Ocean County by Municipality and Time Period

Municipality	Constructed before 1976	Constructed 1976-1979	Remaining approvals
Brick	1,652	256	0
Dover	2,297	15	5
Lakewood	4,990	31	100
Berkeley	3,150	1,628	2,504
Jackson	628	346	6
Manchester	7,110	1,468	2,900
Eagleswood	0	1	53
Stafford	28	62	0
Tuckerton	55	31	0

Source: Ocean County Planning Board surveys 1976 and 1979. Analysis by Alan Mallach Associates

In addition to the remaining approvals noted in the table, there is a certain amount of anticipated activity. Substantial developments, although not comparable to the largest, are in the planning stages in Little Egg Harbor Township (Mystic Shores, with 1,327 proposed additional units) and Barnegat Township (Great Oaks, 530 units). In addition, approximately 300 units of senior citizen housing under governmental subsidy programs are under construction or in planning. (The county now has approximately 300 of these units.)

During the past 15 years, retirement communities have been a significant but not dominant element in the development picture in Ocean County. Although it is impossible to tell precisely, it would appear that units in retirement communities (as classified by the county planning board) represent between 30 percent and 35 percent of the units constructed in the county. Total building permits issued from January, 1970 through December, 1978 were 55,428, to which one may add 21,138 units constructed from 1965-1970, according to the 1970 Census, for a total of 76,566. Reported retirement community units represent 30.8 percent of this total. The share may be higher, however, since some percentage of building permits issued do not result in construction.

By no means all of the increase in senior citizen population in Ocean County is accounted for by retirement community households, however. Retirement communities developed in the county since the middle 1960's have generated an estimated population of individuals over 55 of 42,300 through 1980, assuming a 1979-1980 increment comparable to the past three years. During this period, the total estimated population of Ocean County aged 55 and over has increased by roughly 73,750. The population in retirement communities represents, therefore, about 57 percent of the total. This is in keeping with informal information about development in Ocean County, which indicates that large numbers of the units in modest developments not explicitly limited to senior citizens are indeed bought by such households, either for retirement or as "pre-retirement" dwellings. An example of such a community is Beach Haven West in Stafford Township.

The shift in age distribution should not necessarily have a significant impact on retirement community development. Despite the image of many such developments as oriented toward the "younger" retirees, the demographic data for Ocean County strongly suggests that the great majority of retirement community residents are indeed aged 65 or older. Specifically, between 1970 and 1980, the county population over 65 is estimated to have increased by roughly 41,000 compared to an increase of only 10,000 for the population between 55 and 64. This is shown in Table 5.12. Based on this series of estimates from the Department of Labor and Industry, Ocean County accounted for 26 percent of the statewide increase in population aged 65 and over during the 1970's.

Table 5.12—Population Aged 55 and Over in Ocean County, 1960 to 2000

	Total population				
	1960	1970	1980	1990	2000
55-64	10,790	22,608	33,000	38,600	45,400
65 +	12,793	32,920	73,900	100,200	96,500
	Population change by decade				
	1960-70	1970-80	1980-90	1990-2000	
55-64	11,818	10,392	5,600	6,800	
65 +	20,127	40,980	26,300	(3,700)	

Source: 1960 and 1970 data from U.S. Census. 1980, 1990, and 2000 projections by New Jersey Department of Labor and Industry.

Development Trends

The development of retirement communities in Ocean County is triggered by demographic trends on a statewide rather than a local basis. According to the county planning board, 70 percent of retirement community residents lived in New Jersey previously, including a substantial share within Ocean County itself. The level of increase in population aged 55 or over in the state therefore is a significant determinant of the future of retirement community development.

The Department of Labor and Industry's projections of age distribution for the state indicate that the population aged 55 and over will increase by 215,600 between 1980 and 1990 (see Table 5.13). While this level of increase is less than that which occurred during the previous decade, it represents a substantial market for retirement community units.

Based on the department's projections, and an assessment of the relationship between population and household increases, the Commission estimates an increase in Ocean County between 1980 and 1990 of 18,000 households headed by an individual 65 or over, or roughly 75 percent of the increase during the 1970-1980 period. It would appear, referring back to the information presented in Table 5.11 and the accompanying narrative, that this is a sustainable level in light of retirement community development trends.

Table 5.13—Population Aged 55 and Over in New Jersey, 1960 to 2000

	Total population				
	1960	1970	1980	1990	2000
55-64	571,491	694,722	811,900	795,300	841,200
65 +	550,237	696,989	854,400	1,086,600	1,186,000
TOTAL	1,121,728	1,391,711	1,666,300	1,881,900	2,027,200
	Population increase by decade				
	1960-70	1970-80	1980-90	1990-2000	
55-64	123,231	117,178	(16,600)	45,900	
65 +	146,752	157,411	232,200	99,400	
TOTAL	269,983	274,589	215,600	145,300	

Source: 1960 and 1970 data from U.S. Census. 1980, 1990, and 2000 projections by New Jersey Department of Labor and Industry.

In Berkeley and Manchester Townships, construction has been sustained at a level of roughly 1,000 units per year during recent years, and it could be expected to continue in the absence of regulatory constraints. As the table indicates, existing approvals are adequate to provide for 5,400 additional units. Based on recent trends, these would be built by 1985. The two developments noted in the southern part of the county could be expected to add another 1,800 units, most likely within a five-year span. Assuming that during the next five years at least one additional moderate-sized retirement community is built within the county, one arrives at a conservative estimate of 8,000 potential new retirement community units in Ocean County by 1985.

From a demand standpoint there is no reason to believe that this level could not be maintained for the remainder of the 1980's. As shown in Table 5.12, the over-65 population, which is the principal demand group for senior citizen communities, will probably continue to grow until the 1990's. Continuing inflation, particularly with regard to housing, should add to the demand, since it is likely to increase the value and cost of existing primary housing in areas such as northern New Jersey relative to retirement community units, which tend to be more cost-efficient. Energy costs could arguably divert a larger share of this development to the Sunbelt, but it is likely that proximity to existing communities, friends, and family are a more significant factor in the choice to move to an area such as Ocean County. What may change, however, is the orientation of many such developments, away from the active community like Leisure Village and toward a development type with more supportive services for an older, more sedentary, population.

From the standpoint of feasibility, leaving aside any additional constraints that may be imposed, such as those stemming from this plan, there appears to be no serious barrier to continued retirement community development. All of the preconditions appear to be in place. Land in large amounts at reasonable prices, in view of the nature of the use, is available

throughout the county, with the exception of the barrier island and possibly the northeast area. The scale of much senior citizen development makes it possible to build infrastructure, including sewage treatment facilities, within reasonable cost levels. Finally, there is no reason to believe that local land use regulation will significantly impede continued retirement community development. One municipality, Manchester Township, continues to welcome this development, and others appear at least willing to entertain additional proposals. In short, there appears to be no reason why potential retirement community development should decline, at least during the 1980's.

There is reason to believe, however, that the geographical distribution of senior citizen or retirement community development may shift. As noted, much of the southern part of Ocean County will be influenced by Atlantic City, and such development as takes place there will be reoriented to that market. Retirement community development is likely to continue in Manchester Township, which is relatively far removed from Atlantic City influences. Assuming a positive local climate, another community that would be locationally attractive is Jackson Township, which up to now has experienced only modest retirement community activity. Finally, depending on a variety of factors, including changes in preference, increasing regulatory pressures, and the effect of the age shift within the senior citizen population, higher density multifamily development may accommodate a progressively larger share of the new senior citizen population. Although it may appear unlikely at present, this may come to include the possibility of high-rise development in selected locations along the shore.

Casino Development in Atlantic City

The issue of casino development in Atlantic City is of particular significance to the Pinelands Commission, since the employment, population, and housing that are likely to be triggered as a result are the most significant unknown variables in the entire regional development picture. Even within the short period since development has begun, agencies concerned with predicting its impacts have made numerous changes in their projections, or engaged in extensive controversies over the scale and nature of these impacts. Still, with the experience of the past two years, it should be possible to attempt a preliminary evaluation of the current and future situation.

In order to make any judgment as to the extent of casino development impacts, it is necessary to make a series of prior judgments, regarding initially the number of casinos projected to open and their timetable; the level of employment anticipated per casino; and the secondary employment likely to follow from casino activity. Given employment figures, it is then necessary to establish relationships between these figures and reasonably linked population levels, household numbers, and housing demand figures.

In all of these areas, there is considerable room for argument. Disregarding for the moment the disagreement on projection methodologies, there is a substantial policy question whether or not casino growth should be allowed to continue at a pace which cannot be matched by either the housing market or public service providers. Another important issue to address is the potentially conflicting goals of bolstering the Atlantic City regional economy through casino development and maintaining the character of the Pinelands. Absent a coordinated approach addressing these issues, the levels of development and population growth resulting from continued casino growth will create an enormous impact on the surrounding region. The following discussion is based on the most recent available information related to casino growth and its associated demands, and assumes that this growth will be largely unconstrained. As a result, the projection figures presented should be regarded as being at the upper end of the scale.

Primary Employment

There are four casinos in operation, one or two likely to be in operation in the very near future, at least an additional six in advanced construction or planning, and many others in preliminary but serious planning stages. The most recent analyses have suggested that there will

be 12 casinos in operation by the end of 1982*, and that there will be 26 casinos in operation by the end of 1990**. The New Jersey Department of Labor and Industry's ODEA model projections, which are discussed later in this chapter, assume 14 casinos will be operating by 1990. The ERA study suggests that the development pace will remain rapid through 1985, by which time there will be 20 casinos in operation, and that it will moderate from 1985 to 1990. This study also indicates that the demand for non-casino hotel and motel space will be roughly 32,300 rooms by 1985 and 39,300 rooms by 1990, in addition to the 15,000 to 16,000 casino hotel rooms that will be available by that point. (This is an estimate by Alan Mallach Associates on the basis of more limited data presented in the ERA study. The study is extremely selective in the amount and type of primary data which it presents to support its conclusions.)

The ERA study assumes that employment in each 500 to 600 room casino hotel complex will be in the area of 2,500 to 3,000 workers. Although reasonable, this appears to be on the conservative side since initial employment levels in the first two casinos, according to the DCA study, are over 4,000 jobs per casino. That figure is considerably higher than most projections, or than comparable facilities elsewhere have experienced. As a result, and in the absence of any reason being put forward to explain the higher figure, it is doubtful that it will be sustained. A more conservative projection would be for an average of 3,000 employees per casino by 1990, or 78,000 employees (3,000 x 26).

The increase in hotel and motel rooms will generate a substantial level of employment over and above the casino employment since the great majority of new and renovated hotel rooms in the Atlantic City area will be separate from the casinos. Various figures have been suggested for employment per hotel room; from the sources reviewed, two employees per room appears to be a moderate level. This would result in a non-casino hotel and motel employment level of 64,600 by 1985 and 78,600 by 1990.

In addition, it should be noted that the casino and related industries can be anticipated to employ, more or less consistently through 1990, a volume of construction workers estimated at 8,000 to 10,000. Although the number of construction workers employed directly on casinos is anticipated to decline after the middle 1980's, it is a reasonable assumption that the increase in non-casino construction, particularly housing, will effectively replace casino construction as an employment base for this part of the labor force. Table 5.14 presents a summary of anticipated employment directly related to casinos.

Table 5.14—Casino and Casino-Related Employment to 1990

	1985	1990
Casino employment	60,000	78,000
Hotel and motel employment	64,600	78,600
Construction employment	9,000	9,000
TOTAL	133,600	165,600

Source: Alan Mallach Associates projection

Secondary Employment

The total anticipated employment in the Atlantic City area, of course, includes not only the above, but a certain amount of secondary employment. The ratio between the primary employment shown in the table and the secondary employment, which is generated by the demands of the casinos, the hotels and motels, and their employees for goods and services, is known as a "multiplier." A great deal of the discussion of multipliers in the reports that have been produced dealing with casinos in Atlantic City is confusing and potentially misleading. What is poorly

*New Jersey Department of Community Affairs, *A Review of the Probable Impact of Atlantic City Casino Development* (1980), referred to as the DCA study.

**Economic Research Associates, *Evaluation of the Effects of Casino Hotel Development on the Demand for Housing in the Atlantic City Market Area*, prepared for the Atlantic City Housing Authority (1979), referred to as the ERA study.

understood is that a multiplier which attempts to determine secondary employment levels within a confined geographic area will always be significantly smaller than the total multiplier associated with a facility because of the leakage of economic effects outside the area. The second misunderstanding is the idea that all the multiplier effects stem from Atlantic City proper. This last is not true, and deserves some discussion.

Of all the multiplier effects, only those dealing directly with the purchases of goods and services by the casinos themselves, which are a small part of the total, are entirely derived from within Atlantic City. The non-casino hotels and motels, as well as other tourist services, are likely to be distributed both in Atlantic City and in nearby communities. Finally, the largest part of the multiplier effect is derived from the purchase of goods and services by the employees of the various facilities. The greater part of that activity takes place where the employee lives, rather than where he or she works. As a result, these jobs and their associated population will be widely distributed across the larger region in parallel with the residential distribution of the casino and casino-related labor force.

Housing Shortages

The population increases and resulting housing demand due to casino-related development will have an impact of overriding importance on the Pinelands National Reserve. Given the finite ability of the construction industry to build new units at any time, it is inevitable that a shortage of housing will exist if casino development continues at the anticipated pace. This shortage will particularly affect workers at lower wage levels, who account for a substantial percentage of the labor force (an estimated 50 percent of casino workers earn less than \$15,000). The shortage will also significantly influence the relationship of employment growth and population growth. Even under the most optimistic scenarios imaginable, there is no plausible way in which enough housing affordable to low wage-level workers can be constructed in the area to make possible the influx of large numbers of families in which a low wage, casino-related worker is the primary or sole wage earner. These restrictions produce two possible outcomes in terms of the housing market: first, many low wage-level positions will be filled by secondary workers (husbands or wives of individuals working in more highly paid positions); and second, low wage-level workers who presently live outside the area will not relocate, but will commute long distances to their jobs.

Given the extensive market demand in the area for housing, and the fact that the industry is capable of responding to only a portion of that demand in the near future, it is obvious that the housing opportunities for many income groups will be severely restrained. An additional problem is that existing residents may find themselves priced out of their dwellings. One assumption that is virtually inescapable, given the realities of the Atlantic City situation, is that no anticipated or even plausible level of housing production will adequately address the intense pressure on the existing housing stock in the market area during the 1980's, if the projected number of casinos are built.

Given the cost of new housing, it follows that there will be intense pressure on existing housing from households unable to afford new units. These households, although perhaps not affluent by comparison with many others moving into the area, will be able to outbid a large part of the indigenous population for the available housing units, thereby creating major hardships for low and moderate income households. As an example, certain areas of Atlantic City, such as those defined by the presence of large-scale, subsidized lower-income developments, will undoubtedly remain as "enclaves" of lower income or lower cost housing. In other areas, factors such as landlord pressures and rising property taxes will push less affluent occupants out of sound units in order to make room for newcomers. Still other areas, where the existing housing stock is of such poor quality as to be unsuitable for middle and upper income occupancy, are likely to be redeveloped, with a further loss (at least for a time) in housing units. Although the most intense pressures of these types are being felt in Atlantic City proper, it is likely that during the coming decade they will spread through the market area, wherever an existing housing stock amenable to upgrading can be found.

While the pressing demands on the new and existing housing stock create unprecedented difficulties for many groups, the situation also provides an array of opportunities. For example, the extensive demand for housing for upper income groups may make feasible several approaches for expanding housing opportunities for lower income families. Developers may be quite willing to undertake certain amounts of "least cost" or internally subsidized housing as a condition of approval for development of more expensive units. There is an extensive literature on the ways in which this approach can be carried out, often through provisions incorporated in the local zoning ordinance. The most straightforward is a requirement that a certain percentage of units in any development be for low and moderate income households, usually 15 percent to 25 percent.

An additional incentive is to allow developers to build at a higher density if they agree to exceed the minimum percentage of lower income units. Provisions of this sort are generally more effective where strong market demand makes affluent families more willing to live in economically mixed communities and where the developer, if need be, can pass on his subsidization costs to the expensive units.

One major area in which change is anticipated is that of shore-related housing, including both what is at present year-round and seasonal housing. Conversion of seasonal housing to year-round occupancy is likely to be strong along a substantial part of the shoreline, perhaps extending from Sea Isle City to Long Beach Island. Most communities on Long Beach Island are within roughly one hour of Atlantic City, in the absence of severe bottlenecks. The housing stock in that area, although not inexpensive, is certainly competitive with available alternatives. While this conversion may not result in actual hardship to anyone, it will significantly change the character of these communities, resulting in a sharp increase in demand for public services in communities where services today are largely rudimentary in nature. On the mainland, as has been noted earlier, many of the modest developments in southern Ocean County are occupied by retirees and other moderate income households. These developments have represented in recent years among the least expensive housing units available anywhere in the region. Although the direct pressures will not be as strong as in Atlantic City, it is likely that during the course of the decade there will be a high level of turnover in these developments, with the initial occupants being increasingly replaced by more affluent, younger households. Similar trends, although less visible, will take place among the more scattered, modestly priced housing units throughout the rural reaches of Atlantic County and adjacent areas.

Population and Housing Demand Projections

An important element in the Pinelands management program is the provision of an adequate supply of land in areas which can best accommodate new development to meet the regional need for housing. A significant determinant of the land allocation program discussed in Chapter Seven is the estimate of population and housing demand within and adjacent to the Pinelands National Reserve. This demand figure can be translated into land requirements based on unit type, producing totals for the amount of land required within a selected time frame.

Studies prepared for the Pinelands Commission estimated population and housing demand between 1980 and 1990 and to the year 2000. The development of these estimates involved an analysis of population projections from various state and local agencies, as well as the application of specific estimates such as those produced by Economic Research Associates. The population projections selected for use in the Comprehensive Management Plan are those produced by the New Jersey Department of Labor and Industry's Demographic-Economic Linked Population Model, referred to as the ODEA model (*New Jersey Revised Total and Interim Age and Sex Populations*, April, 1979). These projections are shown in Table 5.15. As its title suggests, the model links demographic projections to economic activity taking place; the projections shown here assume 14 casinos in operation by 1990. The model contains a separate projection method to deal with over-65 population, which is of particular value for Ocean County. This model is regarded as the most analytically sophisticated available from any public agency source, and consequently it has been factored into the land allocation program of this plan.

Table 5.15—Department of Labor and Industry ODEA Model Projections for Populations of Pinelands Counties

County	Estimates		Projections				
	1970	1975	1980	1985	1990	1995	2000
Atlantic	175,900	187,900	207,800	274,800	306,200	317,800	326,500
Burlington	324,700	347,600	376,700	426,900	475,900	526,600	573,900
Camden	457,500	475,600	483,200	512,000	535,900	545,200	552,300
Cape May	60,100	72,300	85,900	114,400	133,100	148,300	163,100
Cumberland	122,000	132,000	135,100	146,600	155,100	161,700	167,600
Gloucester	173,500	190,900	201,300	222,800	242,300	265,600	287,700
Ocean	213,000	293,800	351,600	417,600	480,300	519,900	555,400

The state policy population projections developed by the Office of the Governor in July, 1979 differ from the ODEA model because they are adjusted for the attainment of certain policy objectives. Based on a policy to promote growth or at least to stabilize population in urban areas, these projections limit growth in Atlantic, Cape May, and Ocean Counties to 66 percent over the 1975 level. It is important to note, however, that neither the ODEA model nor the state policy projections disaggregate population figures below the county level. Therefore, it is possible that growth projected by the model within even a predominantly rural county like Atlantic may concentrate in the urbanized portions, leading to a growth pattern consistent with state policy. Another reason why the two projections are not directly comparable is that the policy projections are a year 2000 figure, whereas ODEA provides projections for five-year intervals.

Recognizing that all population projections are subject to change, the Commission has selected the ODEA series as a basis for its land allocation program. It has also ensured that a degree of elasticity is incorporated in that program to account for possibilities of under or overestimation. With these varying assumptions and alternative responses in mind, the Commission proceeded to translate the ODEA population figures into household increase projections.

In terms of development, land consumption, and similar matters, the significant factor is household rather than population increase. An increase in the number of households triggers a demand for additional housing as well as for non-residential development. Household increase is a function of two separate factors: population increase and demographic change in the existing population. Table 5.16 illustrates potential household increases projected for the Pinelands sections of the seven counties to the year 2000 based upon the ODEA model. These figures represent a substantial increase in the level of development in the Pinelands.

To ascertain the upper levels of a growth range associated with casinos and other factors, projections for the distribution of casino-related housing demand to 1990 were also made. Table 5.17 is based on the ERA estimate of 26 casinos by 1990. Because the ODEA projection based on 14 casinos already include a portion of this growth, the maximum number of new households projected can be derived by adding approximately half of the Pinelands portion of Table 5.17 to

Table 5.16—Household Increase Projections for Pinelands Section of Each County to 2000

	1980-1990	1990-2000
Atlantic	38,700	14,600
Burlington	19,700	18,800
Camden	16,100	6,800
Cape May	4,500	2,800
Cumberland	1,300	800
Gloucester	9,000	8,700
Ocean	52,000	31,000
TOTAL	141,300	83,500

Source: Projection by Alan Mallach Associates

Table 5.17—Distribution of Casino-Related Housing Demand for Pinelands Region and Counties to 1990
(numbers of new units)

	<u>Pinelands</u>	<u>Balance</u>	<u>Total</u>
Atlantic	65,600	10,000	75,600
Camden	6,800	6,800	13,600
Cape May	12,400	2,000	14,500
Gloucester	3,400	3,400	6,800
Ocean	32,000	0	32,000
undistributed	2,900	0	2,900
Total	123,200	22,200	145,400

Source: Projection by Alan Mallach Associates (based on ERA projection of 26 operating casinos)

the figures in Table 5.16. The resulting figures were used as a guide in the land allocation program.

Table 5.17 shows that at least three counties—Atlantic, Cape May, and Ocean—are likely to have a significant increase in housing demand as a result of casino gambling. In the absence of a coordinated land management policy, the demand would be capable of drastically transforming those areas. The increase in the Camden and Gloucester County Pinelands areas, although far less, is hardly negligible.

Pinelands Growth Scenarios

The Commission's consultant prepared three scenarios of future growth in the Pinelands, based on different assumptions about the future course of development. The scenarios are described below and are depicted on Plates 24, 25, and 26, respectively.

(1) Unconstrained growth at moderately high levels: This scenario assumed that growth would not be further constrained, or redirected, through the Commission's efforts; furthermore, that the level of population and housing increase during the 1980-2000 period would be, on the average, approximately 70 percent of that projected in the "Population Trends and Social Economic Factors" reports. It was considered unlikely that in the absence of particular constraints, a plausible growth rate would be significantly below that level. The ratio of growth under this scenario, relative to the projections, was not held constant for all areas, but assumed levels as follows:

- 80 percent of projections for Atlantic and Cape May Counties (most heavily affected by casino development);
- 70 percent of projections for Ocean County; and
- 60 percent of projections for Philadelphia/Camden SMSA counties.

(2) Unconstrained growth at high levels: The scenario assumed that growth would not be further constrained, and that the level of population and housing increase would be consistent with that projected in the reports cited above.

Both of these scenarios used generally comparable assumptions about the population and housing densities of projected development. It was assumed that for most parts of the Pinelands area, development would take place at an average level of 1 acre of land consumption for every 2 dwelling units (DU's) generated. This in turn assumes an average residential density of approximately 3.2 to 3.5 DU's per gross residential acre, the balance of the land being used for non-residential and community-serving purposes. Put differently, it was assumed that the development pattern would be of relatively high density in comparison to current development trends in the area; i.e., a development pattern which (a) contains a substantial mixture of multifamily (townhouse and apartment) units, on the order of 50 percent of the total; and (b) assumes that most detached single family houses will be constructed on lots of 1/2 acre or less. Although this can hardly be considered a "high density" pattern, it represents a considerable increase in density over typical 1970's development. Certain modifications were made to this

standard in areas where it was anticipated that still higher development densities would become the norm during the 1980's and 1990's, specifically:---

- an average development density of 1 acre of land consumption to every 3 DU's generated for the "primary" areas of Atlantic County, corresponding to a pattern in which most development was multifamily housing at intermediate densities of 5 to 7 DU's/acre;
- an increase in density to 1 acre per 2.5 DU's generated in Ocean County; and
- an increase in density to 3 DU's/acre in the inner (non-Pinelands) parts of the SMSA, particularly in remaining vacant land in central Camden County (Cherry Hill, Voorhees).

The last two modifications are recognitions of a more intense development pattern, characterized by higher share of multifamily housing (largely condominiums) already emerging in those areas.

(3) High growth levels affected by Pinelands constraints: This scenario assumes overall growth levels generally similar to those in Scenario (2), but further assumes that the location and intensity of development will be significantly modified by the Commission's program, including:

- an effective ban on development (with the exception of scattered modest activity, which is not shown in the scenario maps) within the environmentally sensitive areas designated by the Commission; and
- a significant increase in the average development density in Pinelands growth areas, as a result of land use controls mandating more efficient use of land for development.

Under this scenario, it was assumed that development within the Pinelands generally would be largely multifamily at intermediate residential densities of 5 to 7 DU's/acre. Within the primary casino-affected areas, principally in Atlantic County, development would be at an overall level of 4 DU's generated per acre of land consumption, corresponding to a typical residential density of 6 to 10 DU's/acre. The Commission's analysis indicated that the housing market in the Atlantic County area would be more likely to respond positively to more stringent controls than in other parts of the region. It was further assumed that densities would increase during the total projection period, and would approach the 1 acre per 4 DU level throughout the Pinelands growth areas by the 1990's.

Within these differences, the same overall assumptions about the nature of development were made for all three scenarios. The most important assumptions were as follows:

- Development during the 1980's and 1990's would continue to follow patterns essentially similar to previous decades. The overall direction of development, in a radial pattern moving outward from existing populated areas, would continue.
- Generally speaking, development of areas contiguous to existing development would be favored. With few exceptions (largely those already beginning), dramatic "leapfrogging" will not be a significant development factor.
- A substantial percentage, but far less than the majority of future development in the region, will be accommodated through infill in areas already largely developed. The majority of future development will be in areas today largely undeveloped.
- Road patterns, proximity to existing development, and the availability of vacant land in large quantities will be the most important factors. The availability of existing sewer systems will not be a significant determinant, largely because existing capacity is minimal relative to projected growth.

Although most Pinelands region development will be oriented toward employment centers outside the Pinelands, such as Atlantic City and Philadelphia, there will be significant development of subcenters of economic activity within the Pinelands during the 1980 to 2000 period. These will largely grow out of the accumulation of population within a given area, and particular locational advantages. As suggested above, however, the subcenters are likely to be more oriented toward the service requirements of the population in the vicinity than toward large-scale primary economic activity, such as manufacturing. The Pinelands will still be oriented toward the outside from an economic standpoint.

CHAPTER SIX

Critical Areas

The Pinelands Commission defines critical areas as: (1) geographic areas which contain one or more significant natural, cultural, or economic resources which could be degraded or lost as a result of unregulated development; and (2) natural hazard areas in which development may result in the loss of life or property. A basis for the definition is provided in the federal and state Pinelands laws. In these laws, Congress and the New Jersey Legislature recognize that the Pinelands contain significant resources which have special values and that these may be lost or degraded by incompatible development. Both acts imply that the Pinelands are environmentally critical throughout. The ubiquitous nature of many of the region's valuable features, including groundwater, plants and wildlife, and scenic, cultural, and recreational resources, also argues for the designation of the entire Pinelands as critical.

Within the Pinelands, however, specific areas can be identified and mapped as being of more critical environmental importance than others. These areas can be distinguished by the presence of significant resources and their susceptibility to damage from uncontrolled or incompatible development. The selection of critical areas is the first step towards protection through either regulation or acquisition, two techniques which cannot be applied uniformly across the Pinelands.

The Commission's critical areas study was completed by the firm of Rogers, Golden, & Halpern (1980). The objective was to develop and execute a method for establishing a ranked list of critical areas in the Pinelands. The first step was the definition of significant, natural, and cultural resources. Significant resources are those which are identified as being necessary to maintain the essential character and integrity of the existing Pinelands environment. They are recognized as being valuable to the public in terms of economics, public health, safety, recreation, aesthetics, research, or education. Natural resources are the abiotic element of air, water, and soil and the biotic elements of individuals, species, populations, communities, and ecosystems. Cultural resources consist of archaeological or historic sites of national, state, or local importance, as well as sites which are of value to a local community's way of life. A specific resource may embrace more than one value. Its combined values may also change according to its proposed use.

Standards for Selection of Areas

Specific criteria were used to select critical areas. The criteria were derived from the Commission's consultant reports, from the Pinelands Technical Advisory Committee, from the literature on critical areas, and from the public through public participation workshops. Criteria used to delineate the different classes of critical areas were the presence of the following features:

Ecologically Critical Areas

- Linkage corridors
- Unique or exceptional ecosystems
- Pristine aquatic communities
- Headwaters

- Endangered animal species (national list)
- Diversity of vegetation types within a given area
- Plant or animal species proposed or under review for national threatened or endangered status
- Endangered, threatened, declining, or undetermined animal species (state list)
- Endangered, threatened, or undetermined plant species (Caiazza and Fairbrothers, 1980)
- Representative vegetation types
- Outlier, disjunct, or relict species
- Species at the limits of their geographic range
- Restricted and endemic species
- Breeding areas (nesting and spawning)
- Overwintering concentrations
- Migratory stopover areas
- Areas of scientific interest and research
- Oldest, largest, or exceptional specimen trees

Perceptually and Culturally Critical Areas

- Scenic areas
- Recreation areas
- Archaeological, historic, or architectural areas, including: (1) sites on or potentially eligible for inclusion on the National or State Register of Historic Places; (2) sites containing significant archaeological or historic resources; or (3) buildings on or potentially eligible for the Historic American Building Survey.
- Areas essential to the lifestyle of local residents

Economically Critical Areas

- Agricultural areas, including: (1) prime farmland; (2) unique farmland; or (3) additional farmland of statewide importance
- Timber areas suitable for potential production
- Mineral areas suitable for sand and gravel extraction

Natural Hazard Critical Areas

- Fire hazard areas
- Flood prone areas

Some criteria for the four classes of critical areas conflict when the uses of significant resources are incompatible. For example, the maintenance of habitats for rare or threatened species may conflict with timber harvesting practices. In general, ecologically critical areas are considered the most important.

Ecologically critical areas were emphasized by the Commission because both the federal and state Pinelands acts stress the importance of existing natural resources. The New Jersey Pinelands Protection Act stresses the need to maintain the overall ecological values of the Pinelands. It notes that development poses an immediate threat to the region's ecological resources, especially to the survival of rare, threatened, and endangered plant and animal species and their habitats, and to the maintenance of the existing high quality of surface and ground waters. Both acts require that a map delineating major areas within the Pinelands National Reserve which are of critical ecological importance be included in the Comprehensive Management Plan. The legislative emphasis on the ecological importance provides a basis for establishing a hierarchy of critical area classes. Of the four classes, the ecologically critical areas are paramount.

Criteria for Ecologically Critical Areas

As indicated above, ecologically critical areas are designated on the basis of resource quality, scarcity, or the role their resources play in the ecosystem. Used wisely, these natural resources provide many cost-free amenities and services to the public and to private landowners.

Maintaining the natural system helps to provide flood control, water purification, water supply, pollution abatement, energy conservation, wildlife diversity, and a pleasing and visually diversified landscape. These areas provide sites for outdoor education, scientific study, and production of cranberries and blueberries. They are also of psychological or philosophical value to those who gain comfort from knowing that semi-wilderness areas and rare and endangered species and their habitats still exist. Unnecessary disturbance or pollution can destroy the natural balance, curtailing natural functions or reducing their usefulness. Once lost, these resources and benefits are extremely difficult or impossible to replace.

The following is a description of the features used as criteria to select ecologically critical areas:

Linkage corridors: These corridors connect areas which are preserved in their natural state. They provide continuity for dispersal and genetic exchange among populations of a plant or animal species, ensuring both the recolonization of populations which become locally extinct and the maintenance of genetic variability.

Unique or exceptional ecosystems: These are ecosystem units such as the Plains which have outstanding characteristics. Regenerating cedar swamps are included in this category.

Pristine aquatic communities: These aquatic communities have been exposed to the least amount of disturbance by man, and consequently are truly characteristic of the Pinelands. The data are sufficient to designate four Pinelands streams or portions of them as pristine on the basis of the aquatic communities they contain. Data indicate that 12 other streams or portions of streams are probably pristine on the same basis. Since man's effects on aquatic communities and their habitats are largely derived from activities on adjacent lands, entire watersheds containing streams which are known or believed to harbor aquatic communities characteristic of the pristine Pinelands environment have been mapped.

Headwaters: These are the beginning portions of a river system in which surface waters initially flow. They are more fragile and vulnerable to pollution than the main stem portion of the river. Headwaters are important for the protection of the river system's water quality and for the reproduction of aquatic species. Drainage sub-units containing bogs along with drainage areas in the upper reaches of the stream were mapped.

Nationally endangered animal species: Two species on the national list of endangered and threatened species, the bald eagle and the peregrine falcon, are found in the Pinelands.

Diversity of vegetation types within a given area: There are eight natural vegetation types within the Pinelands. They are pine-oak forests, oak-pine forests, hardwood swamps, cedar swamps, pitch pine lowlands, bogs, inland marshes, and coastal marshes. This criterion is satisfied if at least five of these natural vegetation types are found within a drainage sub-unit.

Plant or animal species proposed or under review for national endangered or threatened status: Before a species is added to the national endangered or threatened list, it must be reviewed by the U.S. Fish and Wildlife Service and then be proposed for inclusion on the national list. Although species being considered for national listing are not officially designated, the Pine Barrens treefrog, which is already listed as endangered in Florida, is known to be under consideration.

Endangered, threatened, or otherwise jeopardized species (state list): Both federally listed species, the bald eagle and the peregrine falcon, are also included on the official state list. The osprey is listed as endangered in New Jersey, although it is not federally listed. Known nest sites were considered in critical area identification. Coastal islands used for breeding by colonial nesting birds such as the least tern, black skimmer, and common tern, were considered, as was a known rookery of the great blue heron. Areas where state endangered and threatened reptiles and amphibians have been sighted since 1970 were considered where information was available. No official state list of threatened and endangered plants exists. The known and probable habitats of plants identified as threatened and endangered by Caiazza and Fairbrothers (1980) were considered.

Representative vegetation types: These are high-quality examples of the eight natural vegetation types (pine-oak, oak-pine, hardwood swamps, cedar swamps, pitch pine lowlands, bogs, inland marshes and coastal marshes).

Outlier, disjunct, or relict species: As described in Chapter Two, some plants and animals may occur as isolated populations separated from the main population distribution of their species. These populations are referred to as disjuncts or outliers. Sometimes these disjunct populations are remnants of a distribution that was more widespread in the past. Such remnant populations are referred to as relicts.

Species at the limits of their geographic range: A plant or animal species can be found distributed over a specific area. This area is the species' range. Populations of species living at the edges of their range are functioning at the limits of their adaptive capacities and are valuable for research. The Pinelands are unusual because many species reach either the northern or southern limits of their range here. These include the corn snake, the Pine Barrens treefrog, and the broom crowberry.

Restricted and endemic species: Endemics are species which are restricted to a small geographical area, such as to a locale within a state, to one state, or to several states. Examples are Pickering's morning glory and sand myrtle.

Breeding areas (nesting and spawning): Many species of animals, especially migratory birds and fish, concentrate in areas to breed. Large concentrations of waterfowl breed in the marshes of the Pinelands region, and large numbers of herons and other colonial nesting birds concentrate in island breeding areas along the coast and in marshes further inland. Other areas which contain a diverse population of breeding bird species were also considered.

There are historical records of four migratory fish, the blueback herring, alewife, Atlantic shad, and striped bass, ascending Pinelands streams in the spring to spawn. The blueback herring and alewife are known to currently spawn here. Recent reports of American shad spawning runs are unconfirmed. Striped bass used to be found in the Lower Mullica, but there are no recently confirmed records. The spawning areas and adjacent nursery areas were considered in identifying critical areas.

Overwintering areas: Large numbers of waterfowl congregate in the marshes of the Pinelands in the winter. Since overwintering species tend to move about, primarily in response to food availability, it is difficult to consistently pinpoint overwintering areas at any given time. Nevertheless, some areas, particularly those managed for waterfowl, tend to have predictably high concentrations from year to year. As described in the wildlife section of this document, deer tend to congregate during winter in sheltered areas that provide food. In the Pinelands, these areas are usually in pitch pine lowlands, cedar stands, and hardwood swamps.

Migratory stopover areas: The Pinelands region is located along the Atlantic flyway, a broadly defined north-south route along which birds migrate in the spring and fall. Certain areas, particularly along the shore, serve as resting and feeding areas for shorebirds, birds of prey, and passerines flying north or south during migration. Where known, such areas were considered in the critical areas evaluation.

Areas of scientific interest and research: Many areas in the Pinelands are important for scientific research. These areas contain examples of different types of biological communities and natural features. Their protection will ensure their availability for research and educational use. Many of these areas were identified by consulting the scientific literature and members of the scientific community. Areas of botanical and herpetological interest, areas of wildlife and forestry research, and water quality and land use study areas were included.

Oldest, largest, or exceptional specimen trees: In the Pinelands, this category refers specifically to champion trees identified by the New Jersey Bureau of Forestry (1977). These are trees which have grown to an exceptionally large size. The Bureau of Forestry keeps a list of the state's largest trees. Thirty-five of these trees grow in the Pinelands including both native species such as a white cedar, with a 9'2" circumference, and exotic species such as a Chinese chestnut, also with a 9'2" circumference.

Area Identification and Ranking

The identification of critical areas involves the choice of criteria, the collection of data, and the identification of specific locations which meet the criteria. Ecologically, watersheds are the most logical geographic units for delineating these areas. Dividing major watersheds into drainage sub-units provides more closely defined boundaries. In the Commission's study, these drainage sub-units were used as the basis for delineating critical area mapping units.

Once critical areas have been identified, it is necessary to determine their relative importance. Ranking land areas according to their levels of criticality is a prerequisite to establishing planning, regulatory, and acquisition priorities. A scaling technique was used to rank the inherent qualities of each critical area. Under this method, individuals assign weighted values, termed importance values, to the criteria. The summation of the importance values of all the criteria associated with a mapping unit yields a numerical value, which is then ranked in comparison to the values of all the critical area mapping units. This method is usually referred to as a weighting summation model. The procedure used by those who ranked ecologically critical areas for the Commission is outlined below:

1. The 17 criteria for determining ecologically critical areas were ranked in order of importance. An importance value of 1 to 10 was then assigned to each criterion.
2. The importance values of all criteria occurring in each critical area were totaled.
3. The critical areas were ranked based on total points. The area with the most total points was ranked highest and the area with the least total points was ranked lowest. An example of the form used to rank critical areas is shown in Figure 6.1

The available data does not permit a determination of the degree to which an area satisfies each criterion. For example, all sightings of threatened and endangered animals were ranked equally because the data is insufficient to determine factors such as population density and habitat quality.

Multiple occurrences for some criteria, such as two endangered species in a mapping unit, were also considered in the final determination.

Information on how people value different criteria for ecologically critical areas was gained from three public workshops conducted during March in Atlantic, Burlington, and Ocean counties and from a survey of the Pinelands Commission staff, natural scientists, and the consultants (Rogers, Golden & Halpern) who compiled the criteria and definitions.

Table 6.1 shows how the different groups ranked the criteria for ecologically critical areas. In all cases, pristine aquatic communities, headwaters, and unique or exceptional ecosystems were ranked in the top three. Linkage corridors, nationally endangered species, breeding areas, state endangered, threatened and declining species, and diversity of vegetation types were also considered to be of relatively high value. Table 6.2 shows the importance values assigned to the criteria for ecologically critical areas. In both cases, the scores and range in values are very similar for the more highly valued criteria and the lower valued criteria.

The average of the values assigned by staff, scientists, and consultants was used to determine the importance value associated with each critical area mapping unit. These relative values are displayed as classes of ranges in Table 6.3 and Plate 27. The classes are 0, 0.1-9.9, 10-14.9, 15-19.9, 20-24.9, 25-29.9, 30-39.9, 40-49.9 and 50. A similar analysis was done for the public values. The relative importance assigned by the public to different mapping units was not substantially different from the values displayed here. This can be attributed to the similarity in ranking of criteria and importance values.

In developing the importance value of each critical area, it was assumed that an area with many different species is more valuable than an area with only one species. The values were increased by a factor of 1.5 for two species associated with a criterion, and by a factor of two for three or more species.

The data indicate that most mapping units have one or more significant resources and qualify

to some degree as critical areas. A low ranking does not imply that an area is not environmentally sensitive. It merely indicates that the area does not contain as many critical factors as an area with a higher score, or that it is not considered as significant by those who placed values on these resources. Many areas have not been extensively studied and data may be sparse or lacking. Further field investigations will add to the data base and may increase the total importance value of some areas. Information of this nature has been provided by the public during the preparation of the critical areas study.

Because of the variation in size among the mapping units, two smaller units which are equal in size to a larger one and which collectively contain the same resources as the larger unit may have lower individual total importance scores. Analysis of clusters of mapping units provides an indication of the overall value of a region such as a watershed.

Basins within the Mullica River system contain mapping units with high importance values. Approximately 68 percent of the mapping units in this basin have importance value totals in the three highest classes. These watersheds include the Wading, Bass, Batsto, Atsion, and Lower Mullica Rivers, and the Sleeper Branch. The significance of this system, which forms the core of the Preservation Area, is evident from a review of Plate 27. Other watersheds within the Preservation Area such as the Cedar Creek and the upper portions of the North Branch Rancocas and Westcunk Creeks exhibit a similar aggregation of highly ranked critical areas.

As shown in Plate 27, critical areas with high total importance values are not restricted to the Preservation Area. For example, the Oyster Creek watershed is composed of two mapping units, both outside the Preservation Area. One of these scored in the highest total importance value class. Furthermore, a number of highly ranked critical areas are clustered in the Dennis Creek watershed in Cape May County.

Nominated Ecologically Critical Areas

At each of the three public critical areas workshops conducted in March, participants were

Figure 6.1—Sample of Form Used to Rank Ecologically Critical Areas

Critical Area Mapping Units	Critical Areas Criteria																
	Linkage corridors	Unique or exceptional ecosystems	Pristine aquatic communities	Headwaters	Nationally endangered animal species	Diversity of vegetation types within a given area	Nationally proposed or under review plant or animal species	State endangered, threatened, declining, or undetermined plant or animal species	Representative vegetation types	Outlier, disjunct, or relict species	Species at the limits of their range	Restricted and endemic species	Breeding areas (nesting and spawning)	Overwintering concentrations	Migratory stopover areas	Areas of scientific interest and research	Oldest, largest or exceptional specimen trees
Cedar Creek (1)																	
Cedar Creek (2)			•	•		•	•	3		•	3	•	•	•			
Factory Branch			•	•		•	•		•								
Newbolds Branch			•	•		•	•										
Daniels Branch		•	•	•		•	•		•	•	•						
Bamber Lake		•	•	•		•	•		•	•	•			•			
Chamberlain Branch			•	•		•	•		•	•	•			•			
Webbs Mill Branch		•	•	•		•	•	3		2	2			•		•	

Legend

- The criterion applies to the critical area.
- 2 Two species from the criterion are found in the critical area
- 3 Three species from the criterion are found in the critical area

asked to nominate areas which they considered to be critical and in need of protection. Public nominations for critical areas were also received through forms distributed at workshops, letters, and other personal communications. Many of these recommendations were general and included headwaters, floodplains, or certain wetlands. Bodies of water such as Barnegat Bay, the Manumuskin River, Cedar Creek, Wells Mill Reservoir, and the Oswego River were nominated. Natural features included the East and West Plains, the Forked River Mountains, and Apple Pie Hill. Bass River State Forest and Colliers Mills Wildlife Management Area were among public lands identified as critical areas through this process. Specific site recommendations included Martha, Sim Place, Bulltown, Friendship, the Makepeace Lake area, and Atlantic Goose Ponds.

Table 6.1—Ranking Criteria For Ecologically Critical Areas

Critical Areas Criteria	Group and Sample Size (n)				
	Staff, Scientists, and Consultants (n = 17)	Burlington County Public Meeting (n = 31)	Atlantic County Public Meeting (n = 22)	Ocean County Public Meeting (n = 29)	Average (n = 99)
Pristine Aquatic Communities	1	1	1	2	1
Headwaters	2	2	2	1	2
Unique or Exceptional Ecosystems	3	3	3	3	3
Nationally Endangered Species	5	5	5	7-8	6
Linkage Corridors	4	4	7	4	4
State Endangered, Threatened, Declining, or Undetermined Species	7	9	6	5-6	5
Breeding Areas (Nesting and Spawning)	6	6	4	5-6	5
Species Proposed or Under Review for National List	8	12-13	10	10	11
Diversity of Vegetation Types Within a Given Area	9	7	11	9	8
Outlier, Disjunct, or Relict Species	11	16	14	15	15
Migratory Stopover Areas	12	8	8	12	9
Restricted and Endemic Species	10	11	12	14	13
Overwintering Concentrations	14	10	9	11	10
Representative Vegetation Types	13	12-13	13	7-8	12
Species at Limits of Their Geographic Range	15	15	16	16	16
Areas of Scientific Interest and Research	16	14	15	13	14
Oldest, Largest or Exceptional Tree Specimens	17	17	17	17	17

Table 6.2--Importance Values of Criteria For Ecologically Critical Areas

Critical Areas Criteria	Group and Sample Size (n)				
	Staff, Scientists, and Consultants (n = 17)	Burlington County Public Meeting (n = 31)	Atlantic County Public Meeting (n = 22)	Ocean County Public Meeting (n = 29)	Average (n = 99)
Pristine Aquatic Communities	9.8	9.1	9.0	8.8	9.0
Headwaters	9.2	8.6	8.5	9.2	8.8
Unique or Exceptional Ecosystems	8.9	8.3	8.3	8.2	8.3
Nationally Endangered Species	8.0	7.2	7.4	6.9	7.2
Linkage Corridors	8.2	7.4	6.8	7.8	7.4
State Endangered, Threatened, Declining, or Undetermined Species	7.1	6.3	7.0	7.1	6.8
Breeding Areas (Nesting and Spawning)	7.4	7.1	8.0	7.1	6.8
Species Proposed or Under Review for National List	6.8	5.4	5.8	6.7	6.5
Diversity of Vegetation Types Within a Given Area	6.8	6.7	5.8	6.7	7.2
Outlier, Disjunct, or Relict Species	5.4	4.1	4.8	5.6	4.9
Migratory Stopover Areas	5.3	6.3	6.3	6.2	6.2
Restricted and Endemic Species	5.7	5.5	5.5	5.9	5.6
Overwintering Concentrations	4.9	6.1	6.1	5.9	5.9
Representative Vegetation Types	5.3	5.4	5.0	6.9	5.7
Species at Limits of Their Geographic Range	4.4	4.5	4.2	5.2	4.6
Areas of Scientific Interest and Research	3.9	4.9	4.4	6.1	5.0
Oldest, Largest or Exceptional Tree Specimens	2.6	3.8	3.7	4.0	3.8

Table 6.3—Summary of Importance Values of Critical Areas

Watershed & Coastal Areas	Total Number of Critical Areas Within Each Watershed or Coastal Area	Number of Critical Mapping Units Within Each Importance Value Class								
		0	0.1-9.9	10-14.9	15-19.9	20-24.9	25-29.9	30-39.9	40-49.9	50 +
Absecon Creek	4				1			1	2	
Atsion River/Sleeper Branch	14		3		1			1	3	6
Barnegat Bay	17	1	2	3		1	2	5	3	
Bass River	7			1	1		1	1	1	2
Batsto River	11		1				2	1	1	6
Cedar Creek	8			1				1	1	5
Crosswicks Creek	5	1	2		1	1				
Dennis Creek	17		3			4	1	2	3	4
Forked River	6		2				1	1	1	1
Great Bay/Little Bay	4						1		2	1
Great Egg Harbor Bay	1					1				
Hammonton Creek	6				2	2	1	1		
Intercoastal Waterway	1			1						
Little Egg Harbor/Cedar Run	5						3	2		
Tuckerton Creek	11		4	2		1	2	2		
Lower Great Egg Harbor River	30	2	7	2	1	1	3	7	4	3
Lower Mullica River	23		3	4	2	3		4	1	6
Manumuskin River	13		7		2		1	1		2
Maurice River	16	7		1	3		2	2	1	
Mill Creek	4			1	1	1	1			
Nescochague Creek	8	1	2		2			2		1
North Branch Rancocas Creek	29	4	5	1	2	1	2	6	2	6
Oyster Creek	2					1				1
Patcong Creek	5				4			1		
Reeds Bay	3		1					1		1
South Branch Rancocas Creek	27	8	6	2	3	2	3	3		
Toms River	32	8	3		5	4	2	3	2	5
Tuckahoe River	15		4		1	3		2	1	4
Upper Great Egg Harbor River	28	6	5	1	5	3	3	4		1
Wading River	38				4	2	2	2	4	24
Westecunk Creek	6	1	1					1	1	2

CHAPTER SEVEN

Protecting the Pinelands

The foregoing chapters have described both the natural and man-induced processes which have affected the Pinelands in the past, are affecting it now, and which may affect it in the future. That information, assembled from detailed studies undertaken over the past months, provides the basis for a strategy which will meet the mandates of the state and federal legislation to protect, preserve, and enhance the significant values of the resources of the Pinelands.

There is no question that the Pinelands' resources would be in a greater jeopardy if these legislative initiatives had not been taken. Even the best efforts of local governments to date have been unable to deal with protection of the area from a regional perspective. Incursions thought to be individually insignificant are, in fact, cumulative. They result in significant deleterious impacts over time. As the New Jersey Legislature declared in the Pinelands Protection Act, the "continued viability" of the area and its resources is "threatened by pressures for residential, commercial, and industrial development."

The protection strategy designed for the Pinelands has evolved in three interrelated steps. The foundation is set forth in the state and federal legislation. From that basis the Commission developed a series of five resource and use goals and 25 policies.

When considered in light of the legislation and the data generated through the Commission's studies, these goals and policies led directly to the second step: a spatial description of the Pinelands and an allocation of appropriate land uses among different areas. The third step involved the selection of programs to ensure that activities allowed within different areas are compatible with the characteristics of particular sites.

RESOURCE GOALS AND POLICIES

The following goals and policies were adopted by the Commission to guide the protection, preservation, and enhancement of the significant values of the Pinelands in a manner which is consistent with the provisions of the National Parks and Recreation Act of 1978 and the New Jersey Pinelands Protection Act.

Natural Resources Goal

PRESERVE, PROTECT, AND ENHANCE THE OVERALL ECOLOGICAL VALUES OF THE PINELANDS, INCLUDING ITS LARGE FORESTED AREAS, ITS ESSENTIAL CHARACTER, AND ITS POTENTIAL TO RECOVER FROM DISTURBANCE.

Policy 1: Preserve, protect, and enhance the quality and quantity of surface and groundwater.

Policy 2: Preserve, protect, and enhance the diversity of plant and animal communities and their habitats.

Policy 3: Preserve, protect, and enhance existing soil conditions.

Policy 4: Preserve, protect, and enhance existing topographic features.

Policy 5: Preserve, protect, and enhance existing air quality.

Policy 6: Protect natural scenic qualities.

Historic and Cultural Goal MAINTAIN AND ENHANCE THE HISTORIC AND CULTURAL RESOURCES OF THE PINELANDS.

Policy 1: Maintain opportunities for traditional lifestyles that are related to and compatible with the overall ecological values of the Pinelands.

Policy 2: Maintain the social and cultural integrity of traditional Pinelands communities.

Policy 3: Maintain and enhance historic and archeological areas and sites of national, state, and local importance.

Agricultural and Horticultural Goal PRESERVE AND ENHANCE AGRICULTURAL AND HORTICULTURAL USES THAT ARE COMPATIBLE WITH THE PRESERVATION AND PROTECTION OF THE OVERALL ECOLOGICAL VALUES OF THE PINELANDS.

Policy 1: Reserve for agricultural purposes prime agricultural soils and soils of statewide significance in or adjacent to established agricultural areas.

Policy 2: Reserve unique agricultural soils and protect water quality and quantity necessary for cranberry and blueberry cultivation.

Policy 3: Protect the long-term economic viability of agricultural activities.

Policy 4: Require the use of Recommended Management Practices in areas of substandard water quality.

Policy 5: Protect agricultural operations and other private landowners from trespass and vandalism.

Policy 6: Encourage horticulture of native Pinelands plants.

Development Goal ACCOMMODATE RESIDENTIAL, COMMERCIAL, AND INDUSTRIAL DEVELOPMENT IN A WAY THAT IS COMPATIBLE WITH THE PRESERVATION AND PROTECTION OF THE OVERALL ECOLOGICAL AND CULTURAL VALUES OF THE PINELANDS.

Policy 1: Permit infill development in existing communities.

Policy 2: Direct new residential, commercial, and industrial development into environmentally suitable areas in orderly patterns which are within or adjacent to existing developed areas.

Policy 3: Assure opportunities for housing for all economic groups.

Policy 4: Allow economic development which supports existing community needs but does not generate new development outside those areas designated for future development by the Comprehensive Management Plan.

Policy 5: Permit growth-generating capital improvements only within those areas designated for future development.

Recreation Goal PROTECT AND ENHANCE OUTDOOR RECREATIONAL USES AND THE NATURAL RESOURCES ON WHICH THEY DEPEND.

Policy 1: Preserve, protect, and enhance those natural resources, including forests, waters, and wildlife habitats, necessary for compatible recreational uses.

Policy 2: Promote diverse recreational opportunities in a manner that minimizes land use conflicts.

Policy 3: Assure that recreational uses in undeveloped areas be of low intensity and compatible with the protection of the natural resources.

Policy 4: Assure that, insofar as possible, intensive recreational uses be located in or near developed areas.

Policy 5: Protect and enhance opportunities for proprietary recreational facilities in areas that are suitable for such uses.

LAND ALLOCATION AND GROWTH

Both the federal and state Pinelands acts guide the Commission in its protection efforts. They direct that a determination be made of the amount and type of human development and activity that the area can sustain while still maintaining its overall ecological values. The acts further provide that a land use capability map be prepared.

The state Pinelands act divided the region into two areas, a Preservation Area and a Protection Area, and established the boundaries for each. In addition, specific goals were established to direct the Commission in the preparation of a comprehensive management plan. For the Preservation Area, the goals included the preservation of an extensive, contiguous land area in its natural state, the promotion of compatible agricultural, horticultural and recreational uses, the prohibition of any development incompatible with the area's preservation, the provision of a sufficient amount of undeveloped land for specific wilderness management practices, and the preservation of surface and ground water quality and quantity. For the Protection Area these goals included the preservation and maintenance of the essential character of the existing Pinelands environment, the protection and maintenance of surface and ground water quality, the promotion of the continuation and expansion of agricultural and horticultural uses, the discouragement of piecemeal and scattered development, and the encouragement of appropriate patterns of development in or adjacent to areas already utilized for such purposes.

To meet the goals and objectives of the legislation, and the Commission's goals and policies, the resources of the Pinelands have been characterized and then evaluated against various land uses to assess compatibility. The intent was to strike a balance between the region's intrinsic natural values and the need to provide for the housing, employment, and recreation on which the region's people depend. The characterization, which is described in a later section, resulted in the designation of the following land use planning areas. These areas are depicted on the Land Capability Map (Plate 28).

Area Allocation

The **Preservation Area District** represents that area found by the New Jersey Legislature to be "especially vulnerable to the environmental degradation of surface and ground waters which would be occasioned by the improper development or use thereof;" and "which constitutes an extensive and contiguous area of land in its natural state."

The **Agricultural Production Areas**, occurring in both the Preservation and Protection Areas, represent those areas which are primarily devoted to field agricultural uses, and adjoining lands with soil conditions suitable for those farming activities.

The **Special Agricultural Production Areas**, occurring in the Preservation Area, represent those areas devoted to berry agricultural and native horticultural uses, and the adjoining lands utilized for watershed protection, to be designated at the option of the municipality.

The **Military and Federal Installation Area**, occurring in both the Preservation and Protection Areas, represents major federal landholdings with an established land use pattern and providing significant benefits to the people of the Pinelands.

The **Forest Areas** of the Protection Area represent largely undisturbed forest and coastal wetland areas adjoining the Preservation Area and extending into the southern section of the Pinelands. The Commission has determined that these areas possess "the essential character of the existing Pinelands environment," which the Legislature said it was the Commission's responsibility to "preserve and maintain."

The **Rural Development Areas** in the Protection Area represent those transitional areas which generally separate growth areas from the less developed, predominantly forested areas of the Pinelands. These areas are somewhat fragmented by existing development and serve a dual purpose as buffers and reserves for future development.

The **Regional Growth Areas** represent those land areas which are: (1) in or adjacent to existing developed areas; (2) experiencing growth-demands and pressure for development; and (3) capable of accommodating development without jeopardizing the most critical elements of the Pinelands environment.

Pinelands Towns and Villages are spatially discrete existing developed areas. Most of these settlements have cultural, historical, and commercial ties to the Pinelands environment, while others represent areas of concentrated residential, commercial, and industrial development.

Each of these land capability areas is quantified by county in Table 7.1. In the discussion that follows, the procedure by which the areas were delineated is explained.

Table 7.1A—Protection Area and National Reserve Land Allocation

Approximate Acreage

County	Military and Federal Installation Area	Regional Growth Areas	Rural Development Areas	Agricultural Production Areas	Forest Areas ¹	Pinelands Towns ²
Atlantic	5,055	28,600	45,550	32,270	158,210	7,720
Burlington	13,300	23,100	33,760	21,220	25,650	—
Camden	—	9,740	9,620	12,540	9,110	—
Cape May	—	7,910	6,480	—	68,525	4,280
Cumberland	—	—	7,420	260	52,090	—
Gloucester	—	4,600	13,540	11,230	4,070	—
Ocean	—	45,100	28,630	—	102,565	3,080
Total	18,355	119,050	145,000	77,520	420,220	15,080

1. The Forest Areas include approximately 105,000 acres of publicly held land.

2. The acreage of Pinelands Villages is included within the Rural Development Area, Agricultural Production Area, and Forest Area totals.

Table 7.1B—Preservation Area Land Allocation

Approximate Acreage

County	Total Acres	State Owned Public Land	Military and Federal Installation Area	Agricultural Production Areas	Preservation ¹ Area
Atlantic	21,300	12,060	—	—	9,240
Burlington	232,400	108,260	6,273	2,100	115,767
Camden	14,400	14,400	—	—	—
Ocean	100,700	40,900	23,383	—	36,417
Total	368,800	175,620	29,656	2,100	161,424

1. Within the Preservation Area are the Special Agricultural Production Areas. The acreage for Special Agricultural Production Areas is not available as they are to be designated by municipalities during conformance.

Area Delineation Procedure

The delineation of the Protection Area into land use areas required a planning method which was sensitive to the many competing goals outlined in the state and federal Pinelands legislation and the additional goals and policies adopted by the Pinelands Commission. The method developed for use in this analysis involved the successive application of a series of factor maps expressing the multitude of resource and human values identified in the above documents. The baseline data for the delineation consisted of the over 130 individual map separations developed by the Commission.

The planning method outlined here reflects a refinement of the original method utilized for the Draft Comprehensive Management Plan. The refinements were accomplished by testing the initial criteria which had been applied, and by introducing other criteria either developed from review comments on the draft plan or previously omitted due to data deficiencies. The sources for method revision included municipal and county comments based on local perceptions and realities, public meetings, and meetings with various interest groups.

The first step in the Commission's procedure was to define the essential character of the Protection Area. Based on a detailed evaluation of resource values and guidelines for their management found in the legislative mandates and the Commission's goals and policies, the following criteria best express, in a spatially explicit manner, those portions of the Protection Area which possess the essential character of the existing Pinelands environment. In addition, several criteria recognize the high water quality in many areas of the Protection Area and the importance of maintaining that quality. Individually, these criteria summarize the many studies done for the Commission by its consultants.

1. *Ecologically critical areas*: These areas are subwatersheds receiving 40 points or more according to the procedure and public values used in the Critical Areas Study, as outlined in Chapter Six.
2. *Undisturbed subwatersheds*: These are subwatersheds that have very little development in them, particularly that which degrades surface and ground water quality and fragments the Pinelands ecosystem. Subwatersheds, or upstream portions thereof, are classified as undisturbed if they satisfy all of the following criteria:
 - Less than 5 percent in urban or developed use categories
 - Less than 10 percent of area in active agricultural land categories
 - No major solid waste disposal sites
 - No point sources of pollution
3. *Wetlands*: Wetlands include the following vegetation categories:
 - Cedar swamp
 - Hardwood swamp
 - Pitch pine lowland forest
 - Coastal marsh and Wetlands Act area
 - Bog/inland marsh
4. *Cranberry cultivation areas and areas draining into them*.
5. *Areas of deep aquifer recharge*: Areas contributing to deep aquifer recharge are those areas where the depth to the unsaturated zone is 20 feet or greater, not underlain by either of the two extensive clay lenses in the east and southeast of the Pinelands.
6. *Unique resources*: Several unique resources are identified that require high levels of protection. They are:
 - The Pine Plains and a buffer zone around them to protect the elements that are necessary to maintain their unique biological characteristics.

- Subwatersheds in which biological surveys show the presence of aquatic species characteristic of the Pinelands. Survey results from main-stem-sampling stations are not considered in this designation.
- The corridor connecting environmentally sensitive areas in the southern portion of the Pinelands with the Preservation Area to the north. The corridor, defined as a large, contiguous, relatively underdeveloped land area, is an ecological imperative. Its function is to provide a protected natural passage for the dispersal of native plants and animals in order to maintain genetic diversity and variability. Should species movement and genetic exchange be restricted through the lack of such a corridor, there is an increased likelihood that changes in the natural and man-made environment would, over long periods of time, lead to the extirpation of one or more species in areas they now inhabit, and to the gradual fragmentation and loss of the Pinelands ecosystem.

7. *Public lands managed for resource protection or recreation.*

These seven components, and their mapped expressions, served as the determinants of the essential character of the Pinelands environment within the Protection Area. They were later utilized in the last step of this procedure to provide guidance in the resolution of conflicts. The delineation of areas of essential character provided the basis for the designation of Pinelands Forest Areas.

The Commission's second step was to delineate Agricultural Production Areas. Designation of these areas responds to the legislative goals to protect and enhance agricultural and to the Commission's goals and policies to reserve agricultural lands for agricultural use.

Agricultural Production Areas were delineated on the basis of significant contiguous areas in active agricultural use and soils in or immediately adjacent to these uses that are suitable for the same agricultural activities. In many areas, suitable agricultural soils could extend the size of a delineated area manyfold over that actually in production. Therefore, delineations based on prime agricultural soils, soils of statewide significance, and unique soils adjacent to areas actively farmed were limited by watersheds lines, urban uses, extensive wetlands, or highways.

The third step in the procedure recognized major existing federal land ownership patterns and resulted in the delineation of the Military and Federal Installation Area. This land capability category includes Fort Dix Military Reservation, McGuire Air Force Base, the Naval Air Engineering Center at Lakehurst, and the Federal Aviation Administration Technical Center in Atlantic County (including the Atlantic City Airport). The category includes lands within both the Preservation and Protection Areas.

The fourth step in the procedure was to identify those areas in or adjacent to developed areas that can produce appropriate patterns of further development. This step in the procedure responded directly to the legislative and Commission goals to establish concentrated patterns of development to avoid the cumulative impacts, both economic and environmental, attending to diffuse growth. The state act requires that future growth be directed to areas that are in or adjacent to areas already developed, and where there is capability to accommodate development in order to avoid dispersed and inefficient land use patterns. The following elements contributed to the identification of areas appropriate for development:

- Existing density and pattern of development
- Availability of transportation alternatives
- Proximity to job centers
- Sewerage location and capacity
- Capability to produce phased and flexible growth patterns
- Development of efficient community services
- Land transaction and development approval activity

- Land suitability for development
- Regional growth influences
- Population and housing demand

Having developed the mapped expressions of essential character outlined earlier and the expressions of development opportunity listed above, the next step was to compare the mapped expressions and to identify conflict areas. Those areas exhibiting the essential character of the Pinelands and not conflicting spatially with areas appropriate for development were assigned to the Forest Area. Similarly, those areas most appropriate for development and not demonstrating what was identified as essential character were assigned to development categories. Those areas that both represented the essential character of the Pinelands and were appropriate for development were then identified and described in detail as conflicts to be resolved.

The resolution of each conflict area involved the application of all available information. Particularly important in this process were all available municipal and county planning efforts and suggestions, public comments, and suggestions from other state agencies and interest groups. All of these factors were incorporated not only into the process of conflict resolution, but also into the refinement of the planning method and procedures. Other data used in the resolution process included fire hazard and frequency, detailed soils mapping, current aerial photographs, and social and cultural factors.

The mapping process utilized in the identification and resolution of conflicts operated on two levels. Initially, the various expressions relating to essential character and development potential were compared to each other. These expressions were then transferred to the draft Land Capability Map and analyzed relative to the district boundaries presented in the draft plan. The final Land Capability Map reflects the revisions resulting from the resolution of conflicts on these two levels.

To provide direction in the revision and resolution process, several general guidelines were established. The guidelines arose from the bi-level mapping process discussed previously. On the first level, Agricultural Production Areas were examined. Where an area did not have the necessary amount of 1,000 acres of active, contiguous agriculture land, it was reclassified to an adjacent land capability category. On the second level, the mapped expressions of essential character and development potential and their conflicts were compared to the existing Forest Area, Rural Development Area, and Regional Growth Area categories, and guidelines were developed to effect the appropriate revisions.

In the application of the essential character criteria to the district delineation, where an area exhibited such characteristics and had been previously classified as a Forest Area, the area remained in that class. Additionally, when an area exhibited essential character as an undisturbed watershed, or had greater than 75 percent wetlands and/or critical areas, and had been previously classified as a Rural Development Area, it was reclassified as a Forest Area. When areas of less than 1,000 acres did not exhibit essential character, but were entirely surrounded by, and not merely adjacent to, areas of essential character, such areas also became Forest Areas.

Conversely, rules were established to direct the delineation where lands did not contain essential character and displayed some measure of existing or potential development. If these areas had not previously been classified as development areas, they were reclassified as such, so long as they were not wholly surrounded by characteristic Pinelands areas. As a corollary to this rule, portions of a watershed which were indicated as exhibiting some measure of essential character, but were less than 1,000 acres and adjacent to development areas, were either retained in or transferred into development areas, depending on their previous classification.

The application of these rules resulted in certain areas of conflict becoming Forest Areas, with other areas classified as appropriate for development. The appropriate areas for development were separated into Rural Development and Regional Growth Areas depending upon the degree to which they exhibited the elements important to development and their compatibility with surrounding areas. Important elements in the classification included municipal and county

recommendations, existing level of development, existing development activity and approvals, location of lateral sewage collection systems, availability of transportation alternatives, land suitability for development, and the capability to establish coordinated development patterns. Additional categories of development included Pinelands Towns and Villages, which were defined as localized, spatially discrete areas with historical, cultural, and community links to the Pinelands.

To increase municipal planning flexibility and potential, an additional category, the Municipal Reserve Area, was added, to be implemented and activated at the option of the municipality. These are lands in Rural Development Areas adjacent to growth areas that may serve as future growth areas when the supply of land for growth is essentially exhausted, and the demand for additional growth arises within a regional context.

The procedure utilized to resolve conflicts and to establish land capability areas in the Protection Area produced a flexible approach to growth and development potential while protecting larger expanses of the area's critical resources.

The delineation of the Preservation Area into land capability areas proceeded in much the same manner. The Preservation Area is that portion of the Pinelands generally referred to as the "core area," and containing the greatest concentration of critical resource values. The boundary was established by the state legislation, and is drawn to encompass the major, contiguous public landholdings in the Pinelands. The area also includes the largest expanses of undisturbed lands in their natural state, cranberry watersheds, and critical ecological values. It is the region designated by the legislature "wherein more stringent restrictions on the development and use of land should be utilized and public acquisition of land or interests therein should be concentrated."

The Military and Federal Installation Area within the Preservation Area again recognizes major federal land ownership patterns, and includes lands of the Fort Dix Military Reservation, McGuire Air Force Base, and the Naval Air Engineering Center. This classification accommodates the unique characteristics of these installations and facilities, which represent a substantial economic resource to the area, while preserving and protecting the region's unequalled natural resources.

The Agricultural Production Areas established in the Protection Area extend into the Preservation Area where fields of conventional row-crop agriculture are crossed by jurisdictional boundaries. These areas were delineated on the basis of active agricultural lands contiguous to Agricultural Production Areas in the Protection Area. The extent of the boundary is terminated by non-agricultural use.

An additional land class in the Preservation Area relating to agricultural land uses is the Special Agricultural Production Area. These are intended to be well-defined areas utilized for berry agriculture or horticulture of native plants. They represent a unique and integral element of the Pinelands economy and are part of the Pinelands' essential character. The delineation of the areas is not shown on the Land Capability Map, but is instead to be accomplished by municipalities during the period of conformance. The special areas are to encompass active cranberry bogs and their immediate upstream drainage area, along with blueberry fields and native horticultural areas.

The remainder of the Preservation Area was examined using the same procedure to identify the areas of essential character as was outlined under the Protection Area. The criteria for ecologically critical areas, undisturbed watersheds, wetlands, cranberry cultivation areas, areas of deep aquifer recharge, unique resources, and public lands were also applied to the Preservation Area. In addition, the Preservation Area was viewed as a functional unit which, together with the adjacent forested areas, serves to maintain the integrity and viability of the unique characteristics of the Pinelands ecosystem. The sensitivity of the resources to degradation requires a high level of protection throughout the Preservation Area and results in the establishment of a Preservation Area District for management purposes.

Area Descriptions and Uses

This section provides more detailed description of each planning area and identifies appropriate uses. Appropriate uses are those which may be permitted within a given area; provided, however, that the requirements set forth in the resource program sections of this chapter and detailed in Part II are achieved.

Preservation Area District

The Preservation Area District contains 334,000 acres and represents what is readily identifiable as the essence of the Pinelands. In total, it contains the most critical ecological values in the region and is the least populated. Of the Preservation Area's 368,800 acres, approximately 30,000 acres are in the Military and Federal Installation Area, 2,100 acres in Agricultural Production Areas, and the remainder in the Preservation Area District. Within the Preservation Area District municipalities are authorized to designate Special Agricultural Production Areas. In addition, the Preservation Area District contains 176,000 acres of state-owned land.

The district contains the largest uninterrupted forests in the Pinelands and the largest pristine watersheds. Cranberry production thrives because of extensive areas of unique soils and currently undisturbed watersheds which produce the necessary flow and quality of water for berry agriculture.

A complex mosaic of wetlands exists here, including some of the largest vestiges of what once were extensive cedar swamps. The headwaters of the Cedar and Rancocas Creeks and the Wading, Batsto, and Mullica Rivers are found within its boundaries.

The wilderness-like features of the Preservation Area District provide abundant habitats for threatened and endangered plants and animals, including the timber rattlesnake, corn snake, curly grass fern, bog asphodel, and bald eagle.

Much of the area is vulnerable to and yet ecologically dependent upon wildfire. It is, in fact, the section of the Pinelands which is most susceptible to wildfire. This condition and the importance of wildfire as a natural process are exemplified by the unique nature of the Plains, and argue against human intrusion for safety and ecological reasons.

The Pinelands Protection Act sets forth the following specific mandates for the Commission with respect to the Preservation Area:

- Preserve an extensive and contiguous area of land in its natural state, thereby ensuring the continuation of a Pinelands environment which contains the unique and significant ecological and other resources representative of the Pinelands Area;
- Promote compatible agricultural, horticultural, and recreational uses, including hunting, fishing and trapping, within the framework of maintaining the Pinelands environment;
- Prohibit any construction or development which is incompatible with the preservation of this unique area;
- Provide a sufficient amount of undeveloped land to accommodate specific wilderness management practices, such as selective burning, which are necessary to maintain the special ecology of the Preservation Area; and
- Protect and preserve the quantity and quality of existing surface and ground waters.

The land uses determined to be appropriate within the Preservation Area District meet these legislative mandates as well as the Commission's natural resource policies, its cultural resource policy regarding opportunities for traditional lifestyles, its agricultural policy dealing with unique agricultural soils and associated water quality and quantity for berry production, and its recreation policies relating to resource protection and intensity of recreation uses. The appropriate land uses include berry agriculture, horticulture of native plants, other compatible agricultural activities, forestry, low intensity and selective intensive recreational uses, limited resource extraction, and public service infrastructure to serve the needs of the district. The uses

in Special Agricultural Production Areas are limited to berry agriculture, horticulture of native plants, other environmentally compatible agricultural activities and related agricultural housing.

Housing opportunities for landowners or their families who have either resided in the Pinelands or are employed in a Pinelands resource-related activity are essential to the maintenance of the culture of which they are a large part. Landowners in these situations will be provided opportunities for single family residential development under conditions designed to minimize environmental impacts.

An additional beneficial use provided to all private landowners in the Preservation Area is contained in Pinelands Development Credits. These are use rights allocated to landowners that can be exercised in the Regional Growth Areas to secure developmental potential and a bonus density. The program to allocate, transfer, and implement this provision is discussed later in this chapter.

Forest Areas

The Forest Areas are largely undeveloped forest areas and coastal wetlands which generally extend southward from the Preservation Area but which also include other areas adjoining the northern forest. In total the areas contain approximately 420,000 acres, of which about one-quarter are in public ownership. Nearly one-third of this total area is outside the Pinelands Protection Area, the great majority of which is coastal or fresh water wetlands or is publicly owned.

Human influences are minimal in these areas and little residential development has occurred. Agricultural production is not prevalent. Point sources of pollution and landfills are virtually non-existent. Consequently, water is of high quality, wetlands abound, and habitat requirements for many threatened and endangered plants and animals are met. In essence, these areas exhibit many of the same critical ecological values as the Preservation Area.

These areas and their appropriate land uses respond directly to the Commission's mandates under the Pinelands Protection Act to:

- Preserve and maintain the essential character of the existing Pinelands environment, including the plant and animal species indigenous thereto and the habitat therefore;
- Protect and maintain the quality of surface and ground waters; and
- Discourage piecemeal and scattered development.

They also support the Commission's natural resource policies, the cultural resource policy regarding opportunities for traditional lifestyles, and the recreation policies relating to resource protection and intensity of recreation uses.

Land uses must be allocated with discretion within the Forest Areas to protect the valuable resources they contain. Forestry, agriculture, horticulture, agricultural employee housing, low intensity and selective intensive recreational uses, and public service infrastructure to serve the region's needs are permitted uses. In addition, a municipality may, at its option, permit certain institutional uses, Pinelands resource-related industrial or manufacturing uses, limited airport facilities and compatible light industrial uses, campgrounds, agricultural commercial establishments, roadside retail sales and service establishments, and resource extraction.

Residential development which is of a sufficiently low density to prevent the loss of cultural and resource values is permitted under municipally designated densities. The total number of new units to be allocated across the Forest Area is calculated based on a density of 17 units per square mile allocated to all land in the area, including wetlands and public lands. This total number of units is then allocated to each municipality based on the total acreage of privately owned upland in the area and within each municipality. The measurement for allocation is one dwelling unit for each 15.8 acres of upland privately held and undeveloped. This municipal allocation is over and above the development which currently exists. Other single family dwelling units which are linked to the social and economic character of the Pinelands are permitted under the same conditions as in the Preservation Area District, as are units on greater than one acre with preexisting ownership and subject to the minimum standards of this plan.

As part of its master plan or land use ordinances, each municipality with jurisdiction over land in the Forest Area must include a provision to allow the clustering of residential development rights from any parcel of land located in a municipality's Forest Area to other areas in the municipality. These cluster areas must contain at least 500 acres and conform to the minimum environmental standards for delineation contained in Part II. The Special Areas Map (Figure 7.1) indicates those areas which should not be utilized for cluster purposes.

Agricultural Production Areas

Although agriculture exists throughout the Pinelands, there are nevertheless several extensive and contiguous areas of agriculture and horticultural lands where little or no encroachment by unrelated development has occurred. These areas are located in Burlington, Atlantic, Camden, and Gloucester Counties in the Protection Area, accounting for a total of 77,500 acres, and Burlington County in the Preservation Area, accounting for 2,100 acres.

The Production Areas are classified on the basis of significant concentrations of contiguous, actively farmed lands (greater than 1,000 acres), and adjoining lands with prime and unique soils as well as those of statewide significance which may be available for future agricultural use. Municipalities may also designate Agricultural Production Areas in their certified master plans.

To allow for the continuation of farming in these areas, conflicts between residential and agricultural land uses should be minimized, as the two are generally not compatible. Conflicts arising from the juxtaposition of these two uses can result in the passage of "nuisance" ordinances restricting and hampering farm operations, higher taxes and costs of operation, increased speculative pressures, increased fragmentation, and other conditions which make difficult the continuation or expansion of agricultural production. Equally important to the continuation of farming are the economic and cultural ties that exist between certain Pinelands communities like Hammonton and surrounding agricultural areas.

In order to fulfill the legislative mandate relating to the continuation and expansion of agriculture, the Commission finds it necessary to provide for farming as the major activity within these areas. This also meets the Commission's policies to reserve agricultural soils for agricultural purposes, to protect agriculture's economic viability, and to promote native horticulture, while providing opportunities to continue traditional lifestyles.

Authorized uses in the Agricultural Production Areas include various agricultural activities, agricultural employee housing, forestry, low intensity and selective intensive recreational uses, commercial agricultural establishments, agricultural processing facilities, and public service infrastructure. Optional uses for municipalities to determine include institutional uses, resource-related industries, agriculturally related airports, other limited airport facilities and compatible light industrial uses, campgrounds, and resource extraction. An additional beneficial use provided to landowners is the Pinelands Development Credits program, which provides development use rights for transfer to growth areas.

Single family residential development which is accessory to a principal agricultural use and intended for the use of owners or employees is allowed at a density of one unit for ten acres, as well as housing opportunities for those with social or economic links to the Pinelands. Units on preexisting lots of greater than one acre are also allowed subject to the management programs contained elsewhere in the Plan.

Rural Development Areas

Rural Development Areas occur in all seven counties in the Pinelands and account for 145,000 acres. These areas are transitional in nature, somewhat fragmented by existing development and with some highly viable agricultural areas. The criteria for essential character are lacking over broad areas, but the relatively open nature of the landscape in these areas makes them important from a cultural, visual, and ecological standpoint. The surface and groundwater resources continue to be of high quality, and the network of wetlands harbor many species indicative of the

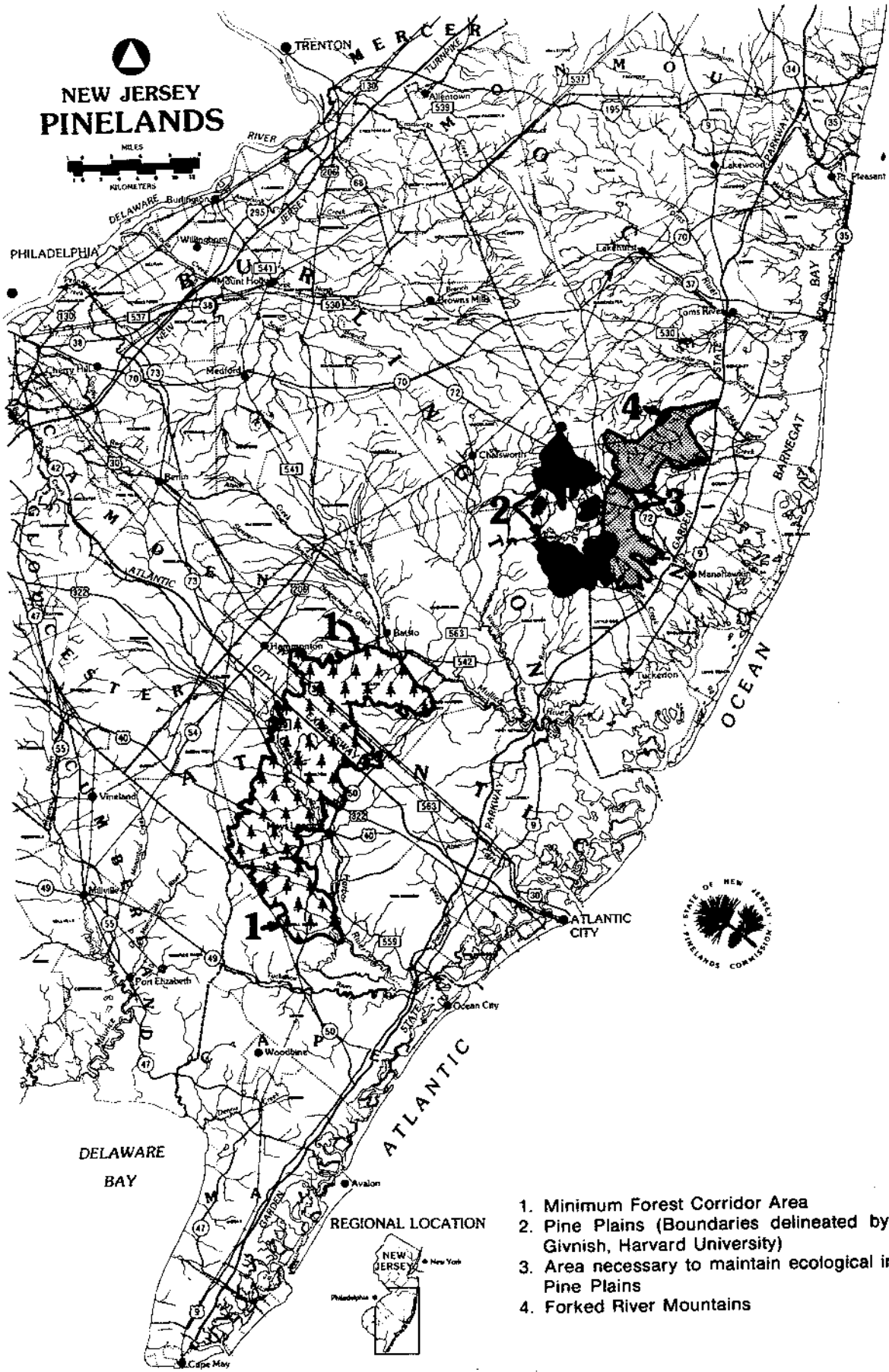


Figure 7.1—Special Areas Map

Pinelands ecosystem. For these reasons, the existing character of the Rural Development Areas should be maintained where practical.

These areas represent a special challenge in land use planning, for municipalities should view them with a critical eye to the future in terms of fiscal, social, communal, and environmental goals. They represent a valuable community asset, exhibiting many of the ecological and cultural values that contribute to the Pinelands' originality, while also serving as a land reservoir for future community development. Planning options should be exercised with forethought and discrimination in the Rural Development Areas.

Uses allocated to these areas are primarily left to the discretion of the municipality. So long as the use is compatible with the Pinelands' essential character and is similar in character, intensity, and impact to agriculture, agricultural sales and processing facilities, forestry, recreational facilities, light industrial uses, and institutional uses, the use may be permitted by the municipality.

Residential dwelling units are permitted at municipally designated densities provided that the total number of new units does not exceed 200 dwelling units per square mile of private, non-wetland and undeveloped land. A cluster provision may be included at the option of the municipality. Existing owners of greater than one acre lots prior to the moratorium may also develop a residential unit subject to certain provisions, conditions, and programs outlined in Part II.

An additional option available to municipalities with Rural Development Areas adjacent to Regional Growth Areas is the designation of a portion of the Rural Development Area as a municipal growth reserve. The reserve is to be designated by the municipality, subject to the conditions contained in Part II of this plan.

Regional Growth Areas

Regional Growth Areas are those areas designated in response to the mandate in the Pinelands Protection Act to "encourage appropriate patterns of compatible residential, commercial, and industrial development, in or adjacent to areas already utilized for such purposes, in order to accommodate regional growth influences in an orderly way while protecting the Pinelands environment from the individual and cumulative adverse impacts thereof." The objective of the federal legislation and the policy of the Commission both are to direct new development into environmentally suitable areas within or adjacent to existing developed areas.

Future growth should be directed to certain areas where the capability to absorb development is high and the pressure to develop is great. The accommodation of this pressure in an orderly manner further requires that the areas should be spatially limited. By creating growth nodes, the Commission can ensure that development densities are sufficiently high to encourage a range of housing types, mass transit facilities, and economies of scale in construction activities. At the same time, it can discourage random and uncoordinated development activities which threaten the region's ecosystem.

The development of the Regional Growth Areas in an orderly coordinated manner, respecting the existing goals and emerging land use patterns, is a key element not only in the protection of the Pinelands' ecological values but also in the maintenance of a pleasant human environment which respects existing cultural goals while allowing innovative and new development patterns to emerge.

In many areas of the Pinelands the recent growth, which has been rapid relative to past time frames, has occurred in a random, dispersed fashion, creating a land-consumptive pattern of development and resulting in service difficulties. This sort of activity produces a fragmented landscape, resulting in high infrastructure and service costs with a negative impact on the fiscal integrity of municipalities, and possibly in a loss of social values. The perpetuation of this pattern would also threaten the continued viability of the Pinelands ecosystem.

In order to reduce these potential disruptions, it is necessary to develop a concentrated and

efficient pattern of development. Certain areas in the region contain land committed to development and in various stages of completion. The existing fragmentation of these areas, and their higher density relative to other areas, indicate the emergence of a developed land use pattern. Effective planning requires the gradual and well-organized infill of these areas to allow reduced municipal costs while promoting innovative approaches to land use transition and management.

The Regional Growth Area land and dwelling unit allocations are given in Table 7.2. The "developable acres" category under Growth Areas includes two numbers. The first represents acres of soils with a depth to seasonal high water greater than 5 feet, and the second includes soil with a depth to seasonal high water from 1.5 to 5 feet. The gross densities for each municipality are given in Part II of the plan. Under "Other Areas," the unit allocations for Pinelands Villages and Towns are estimates, since their precise designation and density is left to the municipality. The estimate for Rural Development Areas is based on the assumption that only 50 percent of the undeveloped land will develop (because of the reserve for future growth). The total for Forest Areas is based on the municipal allocations given in Part II and the formula discussed earlier. The final subdivision units are based on estimates from county and municipal records, and the estimates for single family lots are derived from an extensive search of tax assessment records.

As indicated, one of the criteria used to delineate Growth Areas was regional growth influences. These influences, as discussed in Chapter Five, exert the population and housing demand pressure on the Pinelands. Of particular importance is development related to the Atlantic City casino gambling industry, which impacts not only the Atlantic County area, but also adjoining Pinelands counties. A second major influence is the need of the coastal regions of Ocean and Cape May Counties for continued residential development. The third regional influence is the demand for suburban development emanating from the Philadelphia/New Jersey Standard Metropolitan Statistical Area, which affects the western Pinelands counties of Burlington, Camden, and Gloucester.

As described in Chapter Five, the Commission has assessed housing demand in the region to the year 2000. As with any type of projection which estimates trends far into the future, this growth assessment is highly speculative. The current state of the economy and the relative lack of

Table 7.2—Estimated Development Potential for Regional Growth and Other Areas in Dwelling Units

County	Growth Areas			Other Areas		
	Total Acres	Estimated Developable Acres ¹	Total Allocated Dwelling Units	Pinelands Villages and Towns (Units)	Rural Development and Forest Areas ² (Units)	Final Subdivisions and Single Family Lots (Units)
Atlantic	28,600	9,800 (15,600)	45,300	7,000	10,900	7,300
Burlington	23,100	5,860 (11,100)	12,800	500	5,500	3,700
Camden	9,750	5,180 (5,630)	8,750	250	2,600	2,000
Cape May	7,900	5,480 (5,800)	5,500	1,700	2,400	1,500
Cumberland	—	—	—	300	2,300	1,700
Gloucester	4,600	3,000 (3,300)	6,000	—	2,000	1,500
Ocean	45,100	22,100 (26,100)	63,000	1,100	7,100	4,700

1. The numbers in parenthesis indicate private, undeveloped acres with a depth to seasonal high water greater than 1.5 feet; the first set of numbers include only those private, undeveloped acres with a depth to seasonal high water of greater than 5 feet. Except for a few cases, where sewers are already servicing lands of 1.5-5 feet depth to seasonal high water, the allocations are based on the acreage of land having greater than 5 feet to the seasonal high water table.
2. These unit allocations assume that only 50 percent of developable Rural Development acreage is developed at 3.2 acre lots.

necessary infrastructure are not conducive to the immediate realization of the potential growth pattern. The Commission is therefore attempting to accommodate a substantial portion of the anticipated development in the first version of this plan, subject to continual monitoring of the demand pressure and the impacts of growth on Pinelands natural systems. The unit allocations in Table 7.2 are based on the ODEA projections for 1980-1990 from Table 5.16, and one-half of the casino-related housing demand from Table 5.17. The latter projection was halved because the ODEA projection already accounted for a substantial volume of casino growth. In all cases the Commission's allocations are consistent with or exceed area-wide waste treatment planning population projections. The Commission will reassess its programs every three years to determine the level of growth which should be accommodated in a manner which maintains the Pinelands' essential character.

Permitted uses in the Regional Growth Areas are left to the discretion of the municipality, subject to the density limitations given in Part II.

Pinelands Villages and Towns

Pinelands Villages represent existing, spatially discrete settlement areas within the Preservation Area District, Forest Areas, Agricultural Production Areas, and Rural Development Areas. They have been delineated on the basis of the following information sources:

- Maps and reports of regional and local settlement patterns, ethnicity, and community character (prepared by consultants to the Commission);
- Maps and descriptions of sociocultural patterns (prepared by consultants to the Commission);
- Selected nodal development areas from county plans;
- Place names identified from county and state road maps and county plans; and
- Municipal and county recommendations.

This analysis produced a preliminary list of some 125 possible Pinelands Villages, not including lake communities or subdivisions. The places identified in this preliminary list were then reviewed using current aerial photographs to determine the size and contiguity of existing development and the availability of commercial and communal services. Based on this analysis a list of Pinelands Villages was developed. This list is given in Table 7.3, and the communities are indicated on the Land Capability Map (Plate 28).

A special category of Pinelands Village is shown on the Land Capability Map. These are villages which partially or totally occur in Regional Growth Areas and include the following: Atco, Barnegat, Beesleys Point, Cedar Brook, Cedar Run, Marmora, Mayetta, Medford, Ocean View, Parkertown, Pine Grove, Seaville, South Seaville, Stafford Forge, Staffordville-Eagleswood Village, Waretown, and West Creek. While there are no specific regulatory elements associated with this designation, they are displayed and designated to indicate their importance to the surrounding region. These areas could be recognized in municipal planning efforts by buffering them from the socially disruptive efforts of rapid growth.

In keeping with the Commission's policies to allow infill development in existing developed communities, some limited additional development will be allowed in and around Pinelands Villages consistent with lot size specifications contained in Part II. Since the extent and configuration of the Villages is highly variable, areas proposed for additional development will be reviewed by the Commission on an individual basis. The proposed area will be evaluated based on guidelines such as the following:

- The village area should include the center, typically at a crossroads, and the contiguous developed and cleared lands;
- Village delineations should not intrude into wetland vegetation associations;
- Villages should include areas of high septic suitability (Hydrologic Soil Group B) contiguous to developed lands;

- Village boundaries along roads leading to and from the village center should not be extended more than a total of 1/2 mile from the village center;
- In Forest Areas the village area should not contain more than 50 percent forested land;
- In Agricultural Production Areas the village area should not include active agricultural lands except for isolated fields of less than 10 acres; and
- The designated village area should not contain more vacant land than built land nor provide for the incremental development of more structures than currently exist. Built land is calculated at the existing lot size or 3.2 acres, whichever is less.

The list of Pinelands Villages given in Table 7.3 includes a special category of communities, designated as Pinelands Towns, which currently have sewerage or water systems and which serve as a focus for the surrounding area. The Towns are Lakehurst, Hammonton, Egg Harbor City, Buena, Tuckerton and Woodbine. Additional development may occur at densities consistent with those existing in the area, and in keeping with the above guidelines for Pinelands Villages, provided that sewerage service is available and that other Commission standards are met. If sewerage service is not available, additional development will be in keeping with that allowed for Pinelands Villages.

Any use may be authorized in a Pinelands Village or Town provided that infrastructure is available and that the use will not generate growth in a restricted area. Furthermore, the character and magnitude of the use must be compatible with existing structures and uses. There is a 3.2-acre minimum lot size with conventional septic systems and a 1-acre minimum with alternative and innovative on-site wastewater systems.

Special Categories

There are two special categories of development provided within the plan. In the Forest, Rural Development and Agricultural Production Areas, the owner of a parcel greater than one acre is exempted from the density limitations provided that the minimum standards of Part II are met. The second category affects those subdivisions for which a valid final subdivision approval under the Municipal Land Use Law was in effect on February 7, 1979. These subdivisions may continue to develop provided that the proposed development is in conformance with the standards and guidelines of Part II of this plan. For additional subdivisions on which expenditures have been made in good faith reliance on a valid municipal development approval, the Commission shall determine whether a minimum reasonable rate of return can be realized based on the applicant's debt to equity ratio, and what the appropriate number of units should be to realize this return.

Table 7.3—Pinelands Villages and Towns

<u>Atlantic County</u>		
Buena Boro Buena* Landisville	Estell Manor City Estell Manor	Hammonton Town Hammonton*
Buena Vista Township Milmay Newtonville Richland	Folsom Borough Folsom	Mullica Township Elwood Nesco Sweetwater Weekstown Westcoatville
Corbin City Corbin City	Galloway Township Cologne-Germania Oceanville Pomona Smithville	Port Republic City Port Republic
Egg Harbor City Egg Harbor City*	Hamilton Township Mizpah	Weymouth Township Belcoville Dorothy

*Pinelands Towns

Table 7.3—Pinelands Villages and Towns (continued)

Burlington County

Bass River Township
New Gretna

Medford Township
Lake Pine
Taunton Lake

Pemberton Township
New Lisbon

Shamong Township
Indian Mills

Tabernacle Township
Tabernacle

Washington Township
Green Bank
Lower Bank

Woodland Township
Chatsworth

Camden County

Winslow Township
Blue Anchor
Elm
Tansboro
Waterford Works
Winslow

Cape May County

Dennis Township
Belleplain
Clermont
Dennisville
Eldora
North Dennis
South Dennis

Middle Township
Goshen

Upper Township
Petersburg
Tuckahoe

Woodbine Borough
Woodbine*

Cumberland County

Maurice River Township
Cumberland
Delmont
Dorchester
Heislerville
Leesburg
Port Elizabeth-Bricksboro

Ocean County

Eagleswood Township
West Creek

Jackson Township
Cassville
Legler
Van Hiseville

Lacey Township
Bamber Lake

Lakehurst Borough
Lakehurst*

Manchester Township
Whiting

Ocean Township
Brookville

Stafford Township
Warren Grove

Tuckerton Borough
Tuckerton*

*Pinelands Towns

PINELANDS DEVELOPMENT CREDIT PROGRAM

The Comprehensive Management Plan establishes a land use regulatory system which limits residential development in the undisturbed, environmentally sensitive parts of the Pinelands and seeks to direct growth into a more compact pattern within designated growth areas. One possible consequence of the plan will be an upward shift in land values in the growth areas reflecting the provisions for increased densities. The Pinelands Development Credit program is supplemental to the regulatory elements of the plan and provides an alternative use to property owners in the Preservation Area District, Special Agricultural Production Areas, and the Agricultural Production Areas. The program allocates to land owners in these restricted areas credits which can be purchased by land owners in growth areas and used to gain bonus residential densities. The credits thus provide a mechanism for landowners in the former areas to participate in any increase in development values which is realized in growth areas.

Allocation of Credits

Under the development credit program, land in the Preservation Area District, Special Agricultural Production Areas, and the Agricultural Production Areas is granted development credits. A landowner selling his or her credits is required to record a deed establishing a restriction which limits the future uses of his land to those allowed under the plan for the area in which the land is located.

The system of allocation of credits recognizes the elevated value of farmland and provides fewer credits to owners of non-productive wetlands. In the Preservation Area District, landowners are entitled to one credit for each 39 acres, or the appropriate fraction thereof. Wetlands yield only a fifth as many credits, or 0.2 credits for 39 acres—a ratio based on the comparative values of uplands and wetlands.

In agricultural areas, all uplands and areas of active agriculture, including berry agricultural bogs and fields, are allocated two development credits for 39 acres. Wetlands which are not active agricultural bogs or fields are allocated 0.2 credits for 39 acres.

In addition, the program provides that lots between 0.1 acres and 9.75 acres as of February 7, 1979, will be allocated at least one-fourth of a credit provided that the property is vacant and not in common ownership with contiguous land.

Fractions of dwelling units can be aggregated from different transfers and used when a whole unit is assembled. Sale of credits would take place on the open market, using a legal instrument similar to a conventional property deed.

Use of Credits

Regional Growth Areas are designated as receiving areas for Pinelands Development Credits. Each credit can be used to obtain four bonus housing units. The Comprehensive Management Plan requires that local governments in the growth areas adopt land use regulations which utilize the development credit bonus system. Specifically, residential densities must be presented as a range. The low density establishes the base density for a zone, and the high density represents the maximum density that can be achieved through the use of development credits. The density ranges established by the plan are shown in Table 7.4. The ranges are intended to allow increases in density levels but to maintain the same general housing type, thereby protecting the integrity of the neighborhood in which the credits are used. Each municipality should be zoned to accommodate a bonus housing capacity of at least 50 percent above the base density for developable lands within the growth areas or a minimum of 1.0 bonus unit per acre, whichever is greater.

The planning implications of the development credit program for municipalities with land in the Regional Growth Areas are illustrated by a hypothetical example in Table 7.5.

The success of the credit program rests on the ability of developers to utilize credits to build at higher densities without any additional procedural delays or review requirements. To the

**Table 7.4—Residential Density Ranges Under
Pinelands Development Credit Program**

Maximum Dwelling Units/Acre

Predominant Housing Type	Base Density	Bonus Density (with credits)
Single family detached	a) less than .5	.5
	b) .5	1
	c) 1	2
	d) 2	3
	e) 3	4
	f) 4	6
Single family attached and townhouse	a) 6	9
	b) 9	12
	c) 12	*

*Bonus density can be determined by municipalities. Municipalities may elect increased bonus density allowances in zones or portions of zones.

**Table 7.5—Illustrative Example of Municipal Zoning and
Ability to Accommodate Pinelands Development Credits**

Assumptions:

1. Municipality has 3,000 acres in Regional Growth Area of which 1,500 are classified as developable.
2. Average gross density for developable land in the Growth Area according to Pinelands Plan is 3.5 units per acre.
3. Basic housing unit capacity to be provided in Growth Area is 5,250 units (i.e., 3.5 x 1,500).
4. For zoning purposes all land in Growth Area, including wetlands, is designated for residential or non-residential uses or allocated for streets. Clustering is to be allowed when configuration of wetlands precludes development of particular sites.

Housing Type/Density Range	% Dist. of Housing Capacity	Max. Units Under Base Zoning	No. of Acres	Max Units with PDC Bonus Density
Single Family				
a) Base Density 1—Bonus Density 2 units/acre	25%	1,312.5	1,312.5	2,625
b) Base Density 3—Bonus Density 4 units/acre	35%	1,837.5	612.5	2,450
c) Base Density 4—Bonus Density 6 units/acre	20%	1,050	262.5	1,575
Townhouse				
a) Base Density 9—Bonus Density 12 units/acre	20%	1,050	116.7	1,400
TOTAL	100%	5,250	2,304.2 (76.8% of total land)	8,050 (53% over base housing capacity)

degree that there are delays, or that incremental costs are imposed on projects involving credits, the economic value of the credit to a developer is impaired. To assure that development utilizing bonus densities can proceed as expeditiously as possible, municipal zoning ordinances must incorporate clear standards for development with credits.

Supply and Demand for Credits

The overall relationship between the potential supply and the projected demand for Pinelands Development Credits has been taken into account in designing the credit program. It is recognized that the creation of a viable market for credits depends on the existence of an adequate number of sites within the growth areas to realistically accommodate the credits that are allocated under the plan.

Based on an analysis of lands within the Preservation Area and Agricultural Production Areas, it is estimated that approximately 8,315 development credits will be created pursuant to the allocation provisions described above. Theoretically, this amount of credits could all be utilized in the Regional Growth Areas with a multiplier of four to generate a total of 33,260 housing units. Realistically, it is not expected that this maximum will ever be realized for several reasons: 1) Significant numbers of credits will be kept off the market by the state as it proceeds with its Pinelands land acquisition program. It is estimated that upwards of 5,000 units would be reserved or eliminated in this way. 2) Some credits will not be utilized because landowners will elect to exercise development rights under the "grandfather" clause, rather than to sell development credits. 3) Lack of information, unclear title, or unwillingness to sell credits on the part of other owners is expected to further reduce the total number of credits in the market. Given these conditions, for planning purposes we have conservatively assumed a maximum housing unit potential that could be generated by credits of about 30,000 units.

Based on a bonus housing capacity equal to at least 50 percent of the base density in each growth area, or a minimum of 1 bonus unit/acre, it is projected that there would be a capacity for as many as 70,000 bonus units in the Regional Growth Areas. This represents an overall ratio of capacity to available bonus housing units of about 2.3 to 1.0, which is believed to be more than adequate to provide the necessary market for development credits. Atlantic County alone is projected to have the capacity for 22,650 bonus units, about 75 percent of the projected bonus units available. Further, it should be noted that when development conditions and housing demand warrant, additional capacity for bonus units will be provided through the activation of Municipal Reserve Areas.

Informing the Public

The Commission recognizes that there will be a particular need for a public information effort to explain the Pinelands Development Credit program to property owners, developers, municipal officials, realtors and all others who would have an interest. An effort will be made to inform all property owners individually of the program's establishment by the insertion of explanatory notices in the tax bill mailings of the various municipalities. Further, announcements of the program will be placed in appropriate locations throughout the region and published in local and regional newspapers. Descriptive information about the program, including its economic and legal aspects, will be compiled for distribution to local governments and organized groups and will be available to all interested parties. The general public information program to be undertaken upon adoption of the Comprehensive Management Plan will also be utilized to promote an understanding of development credits. There will be a need as well for regular information about credit offerings, bids and sales in order to facilitate the conduct of the private market.

Pinelands Development Credit Bank

The establishment of a "bank" to facilitate the implementation of the Pinelands Development Credit program has been recommended by the Commission. It is recognized that a bank could undertake one or several alternative functions. It could directly buy or sell credits on the open market; it could provide loans to property owners with credits as security; or it could guarantee loans made by other institutions based on credits as security. A bank could also perform the market information function mentioned above.

The Commission recommends that the credit bank be established with the objectives to provide loan guarantees and to serve on a limited basis as a buyer for credits in hardship situations (i.e., as a buyer of last resort). Initial funding at a level of \$5 million is recommended.

LAND ACQUISITION PROGRAM

Both the National Parks and Recreation Act of 1978 and the New Jersey Pinelands Protection Act direct the Commission to identify a variety of management techniques which will protect the Pinelands' land and water resources. In addition to land classification and permit systems, these techniques may include acquisition of conservation easements and other interests in land; public access agreements with private landowners; purchase of land for resale or leaseback; fee simple acquisition of public recreation sites, ecologically sensitive areas, and historic sites; and any other method of land and water protection and management which will help meet the goals and carry out the policies of the act.

The Commission has selected a number of potential areas for acquisition. These areas have been identified as meriting the greater level of protection implicit in public ownership because of their ecological, historical, recreational, or other value to the public.

Acquisition Criteria

The major objectives of the Commission's acquisition program are to protect ecologically and culturally critical areas and to provide a broad spectrum of recreational opportunities for the public. A number of criteria were considered in identifying lands to be acquired. They were:

- The presence of critical ecological factors, including threatened or endangered plants and animals, characteristic Pinelands aquatic communities, wildlife concentrations, wildlife diversity, breeding areas, and unique natural features
- The presence of prehistoric or historic resources
- Scenic value
- A balanced representation of natural Pinelands features
- Management requirements
- Contribution to the balance of recreational opportunities
- Size
- Contribution to the maintenance of contiguous landscape and/or corridors
- Location
- Threat to resources (development pressure)
- Adequacy of land use controls
- Significant public interest

Ecological factors were paramount in identifying acquisition areas. Scenic value and the presence of prehistoric and historic resources increased the significance of an ecologically critical area. Providing a balanced representation of natural features has been accomplished by identifying those areas which would strengthen the ecological and cultural diversity of public land holdings. Management requirements needed to maintain the integrity of the resource have also been considered.

The location and size factors are closely related to the management criterion. Special consideration has been given to areas which are large enough to be self-maintaining (for example, to accommodate wildfire) or which may be more easily managed than smaller parcels. Large, contiguous land areas may also support more diverse plant and animal communities. Small tracts adjacent to public lands may be more easily managed than small isolated parcels. Small outliers provide a reserve of ecological diversity apart from the larger, contiguous publicly owned tracts. They may also serve as corridors between the larger areas. Proximity to population and growth centers also facilitates the use of an area for recreation. Protection of lands which provide a balance of recreational uses, such as hunting, fishing, canoeing, and nature study, was a major consideration.

In many cases, areas which are sensitive to alteration or destruction or which are exposed to development pressure have been given priority. Critical areas may or may not be presently regulated or managed in a manner which ensures the protection of the significant resources found there. The adequacy of these controls has been evaluated.

A final criterion was significant public interest. The Commission has solicited and considered recommendations from the public on critical areas and areas where acquisition would be desirable.

Acquisition Techniques

The term "acquisition" is used here in a generic sense. Financial forecasts envision a phasing of all Pinelands acquisition within a five-year period. Format and timing for acquiring the parcels or specific ownership rights will depend upon a number of factors, including the availability of funds for acquisition, purchase price, and the selection of techniques appropriate for preservation.

The Commission is charged by legislation to identify lands for acquisition. However, it does not have the authority to act as the purchasing agent. Rather, the Commission makes recommendations to the Department of Environmental Protection to enter into agreements for public acquisition. While the Commission may not buy lands itself, it may recommend the specific acquisition technique, as well as how the land, once in public ownership, will be managed.

Fee simple acquisition is the best known and most common method for government to acquire land for preservation. The public agency buys the land outright from a landowner through a negotiated sale or, when a negotiated sale is not possible, through the power of eminent domain. Variations of fee simple acquisition include installment buying, which involves purchase of land over a given number of years, and bargain sales, in which the landowner sells to a public or non-profit agency at a reduced price and then is eligible for a tax deduction for his charitable donation.

Other methods which involve fee simple acquisition, at least initially, are purchase and leaseback and purchase and saleback. In the first case, the governmental body purchases the land, then leases it back to the former owner or to a third party. Uses of the land are subject to restrictions included in the lease. Purchase and saleback operates in a similar fashion. However, the government places a restriction in the deed on the use of the land, and then sells the property subject to the new restrictions. The distinction between these methods and traditional governmental land purchase practices is that a public agency obtains control over the use of the land without undertaking all the responsibilities of ownership and management. Another economic advantage is that the land remains productive in the private market.

Acquisition alternatives to fee simple are generally categorized as "less than fee simple" interests, and are manifested in the form of "easements"—scenic, conservation, or historic, for example. Easements include the positive easement, which pertains to the acquisition of a right to use all or part of a tract of land for specific activities, and the negative easement, which prevents the landowner from engaging in specific activities on his land. An example of the former would be the purchase of fishing rights, or a right-of-way for a public footpath or a hiking or bicycle trail. An example of a negative easement would be government acquisition of a guarantee that an owner will not put up billboards, cut down trees, or fill in marshland. Easements may also be used to acquire development rights to prevent all development or to restrict the type of development which may take place.

These several techniques have advantages and disadvantages, most of which center on the purchase cost, acceptability to the landowner, the impact on municipal taxes, operation and maintenance of the properties, and adherence to preservation agreements over the long term. It is anticipated that all of these techniques will be utilized as the Commission recommends specific parcels for acquisition.

The reasons for employing a variety of acquisition methods are to provide flexibility in the preservation process and to allow selection of a strategy which will most suitably meet the objectives for the parcel in question. As an example, fee simple acquisition may be the most direct technique for ensuring that land will remain in open space. The disadvantages of fee simple, however, are the short-term impact on the tax rolls, the costs to government of maintaining the

property, and the acrimony which may result if a landowner does not wish to sell outright at the time and at the appraised value.

Given the options for a particular site, the public purpose may best be served simply by ensuring that the land will remain in its present use, under its present owner or subsequent owners who will continue that use. One of the two purchase and leaseback/saleback arrangements would be most appropriate for lands presently in uses which actually protect the resources, such as cranberry cultivation. Easement purchase would apply where the intent is merely to obtain public access through a portion of a site which will remain undisturbed. It is important to consider the range of available acquisition techniques and to select the method which will prove most desirable to all parties involved. These include the landowner, the municipality, the general public, the administering agency, and the Commission.

Acquisition Areas

Priority acquisition areas selected by the Commission are as follows:

Cedar Creek Watershed

The Cedar Creek basin is an extensive, relatively undisturbed area which has enormous ecological, historical, and recreational value. Its waters are characterized by relatively high quality and the presence of aquatic communities which are typical of "pristine" Pinelands streams. The basin's wetlands support populations of the Pine Barrens treefrog and a number of threatened and endangered plants, including the curly grass fern and the purple bladderwort. The upland and lowland complexes provide habitat for many animal species, including white-tailed deer, mink, and beaver. The lowland forests are especially critical as wintering areas for the basin's deer population.

Because of its unique qualities, Cedar Creek has been studied by the New Jersey Department of Environmental Protection under the state's Wild and Scenic Rivers program. This watershed also ranked high in the Pinelands Commission's critical areas study and is rich in historic resources.

The area of interest links Double Trouble State Park to Greenwood Forest Wildlife Management Area and Lebanon State Forest, and includes approximately 10,000 acres. The acquisition would meet a number of criteria. A critical resource would be protected, and recreational opportunities would be maintained for hunters, fishermen, trappers, hikers, naturalists, and canoeists. A valuable corridor would be provided which would connect existing state lands and create a large, more easily managed land area, thereby helping maintain the region's ecological integrity.

Core Preserve

A number of linkage corridors and additions to public lands are proposed in portions of the Wading River, Bass River, and Westcunk Creek watersheds. These watersheds are perhaps the least disturbed drainage basins in the Pinelands. The lands proposed for protection, totaling some 32,000 acres, fall within those areas which were ranked highest in the critical areas study. They include significant natural, scenic, and cultural features.

Sites within the proposed additions to public lands support some of the largest concentrations of threatened and endangered plants and animals in the Pinelands, including the timber rattlesnake, northern pine snake, Pine Barrens treefrog, purple bladderwort, bog asphodel, curly grass fern, and false asphodel. This area supports aquatic species such as blackbanded and banded sunfish which typify characteristic Pinelands communities. Species indicative of disturbed conditions are uncommon in the area's waters.

The area currently provides abundant recreational opportunities for the public, including hiking, nature study, fishing, hunting, and trapping. Portions of the Oswego River which are included in the project are among the finest canoeing waters in the Pinelands. Priority will be given to the East Plains, one of the Pinelands' most important ecological and scientific areas.

The application of protective measures in this area will ensure that many critical resources are preserved, and that recreational opportunities are maintained and enhanced. Protection will also link existing publicly owned lands and help to develop a large, contiguous parcel which supports the maintenance of the region's ecological character and facilitates management.

Additions to Wharton State Forest

Approximately 5,000 acres have been identified for addition to Wharton State Forest. By protecting these critical areas, the integrity of the Wharton Tract will be maintained. Included within the acquisition is a western corridor connecting Wharton and Lebanon State Forest.

Lower Mullica/Wading River Watersheds

Acquisition of approximately 2,000 acres in the lower Mullica and Wading River watersheds will enlarge present state landholdings and increase the area's recreational potential. These lands provide exceptional habitat for otter, mink, muskrat, and various wading birds, and are also a feeding area for bald eagles.

Toms River Watershed

The area of interest is adjacent to public lands which provide recreational opportunities for hunters, trappers, fishermen, and naturalists, and which support characteristic Pinelands plants and animals, including some identified as threatened or endangered. Additions to these public lands totaling approximately 1,400 acres will enhance the contiguous nature of the parcels, ensure the maintenance of ecological values associated with the Pinelands, and provide an important recreational area for residents in nearby developing communities.

Oyster Creek Watershed

Approximately 2,500 acres are proposed for protection in the Oyster Creek basin. The project area meets a number of the selection criteria. It supports rare species, including the Pine Barrens treefrog and the northern pine snake, and includes scenic areas and historic sites. This publicly nominated site can provide many recreational opportunities to growing communities in adjacent areas.

North/South Corridor

Protection of a corridor linking the northern and southern forests is essential to preservation of the Pinelands. Acquisition of strategically located land totaling approximately 7,500 acres will provide another major recreational area in the Pinelands and contribute to the establishment of a permanent corridor. Lands within this region support a highly diverse group of threatened and endangered plants, and have the potential to provide a number of recreational opportunities including fishing, boating, camping, and nature study. They include representative parcels in the Great Egg Harbor River watershed and historic sites.

Southern Forest Region

Preservation of a core of the southern Pinelands forest is necessary for the maintenance of the Pinelands' overall ecological character. Publicly owned lands form the nucleus of this core. They include Peaslee, Dennis Creek, Beaver Swamp, and Lester G. MacNamara Wildlife Management Areas and Belleplain State Forest. Available data indicate the presence of characteristic Pinelands aquatic communities in portions of three major river systems: the Dennis Creek, Maurice River, and Tuckahoe River basins.

The southern forest region is a stronghold for two species designated as endangered in the state, the tiger salamander and the southern gray treefrog. The areas of interest meet the criteria for ecological significance, historic resources management, balanced recreation, and size, among others. Acquisition areas totaling approximately 6,600 acres include additions to public lands and corridors linking these parcels, thereby creating a contiguous parcel of public land in the region.

Summary of Acquisition Areas

The following list summarizes potential acquisition areas identified by the Commission:

Area	Approximate Acreage to be Protected
Cedar Creek Watershed	10,000
Core Preserve	32,000
Lower Mullica/Wading River Watersheds	2,000
Additions to Wharton State Forest	5,000
Toms River Watershed	1,400
Oyster Creek Watershed	2,500
North/South Corridor	7,500
Southern Forest Region	6,600
Total	67,000

Estimated costs of acquiring these parcels, and a five-year schedule under which the acquisitions will be made, are presented in Chapter Nine. The Commission also foresees the need to acquire additional lands totaling approximately 30,000 acres, including interior and exterior additions to public lands.

The New Jersey Conservation Foundation and the New Jersey Natural Lands Trust have been leaders in the use of various acquisition techniques to protect land for the public. The Commission will cooperate with these organizations in this continuing effort. The Commission will also cooperate with the New Jersey Department of Environmental Protection (through the Pinelands Acquisition Office, the Division of Fish, Game and Wildlife, and the Division of Parks, Forestry and Green Acres) and the U.S. Department of the Interior (through the Heritage Conservation and Recreation Service and the Fish and Wildlife Service) in delineating acquisition areas and determining the best methods for their protection.

It is recommended that the Department of Environmental Protection review its appraisal, application, and other administrative procedures and make revisions necessary to facilitate the acquisition of lands for public use.

SURFACE AND GROUNDWATER RESOURCES PROGRAM

The extensive groundwater reservoir containing unpolluted fresh water is the principal hydrologic feature of the Pinelands National Reserve. This water supply is replenished only by precipitation, of which approximately 50 percent of the annual total (22 inches) is lost to evapotranspiration and 6 percent (2.5 inches) to stream flow. This leaves 44 percent (approximately 21.5 inches) to percolate through the soil and recharge the groundwater. Surface and groundwaters of the Pinelands are characterized by low nutrients, hardness, alkalinity, and pH. Maintenance of the typical Pinelands flora and fauna depend upon the preservation of the existing quality and quantity of those water resources. The soils of the Pinelands have been described as chemically inert, allowing polluted waters to pass through them with little if any renovation. Therefore, development in the extensive and highly permeable aquifer recharge areas has and will result in degradation of the waters.

Since water plays a critical role in the maintenance of the Pinelands ecosystem, it is essential that this highly fragile resource be protected, and where degradation has occurred, that its quality be enhanced. Excessive nitrate-nitrogen has been recently recognized in the surface and groundwaters in certain areas of the Pinelands region. This nutrient is important for several reasons. The Pinelands environment may not be able to accept elevated concentrations of nitrate without change; secondly, nitrate has been identified as a health hazard; and finally, nitrogen is

a contaminant which is associated with most land use activities. It is therefore a good indicator of the impacts on the natural resources.

Water Quality Standards

In accordance with the Pinelands Protection Act, the Commission has adopted a policy for the preservation, protection, and enhancement of the quality and quantity of the surface and groundwaters. Section 6(i) of the act mandates that the Pinelands Commission recommend water quality standards to the New Jersey Department of Environmental Protection (DEP). Studies conducted during the development of the Comprehensive Management Plan indicate that there are several key water quality parameters which characterize the Pinelands' surface and groundwaters and which are suggested as essential to the maintenance of the Pinelands ecosystem. The values associated with these parameters, which are used to describe the ambient water quality conditions in the undisturbed areas of the Pinelands, are:

- pH—less than 5.0
- Nitrate-Nitrogen—about 0.17 parts per million (seasonably higher in winter)
- Ammonia-Nitrogen—about 0.036 parts per million
- Total Phosphate—about 0.019 parts per million
- Dissolved Oxygen—about 85 percent saturation
- Total Dissolved Solids—less than 100 parts per million.

On January 23, 1978, the New Jersey Department of Environmental Protection adopted the Central Pine Barrens Water Quality Standards. These standards are in effect throughout what is known as the "Critical Area" as depicted in Figure 7.2. The surface and groundwater standards which have been adopted together with proposed revisions are:

Parameter	Criteria (equal to or less than)	
	Surface Water	Groundwater
1. pH (standard units)	3.5 - 5.5	4.2 - 5.8
2. Dissolved Oxygen (% saturation)	85%	—
3. Biochemical Oxygen Demand	5.0 mg/l	3.0 mg/l
4. Nitrate-Nitrogen	2.0 mg/l	2.0 mg/l
5. Ammonia Nitrogen (un-ionized NH ₃)	—	0.5 mg/l*
6. Total Phosphate	0.7 mg/l	0.7 mg/l
7. Total Dissolved Solids	100 mg/l	100 mg/l‡
8. Suspended Solids (non-filterable residue)	40 mg/l	—
9. Turbidity (Jackson Units)	20 JTU's	—
10. Total Alkalinity (as CaCO ₃)	10 mg/l	—
11. Barium	1.0 mg/l*	1.0 mg/l*
12. Chloride	—	10 mg/l*
13. Fluoride	—	2.0 mg/l*
14. Foaming Agents	—	0.5 mg/l*
15. Iron	—	0.3 mg/l*
16. Manganese	—	50 µg/l*
17. Sodium	—	10 mg/l*
18. Sulfate	—	15 mg/l*
19. Arsenic	50 µg/l*	50 µg/l*
20. Cadmium	10 µg/l*	Natural background*
21. Chromium (Hexavalent)	50 µg/l*	Natural background*
22. Copper	—	1.0 mg/l*
23. Cyanide	—	200 µg/l*
24. Lead	50 µg/l*	Natural background*
25. Mercury	5 µg/l*	Natural background*
26. Phenol	—	1 µg/l*

27. Selenium	10 µg/l*	Natural background*
28. Silver	50 µg/l*	10 µg/l*
29. Zinc	—	5.0 mg/l*
30. Aldrin/Dieldrin	0.003 µg/l*	0.003 µg/l*
31. Benzidine	0.1 µg/l*	0.1 µg/l*
32. DDT and Metabolites	0.001 µg/l*	0.001 µg/l*
33. Endrin	0.004 µg/l*	0.004 µg/l*
34. Polychlorinated Biphenyls (PCB's)	0.001 µg/l*	0.001 µg/l*
35. Total Residual Chlorine	3.0 µg/l*	—
36. Toxaphene	0.005 µg/l*	0.005 µg/l*
37. Color	Natural background	None noticeable*

*Proposed standards

‡100 mg/l is proposed revision; 250 mg/l is the current standard

Floating, colloidal, and settleable solids; petroleum hydrocarbons and other oils and grease:

- Surface water—(1) None noticeable in the water or deposited along the shore or on the aquatic substrata in quantities detrimental to the natural biota. None which render the water unsuitable for the designated uses of a Class FW-Central Pine Barrens stream. (2) For petroleum hydrocarbons the goal is non-detectable utilizing the U.S. Environmental Protection Agency's Environmental Monitoring and Support Laboratory Method. The present criteria, however, are those in (1) above.
- Groundwater—No recommendation.

Taste and odor producing substances:

- Surface and groundwater—Allowing for natural conditions, none offensive to humans or which would produce offensive taste and /or odors in water supplies and biota used for human consumption. None which would render the waters unsuitable for the designed uses.

Temperature and heat dissipation areas:

- Surface water—Not to deviate more than 2.8°C (5.0°F) from ambient stream temperature.
- Groundwater—No recommendation.

Bacterial quality:

- Surface water—Fecal coliform levels shall not exceed a geometric mean of 200 MPN/100 ml, with not more than 10 percent of the total samples during any 30-day period exceeding 400 MPN/100 ml.
- Groundwater—The most stringent of the following criteria: (1) As determined by the membrane filter method, coliform bacteria shall not exceed 4 per 100 ml in more than one sample when less than 20 are examined per month; or (2) As determined by the fermentation tube method, with a standard portion of 10 mg/l, coliform bacteria shall not be present in three or more portions in more than one sample when less than 20 samples are examined per month; or (3) The prevailing criteria adopted pursuant to the Federal Safe Drinking Water Act (PL 93-523).

Radioactivity:

- Surface and groundwater—Prevailing regulations adopted by the U.S. Environmental Protection Agency pursuant to Sections 1412, 1445, and 1450 of the Public Health Services Act, as amended by the Safe Drinking Water Act (PL 93-523).

The Pinelands Commission recommends that the New Jersey Department of Environmental

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Figure 7.2—Central Pine Barrens Water Quality Critical Area

Protection, Division of Water Resources, adopt the Central Pine Barrens water quality standards, as proposed, for the entire Pinelands National Reserve. Together with this plan's land allocation program, which considers background water quality from a regional perspective and directs levels and intensities of development to protect the essential character of the area, implementation at the project level of the proposed Central Pine Barrens water quality standards throughout the Pinelands will ensure that the water quality of the area is protected.

Water Resources Planning

Long-term protection and enhancement of the surface and groundwater resources in the Pinelands National Reserve require close coordination with those agencies which contribute to the establishment of policies relating to land use and environmental management. Both the federal and state Pinelands laws require that the Comprehensive Management Plan set forth a strategy to implement the Clean Water Act of 1977 and the Safe Drinking Water Act of 1974. To accomplish this, the Pinelands Commission will review and comment on all 208 Areawide Wastewater Management Plans which have been prepared or are being prepared in the Atlantic, Cape May, Lower Delaware, Tri-County, and Ocean County designated 208 areas. This must be done prior to annual certification given by the Governor to assure that these plans are consistent with the intent and programs of the New Jersey Pinelands Protection Act.

It is also recommended that the U.S. Environmental Protection Agency immediately designate the Cohansey and Kirkwood formations as a sole source aquifer under Section 1424(e) of the Safe Drinking Water Act (PL 93-523). The Pinelands Commission should be designated as an obligatory review agency within the Pinelands National Reserve. Outside of the Reserve, there will be an appropriate review agency as required under federal management and budget procedures. Additionally, it is recommended that the New Jersey Department of Environmental Protection adopt groundwater quality standards for those portions of the Cohansey and Kirkwood outcrop areas which lie outside the Pinelands National Reserve. These standards should be consistent with those recommended by the Commission for the Pinelands.

Public And Private Domestic Waste Treatment Facilities

In the past, public wastewater treatment facilities have been constructed to alleviate existing septic system impacts or to provide service to developing areas. For a variety of reasons, including the absence or mis-application of technology, the location and design of these facilities have not always addressed the necessary environmental concerns, including adequate treatment for the removal of contaminants and the protection of relatively pristine water bodies. Even today, the technological advances in wastewater disposal do not provide sufficiently adequate treatment in a cost-effective manner for such facilities to meet the water quality standards recommended by the Commission for on-site wastewater disposal.

The Commission's program for public and private wastewater disposal recognizes the limitations inherent in plant design and contaminant removal. Therefore, the use of best available cost-effective technology is the most desirable approach to assist in the maintenance of water quality in the developing areas of the Pinelands National Reserve. The programs to implement this objective are as follows.

Regional and Sub-Regional Facilities (Existing)

The Commission will cooperate with the Department of Environmental Protection in examining existing facilities in the Pinelands National Reserve and in investigating the feasibility of:

- Upgrading the level of treatment to advanced wastewater treatment or other best available cost-effective technology for nutrient removal.
- Converting from direct discharge into surface waters, to a land application alternative.
- Adding septage treatment facilities and identifying those plants which would be best suited, locationally and technically, for such modification.

Regional and Sub-Regional Facilities (New)

All 201 facilities planning and sewage treatment plant priority lists for construction in the Pinelands National Reserve, as presented in the Atlantic, Cape May, and Ocean Counties and the Lower Delaware and Tri-County 208 Areawide Wastewater Treatment Management Plans, should be consistent with the land use and land allocation programs contained in this plan. The following guidelines should be used:

- New sewage treatment plants and the expansion of existing facilities should be permitted in the Regional Growth Areas, Pinelands Towns, and parts of Rural Development Areas slated for future higher density development. Sewage treatment facilities in non-growth areas should be permitted only where required to alleviate existing health problems created by malfunctioning septic systems. In such cases, the facility should not be sized to exceed that necessary to support development provided for in this plan.
- Direct discharge of effluent into any surface waters of the Pinelands is prohibited and alternatives such as land application should be utilized.
- The plant should not accept industrial wastes that will render its effluent or sludge inappropriate for land application to food or fiber production areas.
- Sewage treatment plant design should include technologies for the acceptance and treatment of septage and its disposal, either by processing through the plant or in accordance with the programs and recommendations in the solid waste program of this plan.

Small-Scale Waste Treatment Facilities

Planning and design of small waste treatment facilities in the National Reserve shall conform with the guidelines set forth in the plan, including:

- Land application is required in all cases. Such facilities shall be in accordance with the DEP guidelines for spray irrigation which are in effect at the time of construction. Facilities which include lagoon storage as part of the land application alternative shall certify that the lagoons are secure from leakage of effluent into the groundwater.
- Small facilities should be located, where feasible, sufficiently close to dedicated public use areas to provide the opportunity for land application.

Non-Domestic Discharges

Non-domestic discharges emanate from commercial and industrial operations. They are considered to include point discharges as well as the release of pollutants into or onto the land. Such discharges may contain a variety of chemicals that are products, by-products, or materials used in processing. Evidence suggests that many of these discharges are toxic and carcinogenic. If not properly treated and/or disposed of, they may pollute the Pinelands' water supply. If released into a deeper aquifer recharge area, these chemicals could remain in the groundwater for many years.

Industrial and commercial wastes are also introduced into the environment by leakage, spills, improper storage, and intentional illegal dumping. All intentional and accidental land discharges in the Pinelands disappear quickly because of the highly permeable nature of the sandy soils. Unlined storage lagoons or lagoons with damaged linings can also leak significant quantities of chemicals into the ground, as can small-scale operations such as dry cleaners and car washes in areas which are not sewered.

The following programs will protect the Pinelands' surface and groundwater resources from degradation by hazardous non-domestic discharges. Non-domestic discharges to either the surface or groundwaters of the Pinelands National Reserve shall not be permitted.

The Commission recommends that the Department of Environmental Protection expand these controls over non-domestic hazardous discharges to the ground or surface waters to the entire area of the Cohansey and Kirkwood aquifers. The Commission further recommends the NJPDES permits be granted or renewed in the National Reserve, and in the entire Cohansey and Kirkwood areas, only when those permits include the following provisions:

- No hazardous waste product, by-product, or process material will be allowed to enter a surface water body or overland flow.
- An adequate contingency plan for containment and clean-up of spills and leaks of hazardous waste products, by-products, or process materials and an adequate inspection and maintenance program will be prepared.
- All hazardous materials generated or used by the process will be collected and contained for safe disposal in a manner which prevents their introduction into the waters of the Cohansey or Kirkwood aquifers.
- Discharges to any sewage treatment plant must be pretreated in accordance with the Environmental Protection Agency's "Pretreatment Regulations for Existing and New Sources of Pollution" (40 CFR 403, amended by 44 CFR 32854, effective August 13, 1979) and whatever additional Department of Environmental Protection rules and regulations apply at the time of the discharge application.

On-Site Disposal of Domestic Wastewater

The predominant method of domestic wastewater disposal in the Pinelands is by on-site treatment. The most common technology is the standard septic tank with a soil absorption system. Traditionally, the septic system has been considered a temporary measure until sewers are built. However, in rural communities with low densities, the cost of a sewage collection system is prohibitive. The septic system therefore becomes the primary technique for wastewater treatment. Septic systems can be designed to function properly and efficiently as long as they are maintained. Bacterial and viral contamination can be eliminated by providing sufficient depth of unsaturated soil beneath the leach field. However, dissolved pollutants, such as nitrate-nitrogen, tend to move rapidly through the coarse, permeable Pinelands sands. This hazard can be minimized only by increasing the lot size so that the pollutant is diluted by infiltrating rainwater. One potential contamination problem which is not easily resolved technically is the indiscriminant disposal of hazardous materials into septic systems by homeowners. These materials include paints, solvents, cleaning solutions, pesticides, and petroleum products.

The septic tank and the soil absorption system have been linked to groundwater contamination in the National Reserve (Country Lakes, Presidential Lakes, New Gretna, Victory Lakes, and other areas). To resolve and prevent such problems, the Commission has undertaken studies of septic systems, the effectiveness of soil as a waste treatment medium, and alternative technologies to septic tanks with leach fields. Densities for developments using on-site wastewater disposal in the various land use areas established in this plan complement the water quality standards that the Commission is recommending for New Jersey DEP adoption in the National Reserve. The following programs are consistent with the Pinelands Commission's policy to preserve, protect, and enhance the water resources of the area.

Dilution Model

Through the Commission's studies, a nitrate-nitrogen dilution model has been developed to predict the water quality impact of on-site wastewater disposal systems. The model includes an analysis of the nitrogen loading, the desired concentration of nitrate at the property line, the septic effluent leach field area, and precipitation input. While similar to the model currently used by the Department of Environmental Protection in areas of the Pinelands, the model developed for the Commission allows inclusion of a wider range of variables. The Commission recommends that it be utilized by the DEP's Division of Water Resources.

Alternate Design

Alternative technologies to the standard septic tank with a soil absorption leach field for on-site wastewater disposal were studied during the plan's development. The primary emphasis of this study was nitrate removal. The study determined that the waterless or composting toilet is the most appropriate alternative design for use in the Pinelands at this time. Proven cost-effective denitrifying alternatives other than the waterless toilet have not been developed since past research has centered on the disposal of septic tank effluent. Several promising alternatives which provide for denitrification are currently being studied.

The Commission's program for alternative design provides that when individuals who are unable to meet the water quality standards realize development opportunities due to factors such as "grandfather" exemptions or hardship, an alternative system approved by the DEP's Division of Water Resources may be used if that system provides the same level of protection as a standard septic system would on an adequately sized lot. Some assurance must also be given that the waterless system will not be replaced with a flush system. Since a gray water (household washwater) leach field is installed along with a composting toilet, conversion to a flush toilet is not difficult mechanically, and it poses an even higher pollution risk because of the relatively small leach field. When innovative systems (unproven alternatives) are accepted by the DEP, assurance is required that a monitoring program designed in accordance with the system installed will be conducted by the homeowner for some period of time.

On-Site Water Supply

The densities of previous development patterns have caused elevated nitrate-nitrogen levels in some areas. Several wells have already been closed in the Pinelands area because of high nitrate. To assure that on-site wells will not draw contaminants from the upper portions of the water table, the Commission's program requires residences with on-site wastewater disposal to utilize wells which are drilled and cased to at least 100 feet unless a restrictive clay layer is encountered at less than 100 feet. In that event, a shallower well will be permitted.

Septic Tank Cleaners

Some chemical additives which are sold as septic tank cleaners contain toxic and non-biodegradable halogenated and aromatic hydrocarbons. In keeping with the policy to protect and enhance water resources, municipal ordinances will contain provisions prohibiting the use of septic tank cleaners.

Program Recommendations

Since continued operation of a septic tank waste disposal system requires periodic maintenance, the Commission recommends that the counties create septic management agencies. These agencies should develop programs to assure adequate design and installation as well as continued maintenance. In addition, they should be prepared to provide technical expertise to homeowners with malfunctioning septic systems to assure that proper corrective measures are taken.

Some small communities in the Pinelands have been plagued with malfunctioning septic systems. The Commission believes that any system constructed on a lot which is not large enough to meet the recommended nitrate-nitrogen standard should be considered as a malfunctioning system. In the more rural areas, correction of these problems with conventional sewage treatment plants would be costly and undesirable. It is therefore recommended that the Department of Environmental Protection encourage rural communities to establish "Small Community Alternative System" studies in accordance with Section 205(h) of the Federal Water Pollution Control Act as amended by the Clean Water Act of 1977. These efforts, which may be funded in part from

the 4 percent set-aside from the state's Section 201 money, would study alternatives for septage disposal, and cost-effective alternatives to the traditional approach which utilizes major treatment facilities to correct malfunctioning septic tank problems. The Pinelands Commission would participate in all such studies.

Stormwater Runoff Quality

Stormwater runoff from an upland site in the Pinelands with natural vegetation is typically low, since the sandy and permeable soils allow for rapid infiltration. Modifying the surface with impervious ground covers will increase the volume of runoff and introduce pollutants which are associated with development. The programs in this section will minimize the impact of stormwater runoff.

Non-point source pollution from urban runoff can be minimized by eliminating direct discharges into surface waters. Recharging stormwater to the ground helps maintain groundwater supplies, but may have an impact on groundwater quality if not properly treated. The Commission's standards assure that stormwater runoff will be recharged to the ground to the maximum extent possible. Separation of stormwater is recommended to allow for direct recharge using drywells of pollutant-free runoff from places such as rooftops. Runoff contaminated with metals, oils, grease, or animal waste should be treated by vegetal filtration prior to recharge. Where practicable, stormwater should not be recharged into soils which are classified as excessively or somewhat excessively drained, nor into areas identified as deeper aquifer recharge areas. Where recharge is not feasible, stormwater shall be released into pitch pine lowlands using land spreading techniques. The application of road oil, which is sometimes used as a dust control measure, shall be prohibited.

Program Recommendations

Besides metal and organics, stormwater runoff from roads can contain significant concentrations of sodium and calcium as a result of de-icing chemical storage and application practices during the winter season. Salting has been identified as a serious problem in other parts of the Northeast, and restrictions on the use of salt have been established. De-icing chemical storage areas shall be lined and covered with impervious materials to prevent leaching into groundwaters. Further, the Commission recommends that state, county, and local highway departments restrict de-icing chemical applications.

Construction site soil erosion and sediment control is currently regulated by the New Jersey State Soil Conservation Committee through the Soil Erosion and Sediment Control Act of 1975. Originally covering all construction activity which disturbs more than 5,000 square feet, other than single family dwellings, this statute was recently amended to include demolition, construction of parking lots, public facility construction, and all land clearing other than agricultural. However, the standards which are used provide a wide range of choices, from small-scale source controls such as land grading, berms and straw bales to large-scale physical removal techniques such as sediment basins. These large structures destroy the natural landscape and require fencing for public safety. They are often also designed as stormwater retention basins which have limited capacity to remove contaminants.

The Commission recommends that the New Jersey State Soil Conservation Committee adopt a policy that within the Pinelands National Reserve, approaches utilizing large structural measures such as sedimentation basins are strongly discouraged. It is also recommended that the municipalities, in cooperation with the South Jersey Resource Conservation and Development Council and the Soil Conservation Districts, prepare plans and undertake programs to stabilize road banks and other critical unvegetated slopes which contribute sediment to the Pinelands' streams and rivers.

Landfills

Within the Pinelands, landfills are often found in or adjacent to abandoned sand and gravel extractions sites. While such sites were once considered suitable for trash disposal, they have

been identified as sources of potentially serious pollution. The sandy, porous, and highly permeable character of the inert Pinelands soils allows for the passage of landfill leachate with little or no chemical alteration or renovation. Thus, the high quality groundwater resources of the National Reserve are jeopardized by the hazardous and sometimes unknown materials which have been discarded in the dumps. Problems occur locally at first due to the large volume of groundwater available for dilution. As the leachate moves into the deeper aquifer flow systems, regional groundwater supplies are threatened.

The Commission's programs covering solid waste disposal in the Pinelands are detailed in another section. Because of the landfills' impact on water quality, the Commission recommends that agencies such as the Department of Environmental Protection, the New Jersey Department of Health, and the U.S. Geological Survey cooperate in a coordinated program to continually monitor water quality around existing landfills. This program will identify the extent of contamination which has occurred, and indicate any contamination of nearby wells.

Hazardous Chemicals

Many chemicals that are commonly used in the home (cleaning fluids, pesticides, paint solvents, and septic tank cleaners), in commercial establishments (air conditioning water additives, dry cleaning agents), and in industrial concerns (process chemicals, products, and by-products) have been found to be toxic and carcinogenic in very low concentrations. In the past, because of the inability to detect their very low concentrations and the relative lack of knowledge about their effects, these chemicals were discarded indiscriminately. As a result, significant concentrations are now being found in groundwater samples taken throughout the Pinelands.

Another source of hazardous chemical pollution here is intentional and illegal dumping. The vast areas of unpopulated countryside allow "midnight dumpers" to dump undetected, and the sandy soil readily soaks away the discarded material. Because there are no registered hazardous waste sites in New Jersey, and because it is costly to transport the material elsewhere, illegal dumping frequently occurs.

Volatile organic chemicals are of particular concern because they are not readily absorbed and they move rapidly through the soil profile into the groundwater. Protection and enhancement of the Pinelands' water resources require strict control over those chemicals identified as hazardous to prevent their introduction. Minimum concentrations of these materials which are injurious to public health have not yet been determined. In the interim, the EPA has recommended a standard of 100 parts per billion for trihalomethanes, one class of hazardous compounds. As these chemicals may be hazardous in concentrations below the interim standards, the introduction of these materials into the Pinelands' waters should be reduced to the maximum extent feasible until other standards are recommended.

Program Recommendations

The Commission recommends that the New Jersey Legislature provide for a "bounty system" whereby an individual who reports an illegal dumper would receive a monetary reward upon the dumper's conviction. The Commission also recommends that the Department of Environmental Protection establish a "hot line" for reports of spills or illegal dumping of materials.

A significant potential source of hazardous material pollution is underground petroleum storage. Storage facilities include all power plants, gas stations, and homes with underground tanks. Treated metal tanks have a life expectancy of 20 to 25 years, eventually corroding and developing leaks. Newer fiberglass tanks can rupture under cold temperatures and extreme loads. In accordance with the policy to protect the water resource, the Commission recommends that the current permitting system for gas stations and other facilities which have large underground petroleum storage tanks should be modified to provide for a renewable permit that is dependent on inspection for leakage and required maintenance.

Fertilizers and Pesticides

Agricultural chemicals are sources of nutrients, and some are hazardous. They are often used

in urban and suburban areas as fertilizers and pesticides on lawns, gardens, and recreation fields, as well as at commercial and industrial establishments. Commercial chemical applicators are also a source of these materials, particularly where the chemicals are concentrated, as during the storage and mixing of pesticides and the filling and rinsing of sprayers.

Protection and enhancement of the Pinelands' water resources require that operations which cause a concentration of agricultural chemicals should be controlled, and that all unnecessary uses of agricultural chemicals should be eliminated. To accomplish this, the Commission will require that plants native to the Pinelands be used for landscaping to the maximum extent feasible. When other ornamental plants are used, they should be of types which are compatible with the natural Pinelands environment.

Program Recommendations

The Commission recommends that new and existing commercial applicators which have centralized mixing and loading facilities located on the porous sandy soils of the Pinelands be required by the DEP's Office of Pesticide Control to install facilities which can contain pesticide spills, leaks, and washwater. It is further recommended that the New Jersey Department of Transportation's licensing procedure for special airstrips for aerial applicators be required to ensure adequate buffer zones. The zones should include windbreaks to prevent impacts on surrounding and adjacent residences, as well as residences in the flight path.

Water Quantity

The Pinelands' surface waters are supported, for the most part, by groundwater as base flow. As previously indicated, the groundwater supplies are replenished only by precipitation, half of which either runs off as stream flow or is lost to the atmosphere.

The groundwater level in the upper aquifer is the water table level, responsible for creating wetland habitats throughout the Pinelands. The river and stream flows which are supported by groundwater base flow are usually uniform throughout the year, decreasing only slightly during the summer months. Agricultural operations which rely on large volumes of water can therefore safely anticipate adequate supply in most years. This constant supply ultimately discharges to the estuaries and bays, where it helps stabilize the salinity gradients and creates ideal conditions for the culture of shellfish.

Stormwater Runoff Management

Flooding in the Pinelands occurs infrequently because of the low runoff-generating character of the soil and the extensive areas of wetlands which absorb the impact of runoff. However, as land is developed, the permeable soils are replaced by impermeable surfaces which increase runoff volumes. Stream corridors naturally adjust their sizes and shapes to accommodate normally occurring stream flows. A higher flow will thus cause erosion of the channel to accommodate the additional water, and will also increase the area of normal flooding. Correspondingly, water lost during increased flooding is not available during non-storm periods and results in abnormally low base flows. Protection of the quantitative aspects of the surface and groundwaters is a Commission policy to assure long-term availability of water supplies for drinking, agricultural uses, and maintenance of stream and river flow regimes, as well as the general ecological integrity of the Pinelands. The following programs implement the Commission's policies.

Municipal ordinances shall contain provisions requiring stormwater runoff management plans to maximize recharge of runoff to the groundwater using natural drainage concepts such as gravel driveways and drywells for roof runoff rather than large infiltration basins. Runoff predication methodology to determine rates and volumes of allowable discharge shall be that of the U.S. Soil Conservation Service as described in SCS National Engineering Handbook, Section 4 or Technical Release 55. The Commission also recommends that the Soil Conservation Districts and County Engineering Departments review stormwater runoff management plans, and that the Soil Erosion and Sediment Control Standards promulgated pursuant to the Soil Erosion and Sediment Control Act of 1975 and revised July, 1980 be used as interim design standards.

The Pinelands Commission is a participant on the Statewide Stormwater Management Technical Working Group which is currently developing a statewide stormwater program. The Commission will continue to encourage this group to emphasize retention rather than detention facilities in areas of the Cohansey and Kirkwood aquifers outside the Pinelands National Reserve.

The Pinelands Commission recommends that the New Jersey State Soil Conservation Committee, the U.S. Soil Conservation Service, and the Department of Environmental Protection prepare a handbook of Best Management Practices for stormwater runoff control and management for the Pinelands which emphasizes retention techniques. This handbook would supplement the statewide manual being prepared by the Delaware Valley Regional Planning Commission, the U.S. Environmental Protection Agency, and the DEP, and would contain guidelines on the use of the state manual in the Pinelands.

Flood Plain Management

Within the Pinelands National Reserve, only three municipalities are not participating in the National Flood Insurance Program administered by the U.S. Department of Housing and Urban Development. Participating municipalities are required to adopt provisions which control construction in the 100-year flood plain and 100-year coastal flooding area. Under this program, delineation of flood hazard areas has been done for many municipalities by using an approximation method rather than detailed hydrologic and hydraulic analyses. Therefore, 100-year flood areas are not accurately known.

While the Commission has developed programs for wetlands which include flood prone areas, it is recommended that the Department of Environmental Protection, with the assistance of the U.S. Conservation Service, delineate flood hazard areas in the National Reserve as soon as possible. The DEP utilizes a more detailed hydrologic analysis to delineate the 100-year flood boundary which is superior to the approximation method. The Commission will cooperate with the Bureau of Water Supply and Flood Plain Management in the DEP's Division of Water Resources in its ongoing efforts to implement provisions of the New Jersey Flood Hazard Area Control Act. This program is consistent with the Commission's policy to direct development into environmentally suited areas.

Groundwater Withdrawals and Exportation

The large reservoir beneath the Pinelands is the primary source of water supply for residents in the region. Current potential withdrawals have been estimated at more than 950,000,000 gallons per day for the Pinelands' seven counties. The only source of water available to replenish this system is precipitation. The Pinelands' groundwater has been identified throughout the Commission's studies as being essential to the maintenance of the region's existing character. Indeed, the unique communities of Pinelands vegetation and wildlife are dependent on the existing quality and quantity of this water system. The exportation of large quantities of water from the region would have a significant impact upon the ecological stability of the National Reserve and would result in complete alteration of the area required to be protected by both federal and state legislation.

In recognition of the overriding role of abundant and clean water supplies in the Pinelands, the Commission has adopted a policy to preserve, protect, and enhance the water resources of the region. New facilities which export ground or surface waters from the Pinelands shall not be permitted. All new development serviced by existing sewer treatment facilities that discharge effluent to a surface water body in or out of the Pinelands shall utilize water-saving technology such as low-flush water closets, flow restrictors, and low-flow shower nozzles. It is further recommended that the Division of Water Resources of the Department of Environmental Protection undertake a detailed study to determine current groundwater withdrawals from the Pinelands' major aquifers. This information is necessary to determine environmentally safe yields.

Monitoring

Numerous state, county, and local agencies, and institutions of higher education, are studying various aspects of water quality and quantity in the Pinelands. The Pinelands Commission

recommends that these agencies and individuals cooperate together and develop a monitoring network which would avoid duplication and assure compatibility of data. The Commission recommends that a committee consisting of representatives of the DEP, the U.S. Geological Survey, the counties, 208 agencies, and the Commission be formed to coordinate the various studies and to develop a continuous monitoring system so the impact of current and future development in areas underlain by the Cohansey and Kirkwood formations may be determined.

Such a monitoring program should assemble data on the location of sampling points, contaminants sampled for, and rainfall quality and quantity. It should also catalogue all pollution sources (sewage treatment plants and non-domestic dischargers) and non-point sources (landfills, petroleum storage, alternate onsite disposal designs, dry cleaners, storage lagoons, chemical storage tanks, gas stations, and laundries) to evaluate the potential impacts on the surface and groundwater resources of the Pinelands National Reserve.

VEGETATION AND WILDLIFE PROGRAM

The flora and fauna of the Pinelands are important components of the region's ecosystem and are also valued for their aesthetic and recreational qualities. The Pinelands Commission's policy to preserve, protect, and enhance the diversity of Pinelands plant and animal communities and their habitats recognizes the regional and national significance of these resources. Protection and management of habitats and wildlife is necessary to meet the objectives of this policy.

Habitat degradation or destruction will result both in a change in the composition of plant and animal communities and in a decline in population and possible regional extirpation of some species. Unregulated hunting, trapping, fishing, and collecting may also reduce the size of certain populations to a level which threatens the continued existence of a species. Certain animal species may require management to reduce their population to healthy levels, as in the case of the white-tailed deer, or to levels which minimize problems to human health and welfare. Other species require re-stocking (such as the bob white) or reintroduction (such as the wild turkey) to maintain or to reestablish their populations.

Many impacts associated with human activities have a negative effect on plant and animal communities. Unregulated development may result in fragmentation of the landscape which, as previously discussed, has an adverse impact on species and community diversity. The characteristic plant and animal species of the Pinelands, both terrestrial and aquatic, are adapted to the acid and infertile water of the region. The survival of some may depend on the maintenance of these conditions. Other water quality and quantity factors such as turbidity, flow, and depth to seasonal high water table which affect the flora and fauna may in turn be affected by human activities. Degradation of air quality, especially an increase in ozone levels, can be detrimental to vegetation.

Program Description

Maintenance of existing Pinelands habitats necessary to ensure minimal disturbance of the region's plant and animal communities will be accomplished through a number of programs presented in the Comprehensive Management Plan. These cover land use, water quality and quantity, air quality, fire management, forestry, agriculture, wetland protection, and acquisition.

Land allocation provisions in this plan prevent fragmentation and benefit the overall maintenance of water quality and quantity in the Pinelands. These factors alone provide major benefits to the Pinelands flora and fauna.

Regulating development on wetlands and adjacent buffers provides extensive protection to species which are partially or totally dependent on these habitats. The forestry program permits forest management practices which are compatible with the maintenance of the Pinelands environment. The benefits of prescribed burning include the preparation of seedbeds for the

regeneration of pitch pine and the establishment of disturbed habitats which are suitable for a number of plant and animal species. Disturbed habitats are also provided by reclaimed gravel pits. Maintaining and enhancing the region's air quality will, among other effects, prevent damage to vegetation. Public ownership of land kept in a natural state helps to maintain the contiguous nature of the Pinelands landscape and to protect plant and wildlife communities. The program presented in this section complements those addressed in other sections and includes protection of woodlands, specimen trees, threatened and endangered plants, and wildlife.

Woodland Protection

Unregulated removal of trees and other vegetation has ecological, hydrological, and economic impacts. In addition to the obvious benefits of providing habitat for animals, vegetation buffers the effect of flooding, soil erosion, air pollution, and noise. It also provides a psychological counterpoint to increasing urbanization. As a landscape element, vegetation protects and enhances the value of property.

Under this program, municipal ordinances shall contain provisions regulating the removal of trees and other vegetation from an area greater than 1,500 square feet for purposes other than agricultural, horticultural, and commercial forestry activities which conform to all existing federal, state, and local regulations. These provisions shall require that a plan for revegetation be submitted by an applicant desiring to remove vegetation, and that certain conditions exist for permission to be granted. These include the presence of safety hazards, the presence of dead or diseased trees, or the presence of vegetation which must be removed for development.

The revegetation or landscaping plan must include information on the size of the area to be cleared, soil conditions, a description of the existing vegetation, and a description of the vegetation which will be planted following clearing or any subsequent development. Season permitting, revegetation shall follow immediately after clearing or development is completed. Soil stabilization is required. Plantings should be limited to vegetation which is native to the Pinelands.

Maintenance of Rights-of-Way

The use of herbicides and other chemical agents for the control of vegetation in rights-of-way may affect species other than those targeted for removal. The use of these substances for the maintenance of rights-of-way, except when necessary to support farm operations, shall be prohibited in the Pinelands. Municipal ordinances shall contain provisions addressing this prohibition. Mowing and pruning are acceptable means for the removal of vegetation in road and utility rights-of-way.

Maintenance of Critical Habitat

Maintenance of habitats which are critical to those threatened and endangered plant and animal species described in Chapter Two is necessary for protection of the species and preservation of the essential character of the Pinelands. In areas known or found to be critical habitats for these species, developments shall be designed in such a way as to avoid or minimize damage to the habitat.

Fisheries and Wildlife Management

Fisheries and wildlife resources can be enhanced through the manipulation of habitat and animal populations. To ensure that habitat modification is compatible with the maintenance of the essential character of the Pinelands, fish and wildlife management activities will conform to the standards presented in the forestry, agricultural, and wetlands programs and to other provisions of this plan.

General Programs

All activities in the Pinelands shall conform to existing fish and wildlife codes and regulations including Title 23 of the New Jersey Statutes. The Commission shall cooperate with the U.S. Fish and Wildlife Service and the New Jersey Divisions of Fish, Game, and Wildlife and Parks and Forestry and will monitor and evaluate their management practices, including stocking of fish and wildlife, habitat manipulation, and timber harvesting. The Commission's objective is to ensure that the implementation of those practices is consistent with the maintenance of the

Pinelands' natural resources. Special liaison will be maintained with the Division of Fish, Game, and Wildlife's Endangered Species Project.

The New Jersey Heritage Program is responsible for the development of a comprehensive inventory of natural and cultural features in the state which are worthy of preservation. The Pinelands Commission shall continue to participate in this program by serving on the Heritage Program Committee and by providing technical assistance and inventory data.

To continuously update the data base required for planning in the region, the Commission shall secure funds for and participate in relevant studies of the Pinelands' plants and animals. This will be done in cooperation with the New Jersey Department of Environmental Protection, the U.S. Department of the Interior, and local colleges and universities.

Through its public information and education programs, the Commission shall increase public awareness of the Pinelands' flora and fauna. These programs will include a lecture series and the development of literature. Information on landscaping will be provided, including:

- A description of the Pinelands' vegetation in a readable and comprehensive fashion for the layman.
- Planting methods and maintenance practices suited to the Pinelands.
- Examples of the use of native plants to achieve desired design goals, especially at the scale of the residential lot.
- Recommended management practices for large-scale landscapes, including rights-of-way, easements, and roadsides.
- Reclamation techniques for disturbed sites, such as borrow pits and surface excavations.
- A description of available native plant material and acceptable alternatives.

Program Recommendations

The New Jersey Division of Fish, Game, and Wildlife, the New Jersey Division of Parks and Forestry, and the U.S. Fish and Wildlife Service should increase the use of management practices on public lands which provide suitable habitat for threatened and endangered plants and animals and non-game species. These include the establishment of disturbed habitats through clearing and cutting, management of gravel pits, regulation of mosquito ditching, preparation of suitable nesting sites, and limitation of access to critical areas. The Commission also recommends that the New Jersey Division of Water Resources place a priority on conducting intensive aquatic surveys in the Pinelands which emphasize the relationship between land use, water quality, and the composition of aquatic communities.

The Commission recommends that municipalities in the Regional Growth Areas incorporate tree removal provisions in their ordinances. A model ordinance is available from the Commission.

Legislative Recommendations

The percentage of plant species facing the danger of extinction in the Pinelands (12 percent), in New Jersey (8 percent), and the nation (10 percent) is a significant portion of the total number of plant species. It is recommended that the New Jersey Legislature enact legislation that would protect plants identified as endangered in the state. It is further recommended that the Department of the Interior expand its list of nationally threatened and endangered plants and animals to include the following species:

Animals

Pine Barrens treefrog (*Hyla andersoni*)

Plants

Pine Barrens reedgrass (*Calamovilfa brevipilis*)

Southern yellow orchid (*Habenaria integra*)

New Jersey Rush (*Juncus caesariensis*)

Torrey's muhly (*Muhlenbergia torreyana*)

Hirst's panic grass (*Panicum hirstii*)

Knieskern's beaked rush (*Rhynchospora knieskernii*)
Curly grass fern (*Schizaea pusilla*)
Long's bulrush (*Scirpus longii*)
Swamp pink (*Helonias bullata*)
Sensitive-joint vetch (*Aeschynomene virginica*)
Pickering's morning glory (*Breweria pickeringii*)
Resinous boneset (*Eupatorium resinosum*)
Yellow asphodel (*Nartheceium americanum*)
Awned meadow beauty (*Rhexia aristosa*)
White-flowered bladderwort (*Utricularia olivacea*)

WETLANDS PROGRAM

Wetlands have well recognized values. They serve a number of functions considered important to public safety and welfare. The corridors which they occupy provide natural drainage systems for flood waters and stormwater runoff. Swamps, marshes, and bogs retain and detain runoff, and provide a hydrologic connection between uplands and surface waters. Wetlands act both as nutrient sinks, removing excess inorganic nutrients from surface and groundwaters, and as sediment traps. Cedar and hardwood swamps often act as fire breaks, preventing the spread of wildfires.

Wetland forests in the Pinelands National Reserve support Atlantic white cedar and pitch pine, two valuable timber species. Wetland soils are required for cranberry and blueberry production. These lowland complexes provide food and habitat for many wildlife species and are especially important as wintering areas for the white-tailed deer, a valuable game species. They support a number of Pinelands animal species listed as threatened or endangered by the State of New Jersey, and two designated as endangered by the U.S. Department of the Interior. A majority of the plant species which are threatened with extinction in the Pinelands also occur in wetlands. Coastal wetlands are critical as habitat for breeding birds, and they provide wintering areas for thousands of migratory bird species. They make a major contribution to the estuarine food chain, and are necessary for the maintenance of the economically valuable fisheries and shellfisheries resources.

Hazards to human health and safety are also associated with wetlands. Coastal wetlands are exposed to the full force of storms, winds, and wave action. Both coastal and inland wetlands are continually or periodically flooded. Pitch pine lowlands are classified as extreme fire hazard areas by the New Jersey Department of Environmental Protection's Bureau of Forest Fire Management.

Stringent protection measures are required to protect the wetlands and their associated values. Their protection meets a number of the Commission's policy objectives intended to preserve, protect, and enhance the significant values of the Pinelands' resources.

Program Description

The Commission's wetlands program identifies both permitted and prohibited wetland uses. Wetlands include areas with very poorly drained and poorly drained soils as designated by the National Cooperative Soils Survey of the Soil Conservation Service of the U.S. Department of Agriculture; coastal wetlands such as coastal marshes and meadows, swamps, and mud flats; and inland wetlands such as Atlantic white cedar swamps, hardwood swamps, pitch pine lowlands, bogs, inland marshes, lakes, ponds, rivers, and streams. The Commission's complete legal definition of wetlands is included in Part II of this document.

Berry agriculture and horticulture are permitted on all wetlands. Forestry activities are permitted on all forested wetlands provided that they conform with all other federal, state, and

local regulations. Low intensity recreational uses such as hunting, nature study, and hiking are also permitted provided that they do not alter the character of the wetlands.

Water-dependent recreational facilities and nature trails are acceptable on wetlands. Provisions are made for the size of the facility, need, availability of alternate sites, adverse impacts, and other factors. Bridges, roads, and utility transmission facilities are also conditionally permitted under similar provisions. Residential, commercial, industrial, and institutional development are prohibited on wetlands.

Preserving the integrity of wetlands also requires that a vegetated area be established adjacent to the wetland to retain the natural upland-lowland transition and to reduce the impact of upland development. No development shall occur within 300 feet of a wetland, except for those uses which are permitted in wetlands, unless the applicant for development approval can demonstrate that the proposed development will not significantly affect the character of the wetland.

The Commission shall secure funds for and participate in studies investigating the impact of development on wetlands, such as the effect of water level fluctuations and nutrient loading on wetland vegetation communities.

The U.S. Fish and Wildlife Service has expedited the completion of draft wetland maps of the Pinelands as part of the National Wetlands Inventory. The Commission shall actively cooperate with the Service to complete the inventory in the Pinelands. The Commission's management of coastal wetlands in the Pinelands will be coordinated with the Department of Environmental Protection's Division of Coastal Resources.

FIRE MANAGEMENT PROGRAM

As discussed in previous sections of this plan, fire has played a significant role in the development of the Pinelands landscape. Plant species adapted to fire and in some ways dependent on it are common in the region. Plant community composition and the growth forms of certain species are influenced significantly by fire. It has been suggested by some that in the absence of wildfire, the character of the Pinelands would change. Another opinion is that in the absence of wildfire, the environment could still be manipulated in such a manner that selected areas of "characteristic" Pinelands landscape would be preserved.

Fire management in the Pinelands serves many purposes. Prescribed burning reduces the fuel load and decreases the chance of wildfires which destroy timber and property. Although it does not have the same effect as a full-fledged wildfire which burns the crowns of trees and significantly alters the landscape, prescribed burning does provide conditions suitable for the establishment of the pitch pine and other fire-adapted species. The New Jersey Bureau of Forest Fire Management also permits the controlled burning of fires within predetermined boundaries. This technique approximates but does not duplicate the effect of wildfire.

Program Description

In many ways, natural maintenance of the Pinelands ecosystem conflicts with human health and welfare. The role of wildfire in the evolution of this system must be recognized and given major consideration in the management of the region. Strategies must be implemented to ensure that areas designated as environmentally suitable for development are made safe from a fire standpoint. The Pinelands Commission's fire management program recognizes both the significance of fire and the hazards which it presents. This program encourages the increased use of controlled burning techniques which ensure the maintenance of the Pinelands' character, and outlines development standards designed to protect human health and welfare.

Fire Safety Standards for Subdivision Design

Subdivisions in the Pinelands should be designed to be fire-safe. Designs should hinder the spread of fire and facilitate fire suppression activities and the escape of residents. The Commission has adopted fire safety standards developed in cooperation with the Bureau of Forest Fire Management. These standards address road specifications, vegetative manipulations, and structural design. The specific application for each standard is dependent on an area's fire hazard rating. For example, an area of extreme fire hazard would require a larger fuel break around a structure than an area of moderate fire hazard. Both environmental and fire safety concern were considered in developing these standards.

General Programs

The Pinelands Commission will cooperate with the Bureau of Forest Fire Management in disseminating information on fire safety in the Pinelands. This literature will discuss the ecological role of fire and the measures necessary to ensure the protection of human health and welfare in hazard areas. The Commission will also work closely with the bureau in developing a long-range fire management program which contributes to the maintenance of the existing landscape.

The Commission will cooperate with the state Department of Insurance to inform insurance companies of the fire hazards which exist in the region. By relating insurance premiums to general hazard and to site maintenance, better site selection and maintenance may result. This initiative applies to private insurance companies and to any federal government insurance programs.

Program Recommendations

The Commission recommends that the Bureau of Forest Fire Management increase its employment of the DESCON program and other prescribed or controlled burning techniques which contribute to the maintenance of the diverse Pinelands vegetation patterns and habitats. To accomplish this, it is recommended that the state and federal governments increase the funds available for the bureau's program.

Because of the extreme hazard to human health and safety presented by Pinelands forests, and the increase in the region's population, state civil defense authorities should develop an evacuation plan for Pinelands municipalities to implement in the event of a wildfire.

FORESTRY PROGRAM

The Pinelands' forests are an important cultural, ecological, scenic, and economic resource. Proper management of this resource will ensure its maintenance and result in greater economic returns on the harvested timber. The current yield of timber in the Pinelands is below the region's potential because of fire, excessive cutting, and poor management. For example, failure to control litter in a pine stand increases the chance of damaging wildfire which reduces the value of the timber. Failure to clearcut Atlantic white cedars and to control competing hardwoods reduces the chances of the reestablishment of this economically valuable species.

The Commission's policies state that the natural resources of the Pinelands must be preserved, protected, and enhanced, and that "opportunities for traditional lifestyles that are related to and compatible with the overall ecological values of the Pinelands" must be maintained. The Commission's forestry program is intended to meet the objectives of these policies by providing opportunities for the continuing uses of the region's forest resources which are compatible with the maintenance of the Pinelands environment. This will be accomplished by ensuring proper management of the forests through the application of sound management practices, by exploring possible incentives which encourage the use of appropriate management techniques, and through public education.

Program Description

The Pinelands Commission will cooperate with the New Jersey Bureau of Forest Management in implementing a program for the Pinelands. All commercial timber harvesting activities in the Pinelands must be carried out according to a forestry management plan. This plan shall be submitted to the Bureau of Forest Management for review. It must conform to sound management practices which protect site quality. These practices address stream crossings, bank protection, soil erosion, location of roads, skid trails, and landings, harvesting practices, tree regeneration, intermediate treatments, and other forest management techniques. The plan shall include information on ownership, location, current land use, size of tract, soils, and slope; timber type, quality, and age; proposed harvesting method and alternatives; sound management practices required during and after harvesting; and location of stream crossings, skid trails, landings, access roads, and cutting boundaries. The Commission shall coordinate with the Bureau of Forest Management and monitor and evaluate its activities to ensure that forest management in the Pinelands is consistent with the maintenance of the region's natural resources.

The Commission will also cooperate with the Bureau of Forest Management in identifying strategies, such as tax incentives, which will encourage proper forest management in the Pinelands and techniques which will enable small-scale loggers to compete more effectively with the larger operations. The Commission will also cooperate with the Bureau in completing a site suitability index and preparing a site suitability map which describe the timber species best suited for specific soil types.

As part of its public information and education program, the Pinelands Commission will address the issue of forest management in the region in coordination with the Bureau of Forest Management.

Program Recommendations

Current resource information is based on forest surveys of New Jersey conducted by the U.S. Forest Service's Northeastern Forest Experiment Station in 1955 and 1971. This data base is periodically augmented by the New Jersey Forestry Service. Data for the Pinelands region has been derived and interpolated from these sources. There is need for further surveys and mapping of the Pinelands' forest resources in order to more accurately plan and implement forest management activities. The U.S. Forest Service and the New Jersey Bureau of Forest Management should coordinate their efforts to update the resource inventory so a suitable data base for the management of the Pinelands' forests is available. The Commission will cooperate in developing this material.

The Forest Service and the Bureau of Forest Management should also cooperate in the completion of a best management practices manual which specifically addresses forestry practices in the Pinelands. This manual should contain guidelines and standards to be used under various conditions.

An integrated strategy of biological and chemical control should be used by the Bureau of Forest Management in its gypsy moth control program and other insect management programs. The use of biological controls should be emphasized.

The Bureau of Forest Management should encourage the propagation of native tree species such as pitch pine. It should also increase the production of such species in state nurseries for distribution to the public.

AIR QUALITY PROGRAM

With the exception of ozone, air quality in the Pinelands meets or exceeds existing ambient air quality standards. Maintaining the clean, clear air and reducing the ozone problem is a major objective of the Commission's Comprehensive Management Plan. This objective can be met

through project review, enforcement of state and federal air quality regulations, and public education. The public should be encouraged to employ energy saving practices such as car pooling.

Program Description

Development in the region will conform to all guidelines established to meet the requirements of the federal Clean Air Act as amended in 1977. This includes all applicable state and federal emission regulations, ambient air quality standards, non-attainment criteria, and significant deterioration criteria. The Commission's air quality program also includes the review of all proposed major developments to determine the impact on Pinelands air quality. This review, and the implementation of all state and federal regulations and standards, will be coordinated with the Department of Environmental Protection's Bureau of Air Pollution Control. Municipalities shall include air quality considerations in their master plans.

Housing densities which are sufficient to support public transportation will be encouraged in the growth areas. Vegetated buffers required along roads for scenic purposes will also help reduce pollution problems associated with vehicular traffic.

Program Recommendations

Currently there is only one site in the Pinelands which monitors lead, sulfur dioxide, carbon monoxide, and ozone. There are no monitors for nitrogen dioxide. It is recommended that the Department of Environmental Protection expand its monitoring program in the region, especially in areas designated for growth.

It is recommended that municipalities enact air quality ordinances. A sample ordinance as well as technical assistance is available from the Commission and the Bureau of Air Quality.

The Brigantine Wilderness Area is the only part of New Jersey which has been designated as a Class I area for the prevention of significant deterioration (PSD). The designation imposes stricter allowable increments of sulfur dioxide and particulate concentrations, and also protects visibility in the area. The Pinelands Preservation Area is currently designated Class II along with the rest of the state. It may be desirable to redesignate the Preservation Area as Class I. The Class I designation would impose more rigid requirements on developments in surrounding areas which might have air quality impact on the Preservation Area. PSD reclassification of the Preservation Area will be examined by the Commission in cooperation with the Department of Environmental Protection.

The Pinelands are not isolated from the air pollutants generated in the urban areas surrounding them. Atmospheric transport of these pollutants plays an important role in producing high ozone levels in the Pinelands. Another consequence of long-range atmospheric transport is the production of acid rain—precipitation with pH lower than that expected in unpolluted rainwater. This phenomenon occurs when sulfates and nitrates emitted elsewhere are transported long distances and are finally washed out somewhere downwind. It has been shown to have negative effects on plants and animals. A decrease in pH has already been observed in Pinelands streams. The Commission recommends that the Department of Environmental Protection and the federal government conduct studies assessing the effect of this phenomenon in the Pinelands.

CULTURAL RESOURCES PROGRAM

Man has been a part of the Pinelands landscape for thousands of years. During this time, he has used the area's resources for different purposes and in varying intensities. Prehistoric man relied on the resource base first for hunting and later for a combination of hunting, gathering, and agriculture. In historic times, the Pinelands were occupied and exploited for forest products, mineral resources, bog iron, water power, sand for glass making, commercial berry production,

and other forms of agriculture. Physical evidence of many of these uses occur throughout the region. These sites provide a direct link with the past and contribute to the culture of the area.

Cultural resources of the Pinelands include the people of the region, various cultural and ethnic groups, the ways people use their land, and their built environment. The Pinelands Commission has recognized the importance of maintaining both the sites and the lifestyles which contribute to the area's essential character.

The major factors currently threatening the Pinelands' cultural resources are development, including commercial, residential, and agricultural uses, and the neglect and vandalism of sites. For example, historic structures may be torn down to make way for new buildings, or the integrity of a particular site may be compromised by structures which prove overbearing or out of character. Certain prehistoric sites, once their location is made public, are susceptible to destruction through artifact collecting or looting. Construction and agricultural activities often damage sites, since both involve alteration of the landscape. At the same time, land disturbance may contribute to archaeological finds. In fact, the discovery of most prehistoric sites is associated with some degree of land disturbance.

New development produces changes in the physical landscape, which in the Pinelands is closely related to the culture. Traditional Pinelands lifestyles are tied to resource harvesting activities carried out in rural settings. As portions of the region become more suburbanized, the prevailing culture shifts away from the traditional rural orientation. This shift can lead to conflicts and a gradual but continuous deterioration of traditional cultural patterns.

Program Description

The Commission's policy to protect cultural resources will be carried out through the programs presented below, as well as through several other programs presented elsewhere in this plan. Those include acquisition of lands with recognized historic value, use of easements and other strategies, provisions for maintaining land use patterns related to rural and traditional lifestyles, the promotion of timbering and agricultural activities, the designation and protection of wild and scenic rivers, natural or scenic trails, and other corridors, and efforts to increase public appreciation of Pinelands history and culture. The programs discussed in this section include the continuation of cultural resource surveys, historic districting, provisions relating to sites of recognized historic value, and encouragement of the reuse of historic structures.

Resource Surveys

Studies conducted for the Commission have identified a wealth of information concerning the diverse cultural resources of the Pinelands. The prehistoric archaeological assessment is especially instructive, as it has reinforced the concept that the Pinelands are rich with undiscovered prehistoric sites.

The Commission shall continuously update its inventory of cultural resources, and will use this expanded data base to refine the management policies and strategies for protecting these resources. Inventory efforts will be geared towards the development of a resource protection plan which includes the study unit approach discussed in Chapter Three. The surveys will be conducted with the advice and, where possible, the assistance of federal, state, and local agencies, private non-profit agencies, academic institutions, and knowledgeable members of the general public. Federal agencies with which the Commission will consult include the Department of the Interior's Heritage Conservation and Recreation Service and the Library of Congress Folk Life Center. On the state level, both the Department of Environmental Protection and the Department of Education conduct programs dealing with cultural resources management. Local historical societies and heritage commissions will also be consulted. Faculty members of state and regional academic institutions are another important source of assistance.

The Commission will include as an element of its survey efforts the evaluation of resources in light of their eligibility for the State and National Registers of Historic Places. Areas potentially suitable for historic district and historic corridor designation will be identified and studied in

detail. Architecture, including vernacular architecture characteristic of the region, is another subject of interest to the Commission. An example of vernacular architecture in the Pinelands is a cranberry packing house.

The Commission will cooperate with appropriate state and federal agencies to undertake surveys of cultural properties within their jurisdiction. These surveys will apply to existing publicly owned lands as well as those proposed for public acquisition. Large state landholdings include parks, forests, fish and wildlife management areas, and colleges. Federal lands include the military areas, the Brigantine National Wildlife Refuge, and the Federal Aviation Administration Technical Center.

Counties and municipalities will be encouraged to conduct their own resource inventories. The Commission will cooperate with historic preservation authorities in the Department of Environmental Protection in providing information on procedures and availability of funds for these surveys. Information collected through both the local and regional inventory programs will be incorporated into the respective municipal master plans.

Resource Protection

The Commission will develop a resource protection plan which at a minimum will incorporate the study units described in Chapter Three. In developing and then implementing this model, the Commission will seek the advice of various federal, state, and private organizations and knowledgeable individuals. Potential sources of advice and assistance on resource management include the Heritage Conservation and Recreation Service, the National Park Service, the National Trust on Historic Preservation, the New Jersey Departments of Environmental Protection and Education, and faculty members of state and regional academic institutions.

The Commission will integrate historic preservation policy into its land use planning. The existence of historic or prehistoric resources in all areas of the Pinelands will be considered at the earliest possible stage in the planning of any project within the Commission's purview so as to afford those resources the highest degree of protection. Project review will include an assessment of the applicability of all cultural resource management techniques determined possible by the Commission in consultation with historic preservation organizations and specialists.

Based upon the inventory data collected by the Commission and individual municipalities, and consistent with the priorities and strategies of the Commission's resource protection plan, development applications will be reviewed in light of their potential impact. Applications include those for developments which may impinge on known or suspected prehistoric sites, or which would involve development, alteration, or demolition of sites or structures identified as cultural resources. Submission requirements for major development applications will include notifying the Commission and providing information about the known or potential presence of prehistoric or architectural resources. While review of applications is primarily the responsibility of local authorities, the Commission recommends that if necessary, the local agency consult a group with technical expertise such as the county cultural and heritage commission, the local historical society, or the Pinelands Commission.

State and federal actions should also respect the integrity of cultural resources within the Pinelands. In the past, both action and inaction on the state's part, such as the paving of a prehistoric site or the failure to protect a historic furnace from vandalism and arson, have led to the loss of valuable resources. State and federal policy must recognize the irreplaceable nature of these resources. The Commission will aggressively review and monitor state and federal actions within the Pinelands to assure that these disruptions will be prevented or minimized.

State and National Registers of Historic Places

The Registers are official lists of the historic properties that merit protection because of their significance in American history, architecture, archaeology, and culture. Inclusion on the State Register is a prerequisite to National Register designation and provides a degree of protection from any state, county, or municipal undertaking which may encroach on the site. National

Register sites receive similar protection from any federally financed, assisted, or licensed undertaking. Owners of properties listed on the National Register are eligible to apply for federal matching grants for historic preservation. Inclusion may also enable owners of income-producing properties to qualify for tax benefits under the Tax Reform Act of 1976.

The official recognition of historic sites within the Pinelands region will be encouraged by promoting their nomination to the Registers and by having markers placed on those sites already on the Registers. With the cooperation of state historic preservation authorities, the Commission will take an active role in disseminating information about the procedures for obtaining Register status and the implications of this status. This information will be distributed to private property owners, local historical societies, and other interested parties.

In the case of properties which are listed on the Register(s), specific attention must be devoted to applications for development, demolition, alteration of the exterior, or any other work which would encroach upon the site. The Commission's program provides for review of these applications, considering the appropriateness of the proposed work, adverse impacts associated with the work, and possible mitigative measures which may be undertaken. The Commission will report to the State Historic Preservation Officer any change in the condition of a Register property, such as by alteration of the exterior, fire, or demolition, which comes to its attention.

Historic Districts

The designation of historic districts can assist in protecting significant areas and groups of historic structures. A community can derive several benefits from the designation. The most obvious is protection of an area's cultural heritage. The creation of historic districts may also stabilize or even improve property values by stimulating community interest in the upgrading and maintenance of structures. A historic district also may generate tourist interest in the restored area, and provide a significant educational experience for residents and visitors.

The Commission will, in cooperation with local governments, designate historic districts within the Pinelands region. The study units described in Chapter Three will serve as a basis of this designation. Potential historic districts such as parts of Medford, New Gretna, Green Bank, and Woodbine will be identified, and complete inventories of cultural resources will be made. Once districts are designated, steps will be taken to determine eligibility for the State and National Registers of Historic Places. Applications for development, alteration, and demolition within a historic district will be carefully reviewed. In considering the application, the degree to which the proposed work may alter or destroy part of the resource from its cultural or historic surroundings, and possible mitigative measures which may be employed, will be considered.

Historic Corridors

The Commission recognizes that certain trails and roadways in the Pinelands have historic value because of events which took place there, because of their significance as transportation links in past times, or because the structures along them are significant. These routes deserve the special attention afforded by historic corridor designation. Examples are portions of Route 9, Route 542, Route 559, Route 563, Route 561 near Pleasant Mills, the Tuckerton Stage Road, and the Black Horse Pike. Markers will be placed at strategic points along these roads noting their special status.

Restoration of Historic Sites

Certain historic sites within the Pinelands contain great potential for restoration or adaptive reuse. For example, sites which contributed significantly to agricultural history present opportunities for commercial and educational benefits. The Commission will work closely with governmental agencies and private, non-profit organizations to determine the feasibility of restoring these sites. To the extent practicable, the Commission will stress occupancy of the sites while restoration is underway and when the site is in use.

Testing of the Predictive Model

The Commission is moving toward the development of a model to predict the presence of prehistoric sites. The predictive process involves the analysis of environmental conditions to determine the potential presence of prehistoric remains. The Commission will test the efficacy of the model within the context of development review. The intent of this program is to continuously refine the model so as to enhance its capabilities for discovery of new sites.

Program Recommendations

To promote the maintenance of historic properties and to combat the problems of vandalism and neglect, the Commission recommends their occupancy. Public agencies managing historic properties will be consulted regarding potential uses of the sites. The public ownership of historic properties or other properties in their vicinity, such as public parks, brings with it a responsibility to manage those properties with sensitivity for the character and design of the historic resource. The Commission encourages public agencies owning such properties to bear in mind this responsibility.

The Commission also recommends that state historic preservation authorities determine the condition of properties presently on the State and/or National Registers of Historic Places. If the property has been altered or damaged to the extent that it no longer merits special status, it may be advisable to void the Register designation so as to maintain the significance of the Register. A list of jeopardized properties listed in the Registers will be maintained by the Commission in cooperation with the State Historic Preservation Officer for use in developing ways to avert further damage to the Pinelands' most significant historic and prehistoric resources.

The Commission recommends that state and local governments consider the establishment of a preservation easement program. Such a program can be designed so that it complements a conservation easement program such as that described earlier in this chapter.

The Commission will encourage municipalities to implement resource protection programs. To assist municipalities in these efforts, the Commission, in consultation with state historic preservation authorities, will provide information, guidelines, and technical assistance. Consideration will also be given to the establishment of a Regional Advisory Board to deal with historic and cultural resource matters in the Pinelands. When and if this board is established, municipalities will seek advice on questions pertaining to applications, planning programs, and other items relating to cultural resource protection.

Legislative Recommendations

The Commission recommends that the Legislature consider authorizing the creation of historic districts and protection of the resources contained in those districts through the local planning and zoning process.

NATURAL SCENIC RESOURCES PROGRAM

Scenery plays an important role in establishing the character of an area. While residents have long recognized the scenic qualities of the Pinelands, state and federal legislation now officially recognize those qualities and charge the Pinelands Commission with delineating and protecting areas of scenic significance. In response, the Commission has adopted the policy to preserve, protect, and enhance the area's natural scenic qualities.

The Pinelands scenery consists of vast pine and oak forests, including the unique dwarf forests of the Plains, mysterious cedar swamps, tea-colored rivers and streams, rare and beautiful shrubs and wildflowers, cranberry bogs, orchards and blueberry fields. While the region is relatively flat, the view from the occasional hilltop such as Apple Pie Hill, ridge crests in the Plains, and the Forked River Mountains can extend for miles.

In recent years, use of the Pinelands has escalated, both in frequency and intensity. Portions

of the area have experienced rapid residential growth. Development has often occurred in a random, piece-meal fashion, causing intermittent breaks in the natural landscape. Campers, canoeists, hikers, hunters, and off-the-road vehicle enthusiasts flock to the area in increasing numbers each year. The advent of casino gambling in Atlantic City has brought many more drivers passing through the area on their way to the coast. More people are aware of the Pinelands' scenic qualities, but there are also more chances for those qualities to be degraded.

Program Description

The Commission's policy to protect scenic resources will be accomplished through a number of programs presented in other sections of this plan. These programs include acquisition of lands with recognized scenic qualities, trail protection, provisions for clustering to maintain open space in developments, support of the state's Wild and Scenic Rivers program, vegetative buffers for wetlands and resource extraction areas, protection of historic and cultural resources, and land clearing ordinances. The programs discussed in this section complement these other programs and include the designation of scenic corridors and vistas, determination of visual preferences, provisions for setbacks and signs, regulations related to littering and junkyards, and recommendations for new legislation. This range of programs addresses both the protection and the enhancement of scenic resources.

Surveys of Scenic Resources

The Commission has participated in an ongoing study to identify and rank the scenic resource types of the Pinelands. This study is being carried out in cooperation with the U.S. Department of the Interior's Heritage Conservation and Recreation Service (Northeast Regional Office), the New Jersey Heritage Program, and the New Jersey Department of Environmental Protection's Division of Coastal Resources. The completed first phase of the study is discussed in Chapter Three. The second phase will involve Stockton State College in addition to the above participants.

The purpose of the three-part study is to establish the visual preferences of Pinelands' residents and users. As this information becomes available, it will be used to refine the Commission's strategies for protecting scenic resources. Scenic vistas will also be identified as part of the Commission's ongoing planning effort, and strategies will be determined for their protection.

Scenic Corridors

Scenic corridors are areas which the Commission considers especially valuable, as these are the areas from which the public derives its most frequent impressions of the Pinelands. Scenic corridors include lands bordering publicly owned, paved roads in specific areas, and lands bordering rivers, streams, lakes, and ponds. Municipalities shall incorporate in their ordinances provisions related to the use of these corridors, including minimum setback requirements for all new structures, height limitations, and procedures for conducting forestry activities to maintain visual screening.

The Commission will designate areas along scenic corridors where markers will be established informing the public of the scenic qualities there. Such areas may include points along Route 563, Route 539, and Harrisville Pond.

Scenic Highways

The Commission recognizes that portions of certain Pinelands highways provide exceptionally fine views of the scenery for which the Pinelands are famous. These highways deserve special recognition, beyond that which is afforded by scenic corridor status. The following are therefore designated as scenic highways, along which identifying markers will be placed: County Routes 539, 542, 559, 563, and 659 and State Routes 70 and 72.

Signs

Signs can provide important information to the viewer in the form of directions or the location of essential services. Yet signs are often poorly planned, and prove incompatible with the

aesthetics of an area. Proper design and placement of signs will contribute to the overall visual experience in the Pinelands. The Commission will encourage municipalities and the state to employ a consistent design for all directional signs and markers placed throughout the Pinelands. Municipalities in the Preservation Area shall have provisions in their ordinances regulating the size, height, illumination, construction material, and relationship to place and commodity advertised of all new signs. The Commission will provide guidelines covering those factors to municipalities in the Protection Area. These municipalities shall include a sign regulation element in their ordinances. Any municipality may adopt sign regulation standards stricter than those set forth by the Commission. All illegally placed, enlarged, illuminated, or maintained signs shall be removed within ten years of the effective date of the Comprehensive Management Plan.

Junkyards

Junkyards can be a source of visual pollution unless properly screened and operated. Municipal ordinances shall include provisions for the regulation of all new and existing junkyards, providing for the screening of materials from public view.

Program Recommendations

The Commission encourages municipalities to conduct inventories of their scenic resources. Guidelines, including procedures for conducting the inventories and planning and regulation techniques appropriate for the protection of these resources, will be provided by the Commission. In addition, the Commission will seek funds and technical assistance from various groups and agencies to carry out surveys and inventories of the Pinelands' scenic resources.

The Commission will request the Department of the Interior to consider portions of the Pinelands for further study for inclusion in the National Natural Landmarks program. It is also recommended that the Green Acres office of the New Jersey Department of Environmental Protection concentrate its study efforts on evaluating those rivers which are designated by the Commission for inclusion in the Wild and Scenic Rivers program.

The Commission will cooperate with the New Jersey Department of Transportation in designating areas where markers will be placed identifying specific scenic qualities. The Division of Travel and Tourism of the New Jersey Department of Labor and Industry will be consulted regarding the location of tourist information centers along frequently traveled highways such as the Garden State Parkway and Routes 206 and 72. The Commission also recommends that municipalities and the state adopt provisions for a bounty system that would encourage the reporting of persons seen littering or dumping trash along roads.

Legislative Recommendations

The careless disposal of cans, bottles, and other forms of refuse along roadways and in other public and private areas is a problem throughout the nation. The Pinelands, unfortunately, are no exception. While it is difficult to apprehend all litterers, means are available which can reduce the probability of littering. The Commission recommends that the New Jersey Legislature consider enacting legislation that would prohibit the sale of non-returnable bottles and cans in New Jersey.

AGRICULTURAL PROGRAM

Agriculture contributes to the cultural, historical, social, visual, and economic characteristics of the Pinelands. It also contributes environmentally by creating open space, terrestrial and aquatic habitats, and wildlife feeding areas. However, the lands best suited for conventional farming have been subjected to heavy development pressures. Being open, they are the easiest and most economical to develop. Suburban development in areas adjacent to production agriculture contributes to an unfavorable economic environment for farmers through escalating taxes, enactment of inhibiting local ordinances, and increased trespassing and vandalism.

Pinelands Agricultural Production Areas

Through the past decade, New Jersey has lost 4,500 acres of agricultural land per year. Farmland preservation techniques have been tried and tested throughout this country and Canada. Long-term success has been observed only where residential housing is restricted or limited. The Commission has addressed the Pinelands Protection Act's goal to preserve and enhance agriculture by adopting policies to reserve prime agricultural soils and soils of statewide importance in and adjacent to active agricultural areas, and to reserve unique soils and protect watersheds for berry agriculture.

The programs presented in this section complement those addressed in the land allocation section and are designed to accomplish the objective of agricultural land preservation.

The Commission has delineated several Agricultural Production Areas which include areas of existing and intensive farming together with the prime agricultural soils and soils of statewide importance which are adjacent to them. Land uses within these areas will be reserved for production agriculture in accordance with the land allocation provisions identified within this plan. Municipalities may designate additional areas within their jurisdiction as Agricultural Production Areas, provided that they include existing active agriculture and adjacent prime soils. These areas so designated should not contain water and/or sewage facilities, nor should the extension of those facilities be currently under consideration.

Individual farmers or landowners not included in an Agricultural Production Area are encouraged to request inclusion in such an area by petition to the municipality. Once the municipality designates a production area, landowners there should be entitled to benefits which are available in other Agricultural Production Areas.

The land allocation program contained within this plan also provides for the creation of Special Agricultural Production Areas within the Preservation Area. These areas include concentrations of cranberry and blueberry production plus adjacent unique soils and contributing watersheds. Lands used for horticulture of native plant species are also eligible. These areas should be designated by the municipalities. Where they are not, individual farmers or landowners may petition the Pinelands Commission for such designation.

Uninhibited Farm Operation

The preservation of agricultural soils does not, in itself, provide for the long-term preservation of agricultural productivity. Agriculture is a labor and capital-intensive and land-extensive enterprise. It is also an activity of high economic risk, susceptible to normal and sometimes harsh natural phenomena. Under these conditions the efficient production and marketability of farm products is essential for economic survival, and will ultimately determine the fate of agriculture in the Pinelands and New Jersey.

Throughout the years, many economic and social constraints have been placed on the agricultural community. Highest and best use assessment practices for tax purposes have escalated the land value beyond the agricultural production value. Trespassing has increased and could increase more as the recreational aspects of the Comprehensive Management Plan are instituted. This, in turn, increases the exposure of private property and the vulnerability to vandalism, littering, theft, and crop and equipment damage. The enactment of inhibiting ordinances at the local level prevents farm operators from competing economically by restricting their ability to carry on normal operations while still maintaining public health and safety.

The following programs are consistent with the Commission's policies to protect the long-term economic viability of farmers. The ordinances of municipalities which have within their bounds Agricultural Production Areas, no matter how designated, shall contain provisions for normal farm operations which do not endanger public health or ecological character. These provisions shall provide for land clearing and terrain modification for agricultural production in accordance with Recommended Management Practices, for the growing and raising of crops and livestock,

and for uninhibited operation on holidays, Sundays, and weekdays, at night as well as during the day. They shall also allow for the noise, odors, dust, and fumes that are related to crop production. Additionally, nothing in this plan shall be construed to require agricultural activities to meet any water quality standards which are more stringent than the applicable state and federal programs.

Recommended Management Practices

Agricultural activity has been linked to the degradation of the Pinelands' surface and groundwater resources. In general, this activity changes the water's characteristic chemical composition by raising the nutrient and alkalinity concentrations and elevating the pH. Pesticides which are not short-lived tend to attach to soil particles and move with these particles during erosion. Control of soil erosion will reduce sediment loads and can also reduce other sources of surface water pollution.

Use of agricultural Recommended Management Practices (RMP's) minimizes the impact of agricultural activity on the area's water quality. The concept of RMP's was introduced by the U.S. Environmental Protection Agency for implementation of 208 wastewater treatment plans. They consist of those practices which are the most practicable means of preventing or reducing non-point sources of pollution. RMP's do not have universal application for all farming activities, nor will one practice control all the categories of pollution. Therefore, a system of RMP's should be determined by the landowner working with a soil conservation technician and recorded in a resource conservation plan.

The U.S. Soil Conservation Service Technical Guide provides information on RMP's for soil erosion and sedimentation control as well as the management of stormwater runoff. Guidelines for animal waste management are found in the Soil Conservation Service Agricultural Waste Management Field Manual. Guidelines for appropriate use of agricultural chemicals are published annually as recommendations by the New Jersey Agricultural Experiment Station at Cook College, Rutgers University, including quantities necessary, scheduling, and methods of application.

All landowners within Agricultural Production Areas where surface or ground waters have been identified as substandard shall have a resource conservation plan prepared or approved by the Soil Conservation District identifying the RMP's for soil erosion control, stormwater runoff management, animal waste management, and agricultural chemical usage, considering the type of operation. The plan shall be reviewed and updated as necessary.

Program Recommendations

New Jersey's tax policy does not currently allow deduction of business-related costs in the computation of personal taxable income. Therefore, the Commission recommends that the New Jersey Department of Agriculture and the Division of Taxation of the New Jersey Department of the Treasury investigate the feasibility of changing the state income tax law to allow farmers in the Agricultural Production Areas who qualify for farmland assessment to deduct losses which are incurred through crop failure caused by conditions such as drought, flood, frost, or non-manageable pest invasion, and losses due to equipment or crop damage caused by vandals.

The establishment and operation of a farm is an expensive proposition in New Jersey due to high land costs and currently because of high interest rates. The situation is somewhat prohibitive to young persons who want to join or maintain their ties with the agricultural community. Therefore, the Commission recommends that the state Agriculture and Treasury Departments investigate the feasibility of a New Jersey Farm Finance Agency which would provide low interest farm ownership loans as well as low interest short-term operating and emergency funding to farmers in the state.

The Agricultural and Special Agricultural Production Area provisions of this plan's land allocation program may, in some extreme cases, restrict the availability of farm production credit. Such loans are often based on land values, which in some cases have been inflated beyond the agricultural value due to speculative investments. This issue can be resolved using alternative

collateral bases such as "chattel" mortgages, where the lender establishes a lien on the crop, or Pinelands Development Credits (PDC's). It has been suggested that although PDC's can be used, the value associated with them requires time to be established. The PDC bank programs discussed earlier will facilitate the establishment of that value. In addition, it is recommended that the state Department of Agriculture cooperate with the Pinelands Commission in an effort to encourage a more widespread use of chattel mortgages throughout New Jersey and the Pinelands as collateral for production credit.

The economic vitality of agriculture is ultimately dependent on a demand for the crops or livestock produced. The long-term viability of New Jersey agriculture once the land-related economic constraints are removed requires that markets be available. Therefore, the Commission recommends that the state Department of Agriculture institute an aggressive program to promote the sale of New Jersey agricultural produce.

The New Jersey Department of Environmental Protection currently leases state-owned lands for agricultural production. However, such leases are generally short-term, which constrains the lessees from making capital improvements that would be amortized over a longer term. The Commission recommends that the Department of Environmental Protection lease agriculturally productive land to farmers for a minimum of ten years, with renewal options after a five-year period. Such leases should contain provisions which allow for normal farm operations in accordance with a resource conservation plan to be prepared within one year of the date of the lease. The state should assist lessees with posting of the land cleared for agricultural production within state holdings which have significant levels of recreational activity. Additionally, the state should undertake a public education program advising that entrance on such land will be considered trespassing and that prosecution may result. The benefits of this program include enhancement of agriculture in the Pinelands, generation of revenue, maintenance of the land by the lessees, and opportunities for new generations of farmers with insufficient capital. The local municipalities benefit since state-owned land which is leased for agricultural activities can be taxed in accordance with the provisions of the Farmland Assessment Act.

Farmers are now constrained from clearing additional land for agricultural production by air pollution control regulations. They cannot open-burn the cleared material unless it is diseased. Proposed amendments to the current open burning regulations would allow for open burning to dispose of plant material cleared from agricultural lands, provided that no more than 25 acres were cleared in one year and that the cleared land would be used exclusively for agriculture for a period of five years after the burning. The Commission recommends that the Bureau of Air Pollution Control of the DEP's Division of Environmental Quality provide over-the-counter services to agricultural landowners or operators within the Agricultural Production Areas for open burning permits to facilitate land clearing. Those permits should not constrain clearing to 25 acres, nor should they be contingent on the proposed five-year clause since the lands have been dedicated to agricultural use.

During the development of the Comprehensive Management Plan, the Agricultural Advisory Committee, chaired by the New Jersey Secretary of Agriculture, recommended the establishment of county Pinelands Agricultural Review Boards. It was recommended that the boards review complaints and conduct hearings on non-compliance with agricultural Recommended Management Practices. The review boards would then report findings to the appropriate authorities. It is recommended that the boards be formed by the Pinelands Commission with the cooperation of the Secretary of Agriculture. They should include two members of the agricultural community appointed by the Secretary of Agriculture, and a representative from each of the following: (1) local environmental interests; (2) Soil Conservation Districts; (3) the New Jersey Agricultural Experiment Station at Rutgers University; (4) the New Jersey Department of Agriculture; and (5) the Pinelands Commission.

The plan of RMP's prepared by a farmer and soil conservation technician may in some instances require structures or terrain alteration to reduce agricultural non-point source pollu-

tion. Since these measures require capital investments, and since it is the government's current policy to provide some cost sharing for these purposes, the Commission recommends that the U.S. Agricultural Stabilization and Conservation Service (ASCS) increase its level of cost-share funding for Recommended Management Practices installation to those counties with land in Agricultural and Special Agricultural Production Districts. It is also recommended that the ASCS County Committees give priority for cost sharing to those farmers within the Agricultural and Special Agricultural Production Districts. The Commission further recommends that the ASCS request that the U.S. Environmental Protection Agency identify the Pinelands Agricultural Production Districts as project areas for Rural Clean Water Program funding in accordance with Section 208(j) of the Clean Water Act of 1977. Such designation would provide additional funding for the installation of RMP's on agricultural lands.

Legislative Recommendations

New Jersey agriculture is sometimes described as suffering from an "impermanence syndrome" concept. Actions of the state and local governments are purported to reflect that attitude rather than viewing agriculture as a long-term enterprise. The foregoing recommendations were made within the framework that New Jersey agriculture can survive provided that certain measures are taken to assure its vitality and economic competitiveness. It is recommended that the Legislature consider New Jersey agriculture as a long-term enterprise when making decisions on matters such as budget increases for the Agricultural Experiment Station.

Each year, vandalism is very costly to the agricultural community through the destruction and theft of farm equipment, damage to and theft of crops, and damage to farm structures. Trespassing is a primary factor contributing to vandalism. The Commission recommends that the New Jersey Legislature amend the current trespass legislation to place the burden of proof on the trespasser and not the landowner. The amendments should include provisions that posting of private property not be a prerequisite for prosecution of trespassers, that trespassers who are also found guilty of vandalism should reimburse the vandalized party for damage done, and that trespassing fines should be increased. The passage of such legislation should not be construed as permission to restrict legitimate access for purposes of public health, safety, and welfare.

The New Jersey Farmland Assessment Act of 1964 provides for reduced assessments on productive agricultural lands, provided that at least \$500 worth of farm products are produced by the first five acres and \$5 are produced by every farmland acre thereafter for a period of two years preceding the annual application for eligibility. This program, however, applies only to lands that are contiguous. It requires a separate application for a non-contiguous parcel which contributes to agricultural productivity, as in the case of watershed land upstream from cranberry bogs. Secondly, all agricultural structures, no matter how minor, are assessed at non-agricultural rates. Therefore, the Commission recommends that the New Jersey Legislature amend the Farmland Assessment Act to provide additional benefits to farmers on lands within Agricultural Production and Special Agricultural Production Areas, such as:

- That all productive lands in the agricultural areas which are both contiguous and non-contiguous to an agricultural parcel, and which contribute to the continued production of that parcel, shall be taxed in accordance with the rates established by the Farmland Assessment Program.
- That all agriculturally related structures on farms, including seasonal employee housing provided that it is structurally sound and meets the standards and criteria established in the rules and regulations for migrant labor housing, should be assessed on the same basis as the agricultural land. This provision should not apply to parcels of land which contain full-time residential, industrial, or commercial agricultural structures such as cooperative outlets.
- That owners of agricultural lands within the agricultural areas need not apply annually for the agricultural assessment rate. They should, however, provide yearly proof that

their operation meets the economic criteria for eligibility, and they should report any modifications or transfers of land to the local assessor.

- That landowners with actively farmed land within agricultural areas should be entitled to the expanded benefits provided that they have a current resource conservation plan which has been prepared or approved by the local Soil Conservation District.

WASTE MANAGEMENT PROGRAM

The wastes produced in or introduced into the Pinelands include municipal solid waste, liquid and dry sewage sludge, septic waste, liquid and dry chemical waste, and other categories. In addition, hazardous wastes have been legally or illegally discarded in the region. Facilities currently accepting wastes include landfills, transfer stations, and recycling centers. The operating conditions at active landfills result in environmental degradation of the surface and groundwaters, producing a hazard to the public health, safety, and welfare.

Program Description

A program is required to direct the use of waste management techniques so as to minimize threats to existing resources. The program elements include landfill siting and expansion, proper disposal of waste types, and alternative technology. Also, there are programmatic and legislative recommendations.

Landfill Siting

The location of new landfills in the Pinelands is not generally compatible with the Commission's resource protection goals and policies. The soil and geologic conditions of the area for the most part produce unsuitable sites for the necessary containment of leachate and runoff. The low population living in the Pinelands produces a relatively small quantity of waste materials, and should not be responsible for the acceptance or disposal of any waste generated outside the district management areas because the resource conditions of the region are so fragile. The use of landfills as a waste disposal medium, even when supplemented by the best available technology, is an undesirable option which should be discontinued at the earliest possible date. For these reasons, the Commission will allow new landfills only where there are no suitable alternative sites outside the Pinelands, and where the new landfill corrects an existing problem.

Landfill Expansion

The expansion of landfills is a short-term solution to the waste management problem. It further impinges on the regenerative capacity of the ecosystem. In those cases where landfill expansion is the only practicable, short-term solution for waste district management, existing landfills may be expanded subject to all required permits, licenses, and conditions. However, no landfill in close proximity to residential areas, or which causes any other impairment to public health and welfare, may be expanded. Any landfill where expansion is permitted must first undergo remedial measures, such as capping of previously used areas, and lining and provisions for leachate collection in expansion areas.

Expansion is permitted only in specified areas of the Pinelands where consistent with all applicable local, district, state, and federal rules, regulations, plans, and criteria. Landfill expansion must conform to solid waste district plans, and the districts must demonstrate that the expanded areas are for short-term use and subject to detailed phase-out plans within a reasonable period.

Waste Categories

No hazardous or chemical waste emanating from within or outside the region may be disposed of in the Pinelands. Likewise, no septic waste or liquid sludge may be disposed of in any landfill here. These wastes may be land-applied in certain areas under controlled conditions and subject to all applicable state and county regulations, or they may be sent to treatment plants or incinerators for codisposal. Municipal wastes, including residential, commercial, and institutional wastes, may be disposed of in the region's landfills and recovery facilities, provided that solid waste districts demonstrate a detailed effort to phase out landfills. Dry sewage sludge should be land-applied or incinerated, but may be landfilled on an interim basis subject to a facilities plan demonstrating future use of another disposal option. Waste oil and oil spill cleanups should be recycled in a suitable facility. Vegetative, animal, and food processing wastes may be disposed of in the region's facilities provided that the facilities are meeting the New Jersey Solid Waste Administration's most stringent operating requirements.

Alternative Technologies

Landfills, even when operated under the best available technologies, are not a desirable disposal technique. They lead to environmental degradation and a waste of energy and physical resources. Geologic conditions in the Pinelands lessen the effectiveness of naturally occurring soil barriers. Artificial liners are still being developed and are prone to failure.

Source separation, recycling centers, transfer stations, and energy and physical resource recovery facilities are desirable and necessary waste management technologies. Other low technology alternatives, including composting and land application, are suitable for treatment and disposal of specific wastes. Source separation and recycling should be implemented immediately to accomplish the long-range goal of full resource recovery. Conventional incineration does not produce a useable resource and should be discontinued or converted to energy recovery modes.

Program Recommendations

Recent legislation and administrative decisions are producing major shifts in the disposal needs for all waste categories. The ocean dumping ban, closure of municipal and hazardous waste landfills, discouragement of septage and sludge landfilling, and restrictions on other techniques requires new alternatives to satisfy the public needs. A major demonstration program, funded by federal and state sources, is necessary to determine the proper application of alternative technologies. Following this action, a federal funding program, comparable in scale to the Construction Grants Program for wastewater treatment facilities, must be implemented. Proposals for bond issues in New Jersey to finance resource recovery facilities must be aggressively promoted, and funding levels must be increased if a true commitment to resource recovery is to be realized. A Pinelands community should be selected as a demonstration municipality for a full-scale source separation program.

Institutional arrangements for hazardous waste disposal, as outlined by the Governor's Hazardous Waste Task Force, should be implemented immediately to reduce the chance of illegal dumping. Arrangements between and among districts and municipalities necessary to implement district plans should also be developed. Local jurisdictions need financial, administrative, and technical support to carry out their new mandates. This support requires detailed action on the part of state utility and regulatory agencies.

Legislative Recommendations

Federal legislation should be enacted which provides the necessary funding for technological development and implementation. As was recommended in the scenic resources program, state legislation should be enacted which prohibits the sale of non-returnable bottles and cans. State legislation improving solid waste administrative and rate-averaging procedures should also be enacted.

RESOURCE EXTRACTION PROGRAM

Resource extraction, including the mining of industrial sands, sand and gravel, and clays, is simultaneously an economic land use and one which disrupts the Pinelands ecosystem. In certain parts of the Pinelands the extractive industries are major employers, but the economic benefit should be weighed against the environmental impact. Any resource extraction activity changes the soil structure, removes the vegetation, and can alter the surface and groundwater flow regimes. Mitigation measures can be used which greatly reduce the potential for conflicts between extractive and other land uses, and the conflicts between extractive use and natural resource protection.

Program Description

Current state legislation does not adequately address the potential environmental impacts of resource extraction. The Commission's program provides that municipalities shall incorporate within their ordinances provisions for registration, operation, restoration, and safety of resource extraction sites. The registration procedure is designed to promote the coordination of land use activities and management programs at the state level to insure continuous, uniform, and consistent protection of the region.

Registration requirements include the submission of plans delineating the proposed operation and restoration measures. A performance bond to assure adherence to the plan is also required. Provisions and standards regarding the operating of resource extraction areas are designed to minimize the impact on surrounding land uses and the natural resources of the Pinelands. The operational standards include setback requirements, landscaping, and erosion and sedimentation control among others.

Restoration provisions are intended to permit the operation of these important local industries while maintaining the natural conditions found in the region. Standards for restoration include a schedule for performance, recontouring, planting, and the removal of buildings and equipment, as well as the recycling of ponds and lakes for recreational or other civic purposes.

This program provides protection for the health and safety of miners, others employed in the industry, and the general public, as well as for the protection of property. Standards for safety in extraction operations are promulgated under N.J.S.A. 34:6-98.1 et seq. and are administered by the New Jersey Department of Labor and Industry. The Commission will cooperate closely with the Department of Labor and Industry to implement the resource extraction programs and standards.

Program Recommendations

The Commission recommends that municipalities, in cooperation with the State Forester, Division of Fish, Game, and Wildlife, Department of Agriculture, the New Jersey Agricultural Experiment Station, and the extractive industry, develop restoration programs which maximize the benefits of restored sites to the communities, and develop appropriate uses which can be incorporated into the master planning process.

It is also recommended that to the maximum extent practicable, municipalities seek to develop recreational uses for extractive sites and, where feasible, utilize water impoundments for civic, agricultural, or industrial purposes.

Legislative Recommendation

Legislation should be developed which allows the New Jersey Department of Labor and Industry, under its current registration procedure, to require the submission of land use and management plans for resource extraction areas with individual registration applications. Such legislation should require owner-operators to submit to the state plans for operation and restoration similar to those contained in this program.

RECREATION PROGRAM

Due to their diversity of natural and cultural resources, the Pinelands offer a wide range of special recreational opportunities. Upland and lowland habitats for game and non-game animals, high quality water for body contact water sports, undeveloped areas which provide the opportunity for wilderness experiences, sites of historical and cultural interest, and many scenic natural features define the Pinelands' recreational potential. These resources are not only abundant and relatively accessible, but also fragile and sensitive to uncontrolled exploitation.

The preservation and protection of the resource base, and the enhancement of outdoor recreational uses which depend on these resources, are the principal objectives of the Pinelands recreational programs. A balance must be struck between the natural and cultural values of the resources and the demands of many users seeking to increase and improve their recreational pursuits. Where fragile conditions exist, the level of use must be carefully controlled to prevent destruction of these resources. Where less sensitive conditions exist, and where the demand for active, intensive recreational use is high, the recreational resource should be managed so that it can be used while its integrity is maintained.

A thorough recreation program must also take into account the recreational needs of present and future Pinelands residents, the millions of other residents in nearby urban areas, and users from more distant locales who are attracted to the area. Accommodation of these diverse needs requires active and cooperative efforts of public and private recreational providers.

To fully address the challenge of providing compatible recreation in the Pinelands, the Commission has begun to detail a program for the area's recreation resources; its users, uses, and impacts; its providers; and its unused potential. Only when these relationships are more fully understood can a truly comprehensive and effective recreation strategy for the Pinelands be developed. Ongoing studies will be undertaken to refine and expand the Commission's recreation program, as described later, and to target efforts to encourage local recreation enterprises.

Issues

In evaluating recreation needs within the Pinelands, the following key issues were identified and addressed:

Proper Use and Adequate Maintenance

A problem continually faced by state and other public recreation facilities and resource administrators is the lack of funding for adequate personnel and equipment. The increase in public use of the Pinelands' recreation resources and the acquisition of new open space areas as part of the Pinelands acquisition program will aggravate existing shortages of funds and personnel. On private land, trespassing is a frequently mentioned problem of landowners. The proper use and maintenance of recreation resources will require the Commission's attention in order to avoid any further deterioration of the region's resources and to alleviate the improper use of public and private land as more people take advantage of the area's recreation opportunities. Although enforcement of rules and regulations is often viewed as the most apparent solution, environmental and user education programs may well provide the best means of treating the problem rather than the symptoms.

Compatibility and Conflicts

In many cases, a recreational activity is entirely compatible with other recreational activities in the same general area. However, certain activities may conflict with others when they take place in the same area or use the same facility.

While it is important to recognize these conflicts, it is also important to recognize that people have different recreation preferences which deserve recognition, that conflicts among uses may not be as widespread as perceived, and that the extensive nature and diversity of the Pinelands' recreation resources make it impractical to totally eliminate conflicts.

Accommodating Demand While Maintaining Quality

In recent years, there has been a steady increase in the demand for recreation opportunities resulting from population growth, increased mobility of people, the influence of the energy crisis on travel patterns, and other factors which include the need for barrier-free recreation opportunities for the handicapped. It must be recognized that the recreation potential of the region is limited, and the region may not be able to accommodate all of the demands placed upon its resources. A key consideration in examining this issue is the maintenance of the quality of the recreation experiences provided. For many activities, the levels of use are important determinants of a participant's quality of experience. For instance, a significant number of canoeists are seeking a remote, semi-wilderness experience which can be destroyed by a high level of use. Other canoeists are likely to find high river use unobtrusive or even beneficial to their experience.

The challenge, then, for recreation planners is to make a cross section of the region's recreation opportunities available to satisfy the multiplicity of types and levels of uses which are desired by the public in a way which is compatible with the essential character of the Pinelands.

Public vs. Private Facilities

The public and private sectors provide similar facilities for certain activities. The state has generally attempted to avoid direct competition with the private sector by providing the types of opportunities and facilities that the private sector would find unprofitable to develop. However, the private sector has claimed that the public sector, because it does not have to realize a profit or amortize its capital investments, can charge lower fees, creating an unfair advantage. The conflict between public and private campground development is an example of this.

Since complementary recreation programs are advantageous to both the public and private sectors, greater coordination is essential to prevent duplication and to foster effective and efficient development of private recreation enterprises within the Pinelands.

Program Description and Recommendations

Recognizing the complexity of these and other recreation issues, the Commission's recreation program has been developed to address key protection strategies at the outset and to set in motion a coordinated and comprehensive effort to establish an effective, long-term management approach.

Management of Public Lands

The State of New Jersey is an active provider of recreational activities. The Department of Environmental Protection, through the Division of Parks, Forestry and Green Acres and the Division of Fish, Game and Wildlife, administers approximately 240,000 acres of publicly owned land. The bulk of these holdings are within the Preservation Area. The largest of the state's holdings in the Pinelands is the Wharton State Forest, which is approximately 100,000 acres. It includes the Batsto Historic Village and the Atsion recreational area, and provides opportunities for hiking, hunting, camping, and canoeing. Similar opportunities are available at other state-owned lands. At present, over 1,000,000 people visit the state-owned lands annually. It is expected that these lands will continue to be a key provider of recreational activity.

To guide the future management of these important resources, the Commission recommends that the Department of Environmental Protection consult with the Pinelands Commission in developing a comprehensive recreation land management plan for state open space areas within the Pinelands. The plan, containing elements relating to fish and game areas and parks and forests, would serve as a long-range guide to provide diverse recreation opportunities which are consistent with the other protection strategies contained in the Pinelands Plan. It would also provide a vehicle to implement a number of the program recommendations which follow, and would establish a foundation for the creation of a "wilderness" area within the Pinelands. Such an area may be most appropriate within Wharton State Forest. It would be managed to provide as close to a natural, undisturbed setting as is practical within the region.

Recreation Development

The heart of the Pinelands provides a remote, semi-wilderness recreation experience virtually non-existent elsewhere in New Jersey. Hunting, fishing, hiking, trapping, canoeing, nature study, horseback riding, and wilderness-type camping are among the activities one can enjoy. They do not generally involve significant concentrations of people, do not involve major site disturbance, and are compatible with the maintenance of the region's essential character. These uses and associated development are therefore appropriate in the Preservation Area District, Special Agricultural Production Areas, and Forest Areas.

Because of the special character of the Agricultural Production Areas, care must be taken to avoid major conflicts between agricultural and other uses which could displace, interfere with, or substantially fragment agricultural operations. Recreation uses which are relatively low in intensity are thus viewed as most appropriate within Agricultural Production Areas. These uses, although in themselves non-intensive, do in many cases require supporting services and establishments. This supportive type of development should be centrally located and can be provided in village and town centers.

More intensive recreation uses—those which involve greater levels of organization, development, and users—do not in most cases depend directly upon an extensive natural resource base. By directing intensive uses to areas of existing and planned development, the natural resources of the Pinelands are afforded a greater level of protection, and more diverse recreation opportunities can be provided close to where people live. Thus, recreation facilities which support intensive uses should be accommodated within Regional Growth Areas, Pinelands Towns, Rural Development Areas, and locations where such facilities currently exist. Recreation facilities to service the needs of resident populations are also appropriate within villages.

Community-Based Recreation

As population increases, so too does the need for close-to-home recreation facilities. All too often, however, this increasing demand far outstrips the supply. The development of major residential areas must therefore take place with full consideration of residents' recreation needs. To the extent that existing facilities are insufficient to meet demand or are not conveniently located, adequate recreation facilities should be provided in association with new residential development.

The Commission recommends that each municipality adopt standards which require the development of necessary recreation facilities in association with major residential development. Municipalities may elect to use guidelines contained in the recreation element of Part II as a basis for that program. Communities are also encouraged to promote the development of recreation areas, particularly turfed areas, in association with commercial and industrial developments, and to utilize low maintenance grasses where practical to further protect the region's water resources.

Liability

Many recreation activities or opportunities, especially on public lands, are limited due to the risks associated with these activities. Horseback riding and swimming are examples. It is recommended that the Department of Environmental Protection investigate the liability issue as it pertains to the provision of recreation opportunities on public lands and cooperate with the Pinelands Commission in evaluating techniques to encourage private landowners to open lands for recreation use without encountering liability problems.

Reward System

The enforcement of state laws and administrative regulations is a difficult task due to shortages of personnel and the sheer expanse of the Pinelands. To aid the State of New Jersey and its agencies in the enforcement of its laws and regulations as well as to provide a direct opportunity for the public to assist in the protection of the resource, the Commission recommends the examination of a reward system for individuals who notify the appropriate authorities of

illegal or improper activities. Such a system would require legislative action and should be designed to compensate individuals for time and effort spent on protecting the resource from illegal or improper use.

Wild and Scenic Rivers

As described in Chapter Four, the Department of Environmental Protection is establishing a state Wild and Scenic Rivers system. The Cedar Creek and a 12-mile segment of the Mullica River will be the initial components of the system, as mandated by the state law, when designation studies are completed. These studies should be available for public review shortly.

The DEP has developed river study and classification guidelines. Proposed rules and regulations concerning use and development within designated river areas (delineated floodplains and adjoining state lands) are pending approval. In cooperation with the DEP, the Commission will evaluate the effectiveness of these rules as well as the critical nature of resources beyond the floodplain. As the need arises, additional protection strategies for these resources will be developed.

In addition to the Mullica and Cedar Creek segments, the Commission has evaluated other rivers in the Pinelands for their scenic and recreation values. As an outcome of that evaluation, the following rivers are found to be wild and scenic:

- Great Egg Harbor River—Great Egg Bay (Garden State Parkway) to Route 536
- Tuckahoe River—Great Egg Bay to the Route 552 crossing in Milmay
- Middle River—Great Egg Bay to the Schoolhouse Lane crossing north of Corbin City
- Mullica River—(Segment 1) Garden State Parkway to Route 542 at Pleasant Mills; (Segment 3) Route 206 crossing at Atsion Lake to the Medford crossing at the Medford, Waterford, and Shamong Townships boundary
- Wading River—Confluence with the Mullica River to the Route 563 crossing at Speedwell
- Oswego River—Confluence with the Wading River to the Sim Place reservoir dam
- Batsto River—Confluence with the Mullica River to the Carranza Memorial Road crossing at the Shamong and Tabernacle Townships boundary
- Bass River—Confluence with the Mullica River to the Stage Road crossing in Bass River State Forest
- Nescochague Creek—Confluence with the Mullica River to the confluence with Great Swamp Branch and Albertson Branch
- Great Swamp Branch—Confluence with Nescochague Creek to the Route 206 bridge in Hammonton
- Rancocas Creek (North Branch)—Route 530 in Browns Mills to the Pinelands boundary
- West Creek—Confluence with Delaware Bay to Pickle Factory Pond above Route 550
- Dennis Creek—Confluence with Delaware Bay to the headwaters of the main stem in the Great Cedar Swamp west of Route 9
- North Branch of the Forked River—Garden State Parkway to the confluence with Cave Cabin Branch east of Howardsville
- Toms River—Central Railroad of New Jersey bridge to the Route 528 crossing east of Cassville
- Maurice River—Delaware Bay to Manumuskin River
- Manumuskin River—Confluence with the Maurice River to the Route 49 crossing near Cumberland Pond
- Mount Misery Branch—Route 70 crossing to the Greenwood Branch, continuing to the North Branch of the Rancocas Creek

The Pinelands Commission recognizes that these rivers should be protected beyond that level afforded through the scenic program. Thus, all structures erected within 1,000 feet of the center line of these rivers shall be located and designed so as to minimize, to the greatest extent practicable, visual intrusions evident from the river. This requirement also applies to the Mullica River between the Route 542 crossing at Pleasant Mills and the Route 206 crossing at Atsion, and to Cedar Creek from Route 9 to the dam at Bamber Lake, segments which are currently under study. The standard shall also apply to other rivers as may later be identified as qualified candidates for study. In addition, for those rivers meeting the criteria of the National Wild and Scenic Rivers system and included in the national inventory, federal agencies are required to avoid or mitigate adverse effects in accordance with the U.S. Department of the Interior's published guidelines, *Interagency Consultation to Avoid or Mitigate Adverse Effects on Rivers in the Nationwide Inventory*.

It is recommended that the Department of Environmental Protection proceed to study these rivers and major tributaries for inclusion into the state Wild and Scenic Rivers system within five years of the Commission's adoption of the Comprehensive Management Plan. In evaluating these studies, the Commission shall place particular importance on the degree to which recreation use of a river is controlled for environmental and user-satisfaction reasons. This includes control of access points and provision of rest stop areas along the river. Consideration should also be given to the national designation of the river segments which appear to qualify under the National Wild and Scenic Rivers program.

It is further recommended that the Department, in cooperation with the Commission and with assistance from the federal Heritage Conservation and Recreation Service, evaluate the following rivers or segments within the Pinelands to determine which are qualified candidates for study:

Mechesactauxin Creek	Davenport, Ridgeway, and North Branches of the
Oyster Creek	Toms River
Rancocas Creek (South Branch)	Westecunk Creek
	Menantico Creek

Trails

Under the direction of the New Jersey Legislature, the New Jersey Trails Council, with the assistance of the Department of Environmental Protection's Office of Green Acres, is preparing a statewide trails master plan. The plan, to be completed by the end of 1980, will establish a framework for a state trails system for such uses as hiking, horseback riding, and bicycling. The Commission supports the development of a statewide trails system and will cooperate with the Trails Council to establish a trail system which is appropriate in the Pinelands.

The Commission further supports the extension of the present 39-mile Batona Hiking Trail within the Rancocas Creek, Cedar Creek, and Bass River watersheds and its expansion into a looped circuit. Where the trail traverses private lands, public access easements should be acquired.

Important elements of future trail development in the Pinelands are the provision of varied trail experiences, the adoption of uniform standards for trail clearing and marking, standards for the location of new or expanded trails, and right-of-way continuity for existing and new trails. To promote the safe and enjoyable use of the Pinelands for trail activities, the Commission will cooperate with the Department of Environmental Protection and other interested persons in continuing efforts to provide trails and necessary trail facilities for hiking, horseback riding, and bicycling. To promote the proper use and maintenance of trails, it is the Commission's recommendation that volunteer groups such as the Batona Hiking Club assist the Department of Environmental Protection in the construction and maintenance of trails. It is further recommended that bicycle transport on the Lindenwold High Speed Line and on bus routes within the region be provided.

Paved and unpaved public roads are also frequently used in the Pinelands for non-motorized recreation and transportation. These roads may contribute significantly to the establishment of an

integrated Pinelands system to serve these uses. Consequently, all proposals for the improvement of existing public roads or the construction of new ones should consider the extent to which the roads meet these needs.

Motorized Vehicle Use

The use of public roads for recreational and access purposes is a legitimate recreational use. These roads are important to gain access to the Pinelands for such activities as driving for pleasure, hiking, horseback riding, canoeing, bicycling, fishing, and hunting.

The extensive network of sand roads, while a vital cultural and recreational element of the Pinelands, also provides easy access to remote parts of the forest for those who would abuse or destroy the resources through illegal acts such as dumping. For this reason, new sand roads on public lands should be limited to those which are essential for the proper administration and management of the resources. Although localized adverse environmental effects, conflicts between uses, and access for illegal acts do occur within the existing sand road system, it is not advisable to "close" the Pinelands' roads for what are, in the main, legitimate and desirable uses. Therefore, the use of motorized vehicles on public lands should be authorized on public and other roads designated for such use by the appropriate administering agency prior to August 8, 1980. There is, however, a need to evaluate the desirability or necessity of closing selected roads. The Commission will continue to work with public interest groups and the Department of Environmental Protection to determine particular road segments which should be closed. In undertaking these evaluations, the criteria enumerated in the recreation element of Part II of the plan shall be utilized. In addition, the routes for formal motorized trail activities will be reviewed by the Commission to ensure that locations are consistent with unique and sensitive environmental qualities.

Off-road recreation vehicle use is becoming a popular activity across the country and one which, if not directed properly, can have significant consequences on the environmental integrity of the Pinelands. Indiscriminate use often occurs because of a shortage of areas set aside for all-terrain vehicles. If designed properly, areas which are disturbed as a result of resource extraction or waste disposal can provide excellent locations for off-road vehicle use. The Commission encourages that such areas be made available.

Hunting, Fishing, and Trapping

Hunting, fishing, and trapping are perhaps the most traditional and historical uses within the Pinelands. Although private lands have been and continue to be made available for sportsmen's use, an increasing demand is placed upon public lands as development encroaches upon the Pinelands' forests. The Commission's wildlife and acquisition programs contribute directly to the maintenance of these extensive recreation activities. A number of other programs relating to wetland protection, water quality, and recreation access will provide indirect, yet important, benefits.

In addition to these efforts, the Commission recognizes the need for other techniques to be utilized. It supports habitat improvement measures that can be undertaken in a manner which avoids adverse impacts upon native fish and wildlife species and does not detrimentally affect other ecological attributes of the Pinelands. The Commission also recommends that the Department of Transportation consider providing fishing and crabbing access facilities in conjunction with bridge construction and improvement measures.

Canoeing

Canoeing the many Pinelands rivers and streams is an increasingly popular recreation activity. There is, however, an apparent over-use of certain river corridors which have convenient public access. In certain instances, this over-use appears to be causing significant bank damage,

littering problems, and impact on the quality of the canoeing experience. To avoid future problems associated with canoeing and to provide a diversity of canoeing experiences, the Pinelands Commission will work with the Department of Environmental Protection to prepare and periodically update a canoe management plan. These efforts will be in consultation with the region's private canoe liveries. The plan shall consider current use levels of the Pinelands rivers, analyze the potential of new rivers for canoeing opportunities, and assure the continued provision of canoeing opportunities by the private sector. As meaningful elements of the plan are completed, they will be incorporated into the Commission's canoeing program. New or expanded access points will be evaluated on the basis of the plan and for consistency with the Comprehensive Management Plan. Proposals for improvements to county and state roads should consider the provision of access points adjacent to canoeing rivers.

Boating and Marinas

The use of the Pinelands for boating is a popular activity but one which is not without conflicts. In accord with the Pinelands Protection Act, this use shall be limited to boats with 10 horsepower or less on state waters except on that portion of the Mullica River downstream from Route 542 and the Wading River downstream from its confluence with the Oswego River. These restrictions shall not apply to any waters located outside of the Pinelands Area. All new or expanded boating facilities should provide for public access and demonstrate that there is a documented public need for the facility which cannot be met by another existing facility.

Recreation for the Handicapped

Many recreation facilities built in the past have not provided for use by handicapped individuals. Unconscious barriers have therefore been created which eliminate or discourage these facilities' use by the handicapped. The State of New Jersey has developed standards and guidelines in recent years to promote the use of recreation and park facilities by the handicapped. The first major provision was the promulgation of the Barrier-Free Design Standards by the Treasury Department's Division of Building and Construction in 1977. The standards require that barrier-free design must be included in all building and spaces used by the general public. The Office of Green Acres has recently developed guidelines for the provision of barrier-free facilities in new parks and recreation facilities funded by the Department of Environmental Protection.

The Commission supports effort to promote and increase the use of recreation and park facilities by the handicapped. It will adopt the Office of Green Acres guidelines for use in designing parks and recreation facilities.

To ensure that a full range of recreation opportunities are available for handicapped persons, "program accessibility" should be a major element of the land management plan developed by the DEP. In addition, opportunities for the development of special facilities including Braille trails and fishing piers should be examined.

Interpretive Programs

The Pinelands have a rich cultural and historical background as well as environmental values. Many individuals, groups, and agencies currently undertake various information and educational programs about the Pinelands' resources. However, efforts to increase the public's awareness of the significance of these resources and to promote their proper use could be better coordinated to avoid duplication and to fill information voids.

It is therefore recommended that an action committee comprised of state agencies such as the Departments of Environmental Protection and Education, non-profit organizations, educational and research groups, and other knowledgeable people be formed to coordinate and promote

interpretive programs within the Pinelands. Various financial resources, including Commission and state financing as well as federal and private grants, should be pursued to develop a comprehensive interpretive and information program, including curricula for primary and secondary school systems, and to construct additional interpretive facilities such as nature centers and trails.

Because of the Pinelands' national significance, it may also be appropriate for the federal government to have a direct role in fostering greater public understanding and appreciation. Such a role, which could include a central visitor, interpretive, and research complex, is recommended for further consideration by the Department of Interior.

Camping

Camping is both a major recreational and economic activity in the Pinelands. Camping facilities are provided by the public and private sectors, leading to occasional disagreements regarding appropriate roles and competition. To avoid future problems and to increase coordination between the public and private sectors, the Commission will participate with the Department of Environmental Protection and the Campground Owner's Association in studying the potential for cooperative arrangements in the provision of camping facilities. Such arrangements should consider ways to provide diversified camping experiences, the different roles of the public and private sectors, locational and design guidelines, and opportunities to lease public land for certain types of campground developments which can be managed by the private sector.

The Pinelands offer a rather unique opportunity to provide for a relatively wilderness-type camping experience. Although administrative difficulties related to managing isolated and dispersed camping sites are difficult to overcome, it is recommended that a pilot program be established in a state forest or park which provides for a remote segregated use area and common or shared sanitary facilities.

New Jersey Heritage Program

As described in the Scenic Resources section, the New Jersey Office of Green Acres is currently developing a program to protect natural and cultural resources representative of the state's heritage. Eight sites have been designated as part of the National Areas system.

A demonstration project with the National Aeronautics and Space Administration, utilizing information gathered through satellite mapping, is also underway on the Great Egg Harbor watershed. This effort will be evaluated as a basis for obtaining uniform landcover information. The Great Egg Harbor River watershed has also been targeted for a pilot study of the area's historic, archaeological, and cultural resources, financed in part by Department of the Interior planning grant.

The Pinelands Commission is represented on the Heritage Steering Committee, an advisory group of various state agencies established to assist in and guide the development of the Heritage Program. The Commission intends to continue its active participation on the committee. As significant resources are identified, the Commission will consider the application of various land management techniques to protect sites and areas.

Legislative Recommendations

It is recommended that the Department of Environmental Protection, in cooperation with the Commission, investigate the feasibility of developing legislation to protect all sites listed in the National Areas Register from adverse impacts arising from public activities.

Legislation should be considered which provides for a system of rewards to persons who furnish information leading to the conviction of a person who violates the motor boating and motor vehicle restrictions in the Pinelands Protection Act.

HOUSING PROGRAM

One of the basic purposes of the Comprehensive Management Plan is to redirect the pattern of residential development within the Pinelands. The increasing pressure for housing development was a major factor leading to enactment of the Pinelands Protection Act. The act specifically states that the goals of the plan for the Protection Area with regard to residential development shall be to discourage piecemeal and scattered development and to encourage appropriate patterns of compatible development, in or adjacent to areas already utilized for such purposes, in order to accommodate regional growth influences in an orderly way while protecting the area from adverse environmental impacts.

Program Description

In order to provide for appropriate patterns of residential development within the Pinelands, the Commission has adopted policies and programs relating to: a) the location and amount of new housing; b) housing opportunities for all economic groups; and c) the planning and design of residential areas. These elements of the housing program are described below.

Location and Amount of Housing

The provisions for land allocation and growth set forth at the beginning of this chapter will guide the overall location and density of new housing within the Pinelands. As indicated, the majority of new housing that potentially can be built under the Comprehensive Management Plan will be located within the Regional Growth Areas. The capacity of these areas is judged to be more than adequate to accommodate regional housing demand projections for the foreseeable future. In recognition of the uncertainties of projections, especially in connection with the proliferation of casinos in Atlantic City, provision is also made for an orderly expansion of growth areas to assure additional housing capacity when warranted by development conditions.

To assure that growth areas are developed at desired densities, the Commission will actively promote the development of adequate infrastructural facilities. It will also seek to avoid unnecessary procedural delays and other obstacles to the progress of development in the growth areas.

Housing Opportunity

The Comprehensive Management Plan is undertaken in recognition of the basic premise that development cannot simply be restricted in more sensitive areas of the Pinelands without addressing, affirmatively, the balance of development which will occur in regional growth centers. The plan therefore creates an environment conducive to housing opportunity in keeping with the precepts of the New Jersey Supreme Court, as set forth in the *Mt. Laurel* decision.

It is clear that communities in the Pinelands have a measure of obligation under the doctrine enunciated by the courts to provide their "fair share of the present and prospective regional need for low and moderate income housing." Since a substantial part of the responsibility for land use regulation in the region has devolved upon the Pinelands Commission, it appears beyond question that the Commission must assume an equally substantial portion of the responsibility for ensuring that the region's low and moderate income housing obligations are met. This responsibility is implicitly recognized in the *Mt. Laurel* decision, where the Supreme Court held:

"Frequently it might be sounder to have more of such housing, like some specialized land uses, in one municipality in a region than in another, because of greater availability of suitable land, location of employment, accessibility of public transportation or some other significant reason. But, under present New Jersey legislation, zoning must be on an individual municipal basis, rather than regionally. So long as that situation persists under the present tax structure, or in the absence of some kind of binding agreement among all the municipalities of a region, we feel that every municipality therein must bear its fair share of the regional burden."

It seems apparent that the creation of the Pinelands Commission, with its land use controls, is the type of changed circumstance which the court was addressing. The meeting of housing needs on a regional basis must go hand in hand with the achievement of the other regional goals to which the Pinelands Protection Act is dedicated.

The act provides that municipal ordinances governing zoning and land use within the Pinelands must be consistent with the Comprehensive Management Plan. With regard to Regional Growth Areas, consistency will partially be defined in terms of the opportunity to provide housing to meet the regional needs. Municipalities, therefore, will be required to submit revisions in local ordinances that will provide such opportunities.

Contained within Part II of the plan are minimum standards dealing with the percentage of low and moderate income housing to be included in new development activities, along with options for the development community where such percentages cannot be attained. These include the standard that development activities involving the construction of 25 to 99 units include at least 25 percent low, moderate, and middle income units. For developments of 100 units or more, 10 percent shall be low income, 10 percent moderate income, and 5 percent middle income. Where it may be demonstrated that attainment of the minimum percentages is impossible, a substitution or donation of developable land or an equivalent amount of money may be made to an appropriate state or local agency.

The Commission recognizes that municipalities, while desiring to meet their fair share requirements, may have alternate methods that will obtain the same result. In light of that recognition, a community may elect to devise an alternate strategy that meets the intent of the Commission's standards. The Commission will certify a community's ordinances if they substantially reflect the goal of meeting, in a realistic manner, the obligation to provide housing opportunities for low and moderate income families.

Planning and Design

The compatibility of new residential development with the Pinelands' natural environment depends to a large extent on the design of the project. Residential development which reflects an awareness of a site's development limitations and opportunities can effectively reduce the negative impacts of development and simultaneously produce an aesthetically pleasing environment.

The Commission shall require that communities incorporate in their planning process the minimum design standards of the Comprehensive Management Plan for new residential development. These include a natural and physical resource assessment, landscaping and siting requirements, and open space and recreational requirements.

Program Recommendations

The advent of casino gambling in Atlantic City has created new development pressures in the Atlantic City region. The demand for housing, new infrastructure, and community services will be of particular concern in planning for this area. The Pinelands Commission recommends that the Casino Control Commission consider the feasibility of phasing in new casino development in a manner which is responsive to the adequate provision of infrastructure, housing, and community services within the area impacted by casino-related development.

Each casino is required to invest 2 percent of its earnings in non-casino related projects. Also, within a casino's first three years, 50 percent of the 2 percent re-investment tax is to be re-invested in Atlantic City. After three years, 25 percent is to be re-invested in the city and 75 percent outside. The Commission recommends that the 2 percent casino re-investment tax be earmarked for projects which provide least-cost housing.

CAPITAL IMPROVEMENTS PROGRAM

Because capital improvements can make land more capable of supporting development, they serve as significant influences on local and regional growth patterns. The existence of excess capacity in a system, such as in sewerage facilities, can stimulate additional development interest in a given parcel of land. Conversely, municipalities where infrastructure is presently overloaded will prove less attractive to potential developers because of the costs of expanding necessary services, such as roads, public water, and sewers. Planning for capital improvements must therefore be an integral element of the overall Pinelands planning program. The factors to be considered should include needs of present and future users, costs associated with construction and maintenance, and the impact of decisions on the area's character.

Program Description

The federal and state legislation direct the Commission to develop strategies which will best protect the Pinelands' resources and maintain the essential character of the region. The state act specifically refers to the need to discourage piecemeal and scattered development. In responding to this mandate and in recognition of the direct relationship between the existence of public services and growth patterns, the Commission has adopted the policy to limit growth-generating capital improvements to areas designated for regional growth. In other areas, only capital improvements which respond to existing problems of health, safety, and welfare will be permitted.

Public Wastewater and Water Supply Systems

Wastewater treatment systems are major growth-inducing capital improvements. They are and will continue to be an important factor in responding to regional development pressures affecting the Pinelands.

Available wastewater facilities in the Pinelands region are primarily located on the area's outer fringe. Some of the systems, particularly in Ocean and Atlantic Counties, are regional and have the potential to serve significantly more development than now exists. Other facilities are designed for limited service areas. To accommodate future growth in the region, it is important that new or expanded wastewater facilities be designed in response to planned development which is consistent with the Comprehensive Management Plan.

The Commission will work closely with the Department of Environmental Protection to assure that water supply and wastewater facilities planning is directed toward servicing the needs of growth areas in the Pinelands. The Commission also recommends that the department analyze its 208 and 201 facility plans for consistency with the Comprehensive Management Plan.

Roads

Roads are as much an influence on the growth of a region as sewerage. New roads and improvements to existing roads make previously remote areas more accessible. New roadways within the Pinelands can have significant adverse effects by contributing to landscape fragmentation and increased development.

Several major highways pass through the Pinelands. Among these are the Garden State Parkway, the Atlantic City Expressway, U.S. Routes 9, 30, 40, and 206, and State Routes 55, 70, 72, and 73. Major road improvements immediately outside the Pinelands create new development pressures. The construction of the Garden State Parkway in the 1950's stimulated major development affecting coastal and inland communities of the Pinelands. Linear development along existing highway corridors has caused significant traffic congestion in certain areas which contributes to air pollution (for example, portions of Route 9).

The continued expansion of casino gambling and the constant attraction of the Jersey Shore will place a greater burden on existing roadways. An alternative to new roads or the expansion of existing roads to meet these needs is the provision of mass transportation.

When proposals for new roadways or the upgrading of existing roadways are made, an analysis of alternatives will be required indicating the feasibility of those alternatives with a justification of why they are not viable.

Community Facilities

The availability of community services within areas of the Pinelands designated for growth will be important to meeting the future demands of new residential, commercial, and industrial development. New development, particularly residential, places additional demands on public services such as health, education, fire, police, and community administrative services. It is therefore important that growth communities anticipate and provide for these needs.

Local governments shall be required within one year of the adoption of the Comprehensive Management Plan to prepare and adopt capital improvement programs along with their revised municipal master plans.

Developers are required to submit letters from the appropriate utility companies serving the site stating the location and adequacy of the individual service. Developers of large projects shall also be requested to submit a fiscal impact analysis. Should community services be inadequate, the developer shall submit a plan for correcting the inadequacy in cooperation with the appropriate service agencies.

Utilities

The installation of utilities to service new residential, industrial, and commercial development can have significant visual impact. To implement the Commission's adopted policy regarding the protection of scenic qualities, the installation of new utilities shall be underground. Where above ground utilities predominate, exceptions may be allowed. One such exception is in the installation of lines servicing agricultural activities.

DATA MANAGEMENT PROGRAM

The use of computers in land use and resource planning has developed in recent years to a level of sophistication where complicated planning tasks which consume hundreds of man-hours in data gathering, mapping, and interpretation can now be done within hours.

Several federal agencies are interested and actively involved in the development of computer mapping. These are the Council on Environmental Quality, the Environmental Protection Agency, the National Aeronautics and Space Administration, the Federal Highway Administration, the Departments of the Interior and Agriculture, and the National Park Service. The states of New York, Oregon, Colorado, and Minnesota already use land capability data systems. Maryland and Massachusetts are using computers in conducting wetland inventories. The Tahoe Regional Planning Agency has based its zoning controls, in part, on land capability maps generated by computers.

In New Jersey, several agencies within the Department of Environmental Protection, including the Divisions of Coastal Resources, Fish, Game, and Wildlife, and Parks and Forestry, the Office of Green Acres, and the program on environmental carcinogens and toxic substances, are in the process of developing the use of computers in their planning programs. The Department of Community Affairs, in cooperation with the DEP, has utilized computers in Section 208 water quality planning. The Division of Coastal Resources in its Cape May Development Potential study used a computer to complete a resource assessment for the county.

Requirements

These are four basic requirements for developing and implementing a computerized data management program for the Pinelands:

- *Data collection:* Extensive natural resource and land use data have been collected and mapped by the Commission's staff and consultants. These data are current and will provide an excellent base for a computerized data system.
- *Computerized data base:* This involves the machine coding of all manually assembled data. The mapped data is digitized (coded) and transferred to computer data files. All of the maps prepared by the Commission's staff and consultants can be easily digitized by computer scanning and transferred to computer files.
- *Data base management software:* This entails developing a set of computer programs that can perform the basic data manipulations required for data interpretation, continuing surveys and monitoring and policy analysis.
- *Hardware:* This is the actual computer equipment needed to create data files and to produce tabular and geographic outputs. A number of computer systems are available in state government for this task. The Department of Environmental Protection presently has some computer hardware and is developing more sophisticated computer capability.

Potential Uses

The use of computers for future Pinelands land use and resource management planning is desirable. The Commission's planning and development review functions can both benefit. As planning tools, computers could assist the Commission in evaluating the implication of policies, changes in land use, the location of proposed major facilities, and critical plant and animal habitats, among other subjects. The Commission's development review operations would benefit from computerized data management in the areas of application tracking, application review, and enforcement.

The Commission will work with the Department of Environmental Protection in analyzing the need for and potential of computers. After determining the operational and functional requirements of a computerized data management system, the Commission will institute a phased implementation schedule in line with current needs and resources.

ADJACENT AREAS OF IMPORTANCE

Certain areas outside the Pinelands are important to the maintenance of the Pinelands environment or are characteristic of the Pinelands. For each of these areas identified, a management recommendation is given. The areas are shown in Figure 7.3.

Acquisition

Oceanville Bog is located in Galloway Township, Atlantic County, outside the Pinelands National Reserve. It is in close proximity to the Brigantine National Wildlife Refuge. The bog supports seven species of orchids, including the crested yellow orchid, and the venus flytrap. The Pine Barrens treefrog is found here, and there have been reports of the bog turtle. The area is used extensively by scientists, researchers, and educators.

It is recommended that the Department of Environmental Protection or the federal government acquire and manage the Oceanville Bog to ensure its preservation and the maintenance of the many benefits it presently provides to researchers, students, and the public.

Watershed Protection

The watershed of the Great Egg Harbor River is the second largest within the Pinelands. The river has been nominated by the Department of Environmental Protection for inclusion in the state Wild and Scenic Rivers system. A portion of the Great Egg Harbor River has been included in the final list for the federal Wild and Scenic Rivers program.

The headwaters of the Great Egg Harbor River are not within the Pinelands area. As

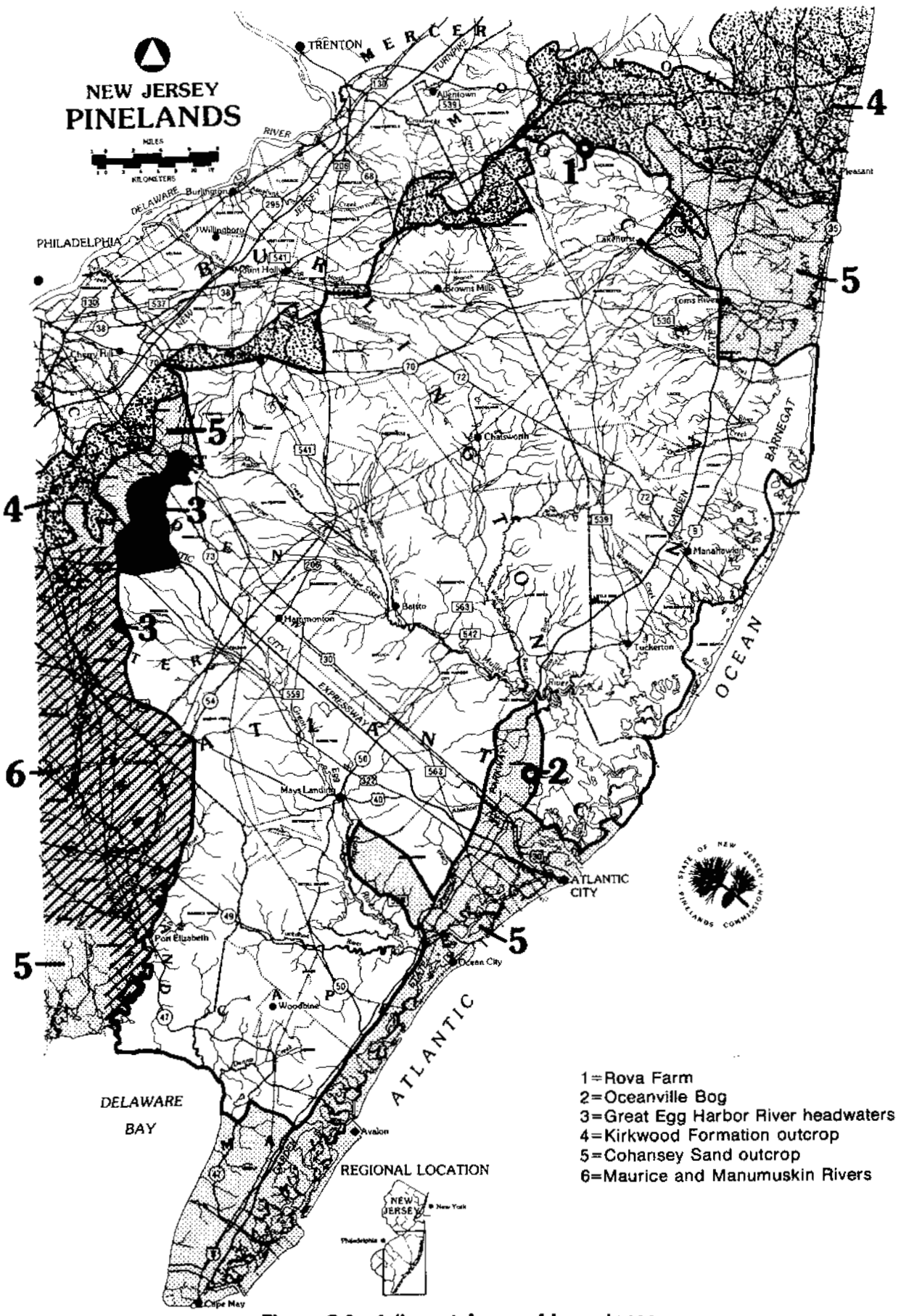


Figure 7.3—Adjacent Areas of Importance

headwater areas are particularly important to downstream water quality, their protection is critical.

The lower portion of the river is within the coastal area and outside the Pinelands National Reserve. The river flows through extensive salt marsh and its borders are generally undeveloped. As time required to flush pollutants in tidal areas is lengthy, the lower stretch is susceptible to water quality degradation.

The Maurice River drainage basin contains the Maurice and Manumuskin Rivers. Approximately two-thirds of the Manumuskin watershed and approximately one-half of the Lower Maurice basin lie within the Pinelands boundaries. Both watersheds are characteristic of a pristine Pinelands environment. The high quality water and the numerous threatened or endangered animals and plants, which include the tiger salamander, the corn and pine snakes, and the sensitive-joint vetch, qualify the area for special protection.

It is recommended that the Department of Environmental Protection adopt and enforce strict ground and surface water quality standards that are adequate to protect the existing water quality for the portions of basins and rivers that are outside the Pinelands area. It is further recommended that state, county, and local agencies which have planning responsibilities in these areas adopt land use regulations to protect and enhance the area's water quality and scenic attributes.

Aquifer Protection

The Cohansey Sand is the uppermost aquifer in the Pinelands. As such, it sustains the Pinelands vegetation and wildlife and maintains the base flow in the region's streams and rivers. The Cohansey is a primary source of potable water.

The Kirkwood Formation lies immediately below the Cohansey Sand. In the coastal communities of Ocean, Atlantic, and Cape May Counties, it is the primary source of water for residential, commercial, and industrial uses.

Portions of the outcrop areas of the Cohansey Sand and Kirkwood Formation are outside the Pinelands area. As outcrop areas are important for aquifer recharge, and vital to the region's overall hydrology, it is important that they be protected from contamination. The Commission recommends that county and local governments adopt regulations which control the type and intensity of land uses within and adjacent to these outcrop areas to safeguard water quantity and quality in the aquifers.

Cultural Viability

The largest and most stable Russian community found in the Pinelands region is Rova Farm, located in Jackson Township, Ocean County, and founded in the 1930's. Approximately half of Rova Farm is located within the Pinelands boundary. It is expected to remain an important cultural center.

It is recommended that Ocean County and Jackson Township coordinate their planning activities with the Pinelands Commission for that part of Rova Farm which is outside the Pinelands area to ensure that Rova Farm remains a viable cultural center.

FURTHER STUDY

The study of the Pinelands ecosystem undertaken in support of the Comprehensive Management Plan was a tremendous yet not fully complete effort. Many questions still exist about the complex natural and human relationships within the region. The answers would contribute to a refined and improved Pinelands management program.

There is also a need to continually assess the management program to determine whether environmental, cultural, or economic implications and impacts are being effectively dealt with. In a dynamic system such as the Pinelands, this is essential to the long-term success of the protection effort.

The following areas of study are felt to be important in a continuing planning effort. As resources permit, the Pinelands Commission will undertake a number of these studies under its own auspices. Other governmental agencies and research institutions are better equipped to handle many of them.

Agriculture

- The preservation of farming in New Jersey is dependent upon the ability to economically produce and market farm products. Over the years, the rising costs of production, land costs, and changing markets have continually reduced the profit margin of the state's farms. Without markets, there is no sale of produce and no income. Therefore, the New Jersey Department of Agriculture and Cook College should continue to study potential new crops and markets for New Jersey-grown produce. Secondly, as the costs of petroleum-based fertilizers continue to rise, alternatives such as organic or slow release formulations of fertilizer and timing and placement techniques should be explored. Studies to determine the feasibility of using sludge and septage as an alternate source of nutrients should be examined. This study should include the nutrient use patterns of the various crops grown in New Jersey to assist the farmers in making their operations more efficient.
- A minimum of \$1,000 per acre is required to produce most vegetable crops. This excludes mortgage and capital improvement costs. The normal procedure for financing a farm operation is to borrow short-term operating funds over and above the long-term capital loans. Several credit cooperatives have been established to provide this credit. The loaned money is based on the development market value of the property. Research should be done to evaluate any impact the plan may have on farmers' borrowing power and to suggest new strategies for loans which are not based on the land's development market value.

Agricultural Pesticides

- Economical production requires intensive management of the wide variety of insects and other pests which invade crops and reduce production. In addition, the water quality aspects of pesticide usage have been the subject of much recent controversy, especially in light of the fact that the effectiveness of new pesticides wanes after a couple of years. Ultimately, integrated pest management using natural predators is the desired end to assure long-term control and minimize contamination. To accomplish this, the New Jersey Department of Agriculture and Cook College should study the application of integrated pest management to Pinelands agriculture.
- Recent research on Long Island indicates that bacterial activity in sandy soils is not sufficient to break down agricultural pesticides. Because of the hydrologic similarities between Long Island and the Pinelands National Reserve, studies should be undertaken to examine the levels of agricultural pesticides in groundwater. This study should analyze, in particular, the pesticides of aldicarb, fensulfothion and carbofuran.

Air Quality

- Investigations should be conducted in the Pinelands to determine what degree of impact degradation of air quality has on the vegetation. Special attention should be given to the effect of ozone.
- Acid rain has recently received national attention. Investigations in the Pinelands should be expanded to determine what effect this regional phenomenon may be having on the flora and fauna.

Capital Improvements

- A study to assess the impact of the Comprehensive Management Plan on mass transportation and to identify the kinds and locations of mass transit systems which the

region can support should be undertaken. Where the means to implement mass transportation can be identified, it should be included in the study.

- Nitrogen and phosphorus concentrations in the Pinelands' ground and surface waters are exceptionally low. To protect and preserve the water quality of the region, it is necessary to develop cost-effective, advanced wastewater treatment for nutrient removal.
- The responsibilities of the public and private sectors in providing essential community services (schools, water supply, etc.) are frequently misunderstood. A study exploring their roles and expectations is needed. Such a study should also identify areas of mutual interest and strategies to stimulate a working relationship between the public and private sectors in the provision of community services.

Economic Impact

- The beneficial effect of small public open spaces on surrounding properties is frequently observed. A similar result may be realized on a large scale. A study to identify the full range of economic effects of open space on surrounding properties should be instituted.
- The financial implications of the Comprehensive Management Plan should be monitored to determine whether fiscal imbalances occur. This should include development of a model for analyzing the plan's economic impact.

Energy

- Energy-conscious community design and building techniques can result in significant energy savings. New energy-conserving community management systems and design techniques should be examined, along with ways to incorporate them into community master plans. A related effort is the development of a model solar ordinance for use by local government.
- Energy exploration off the New Jersey coast is presently underway. Should crude oil and natural gas be found in commercial quantities, there will be a need for their transport, processing, and distribution. The Commission should join with the Division of Coastal Resources and the Department of Energy in continuing their present studies to analyze the need for onshore support facilities, land and marine-related environmental impacts, and siting criteria for new energy facilities.

Historic and Cultural

- Work performed for the Commission has produced an extensive list of prehistoric, historic, and cultural sites throughout the Pinelands. The Commission will continue to improve its data base by conducting field inspections of these sites. The purposes of the field work are to supplement the existing descriptions, to refine study units, to establish the condition of the sites, and to determine which of the sites have the greatest potential for inclusion on the State and National Register of Historic Places. A related study is the development of a model historic district ordinance for local use.

Housing

- The demand for a range of housing prices and types varies widely, depending on the location, character, and economic conditions of an area. Financial and institutional incentives to meet housing needs should be explored and developed.
- The Comprehensive Management Plan's effect on the housing market should be assessed to determine if a variety of housing opportunities for the region's residents are being provided. The Atlantic City region should be the first area of attention.
- The decisions of a number of local and state agencies affect the housing market in the Atlantic City region. These decisions and the roles of the various agencies should be analyzed to identify strategies for meeting the region's housing needs.

Hydrology

- Because of the unusually low renovative capacity of the Pinelands' groundwater aquifer system, contaminants introduced in one basin may have significant impacts on adjacent watersheds. The scope and magnitude of these interbasin transfers must therefore be understood if existing high quality water supplies are to be protected.
- In view of the recognized significance of the Pinelands' headwaters to overall surface water quality and quantity, there is a need to determine the natural attributes of these areas and to define them spatially.
- Methods for predicting stormwater runoff must be further refined and adapted to the distinctive characteristics of the sandy Pinelands soils.
- Water quality and quantity monitoring and analysis programs should be designed to provide additional baseline data necessary to determine the impacts of continuing natural and man-induced changes.
- The characteristic ecosystem of the Pinelands depends on a relatively shallow water table. The maximum amount of water that can be withdrawn from the surface aquifer without adversely affecting the ecosystem needs to be determined so that appropriate water supply strategies can be implemented. This study should take into account previously granted diversion and grandfathered rights.

Landfills

- There are many abandoned and active landfills, dumps, and other waste disposal sites in the Pinelands with potentially severe adverse impacts on the region's people. The feasibility of alternative methods for the renovation and restoration of groundwater quality affected by landfill leachate and contaminants should be explored.
- All types of harmful wastes have been legally and illegally disposed of in the region. A major investigation of hazardous waste disposal should be undertaken to: 1) locate all hazardous material dumping sites; 2) determine the degree of hazard to public health; 3) determine the legal and financial responsibility for cleanup; and 4) carry out a cleanup program.

Land Use

- A study to monitor regional growth influences and to assess the need for future changes in the Commission's land allocation system should be undertaken.
- The recurring patterns of resource and land uses in the Pinelands, and their associated physical and economic determinants, merit additional study.

Public Involvement

- One measurement of the success of the Comprehensive Management Plan is in the attitudes of Pinelands residents and users. The opinions of these groups should be surveyed to evaluate their reaction to the plan's effectiveness in addressing the legislative goals and improving the region's quality of life.
- The English "countryside commission" approach to citizen involvement and participation needs to be explored and adapted for use in the Pinelands.

Recreation

- Recreation within the Pinelands area is now and will remain an important activity. There is a continued need to refine the Commission's recreation program to ensure that recreational opportunities are being provided without adversely affecting the Pinelands environment.

Scenic Resources

- Indiscriminate use of signs and billboards can degrade an area visually. The Commission will cooperate with municipalities to identify any signs and billboards which may be erected or illuminated in violation of municipal ordinances after this plan takes effect.

Soils

- The capacity of Pinelands soils to adsorb certain contaminants before they reach the water table is presumed to be low because of the soils' low chemical activity. However, these levels of activity need to be measured to determine the amount of contamination which can be prevented from reaching the groundwater.
- The underground flow of contaminants from point sources such as septic systems and landfills is not easily predicted in the Pinelands because of specific geologic characteristics. Predictive models which consider the formation of contaminant plumes and other factors need to be developed to protect critical water supplies.
- Alternative on-site wastewater disposal systems in use elsewhere in the country have limited application in the rapidly permeable soils of the Pinelands. Selective designs which appear to have merit must be tested, and other innovative techniques must be developed for use here.

Vegetation and Wildlife

- The vegetation maps prepared by the Commission should be continuously refined and updated to ensure that the best possible planning tool is available to all agencies involved.
- Fire has been identified as a major factor influencing the existing Pinelands landscape. The role of fire in this ecosystem should receive further study. The long-term effects of controlled wildfire and prescribed burning on the vegetation should be determined, and management practices which will ensure maintenance of the existing landscape should be identified. Investigations dealing with the effect of fire on Pinelands wildlife have been limited. This area of study may provide valuable data which can be used in the management of the region's wildlife.
- A complete and updated forest resources inventory should be prepared. This should include the development of a forest type map suitable for forest management and of a stand suitability index to determine the potential value of a site for timber production.
- A fuel type map of the Pinelands which describes the fire hazard of an area should be prepared. This map would facilitate the incorporation of fire safety considerations into all development plans.
- The use of native Pinelands species in landscaping contributes to the maintenance of the existing character of the region. Horticulturalists need to study methods to propagate native species for commercial distribution.
- Many of the records of threatened and endangered plant and animal species are from well-known sites which have been intensely studied. The apparently patchy distribution of some species may be due in part to the lack of a systematic field survey of the Pinelands. Such a survey would add greatly to the existing data base and provide valuable planning information for all levels of government. Investigations of the habitat requirements and population levels of these species would also facilitate their protection.
- Field investigations to determine the distribution, population status, and habitat requirements of other animals described in this plan are also needed. Most previous studies in the region have been directed towards inventory development. Although the available data is rather extensive in areas, this type of work must continue. This is especially true

for the small mammals and birds. Special attention must be given to the specific habitat associations and requirements of Pinelands animals and to their vertical and horizontal distribution within these habitats. Finally, there is a need to go beyond the collection of inventory data, and to integrate descriptions of the animal communities found in the Pinelands with factors such as fire and other disturbances affecting their composition.

- Fragmentation of the Pinelands landscape results in the formation of a series of smaller patches or islands. Studies conducted elsewhere have demonstrated that species diversity in a given area is related to the size and location of the land parcel. Investigations are needed to determine the minimum size of specific Pinelands habitats, such as pitch pine lowland or pine-oak forest, and of upland and lowland complexes required to maximize species diversity.
- Alterations of the flow and quality of Pinelands waters will cause changes in the composition of characteristic aquatic and estuarine communities. The effect will vary among species. Few systematic investigations which study communities of aquatic organisms rather than individual taxa have been completed in the region. Such studies should be conducted first in those areas identified as probably supporting characteristic Pinelands aquatic communities, which include algae, macrophytes, invertebrates, and fish. The effect of land use on water quality and the impact of changes in water quality on these communities must also be investigated. The parameters which have the most significant influence on species composition must be identified, and acceptable ranges for the maintenance of the communities must be determined.

Waste Management

- Alternative methods of waste disposal should be explored and developed for managing the region's waste. This study should include source separation, composting, and recycling centers.

Wetlands

- Development can have a number of adverse effects on the integrity of wetlands. Alteration of drainage patterns by changing the direction and volume of runoff, by withdrawing groundwater, or by directly draining an area is a major factor. Another is an increase in nutrients such as nitrates and phosphates from agricultural runoff and domestic effluent. Investigations are needed to determine and quantify the specific wetland impacts of development activities.

CHAPTER EIGHT

Intergovernmental Coordination

The Comprehensive Management Plan is intended to provide a framework for the coordination of all governmental programs affecting the natural and cultural resources of the Pinelands. According to Section 7(e) of the Pinelands Protection Act, this coordination component *should detail "the ways in which local, state, and federal programs and policies may best be coordinated to promote the goals and policies of the management plan and . . . how land, water, and structures managed by governmental or nongovernmental entities in the public interest within the Pinelands Area may be integrated into the management plan."* There is a similar requirement in the federal act.

The Commission's goal with respect to intergovernmental implementation of the Comprehensive Management Plan is to coordinate the policies and programs of local, state, and federal government agencies to achieve consistency with the plan. Its policies with respect to this goal are to:

- Promote the conformance of federal policies, plans, programs, and regulations to the Comprehensive Management Plan.
- Ensure that the policies, plans, programs, and regulations of all state and local agencies conform to the Comprehensive Management Plan.
- Ensure that management practices on state and local lands and facilities are consistent with the Comprehensive Management Plan, and promote those consistent practices on federal lands and facilities.
- Utilize to the maximum extent practicable provisions of federal, state, and local legislation to accomplish the goals of the Comprehensive Management Plan, and make recommendations for new legislation where needed.

The plan's coordination component evolved as the Commission and staff worked together with officials of Pinelands counties and municipalities and with representatives of several state and federal agencies. During this period, the Commission developed its understanding of how the various levels of government should properly be involved in the Pinelands resource management effort. Just as importantly, the Commission and staff became acquainted with many government officials at all levels whose cooperation is essential for the plan's ultimate success. To meet the planning requirements of the state and federal acts, the Commission also requested certain agencies to produce resource inventory and management reports. These reports proved invaluable in the development of many programs.

The Comprehensive Management Plan's intergovernmental component has three basic elements. The first is the involvement of various local, state, and federal agencies in the plan's development. Although this element is largely completed with adoption of the plan, continued cooperation among all levels of government will be a significant factor in the continuing planning program, and in the further refinement of the plan. The second element is the cooperative effort

required of the Commission and the Pinelands counties and municipalities to bring their land use plans and ordinances into conformance with the Comprehensive Management Plan. The third element is the ongoing role that regional, state, and federal agencies will have in implementing many of the programs described in Chapter Seven. These three elements are described in the sections that follow.

Involvement of Government Agencies in the Comprehensive Planning Process

Without the assistance of many federal, state, and local government agencies, development of a Comprehensive Management Plan for the Pinelands would have been impossible.

During its formative stages in the spring of 1979, the Commission received generous staff support from the New Jersey Departments of Environmental Protection and Community Affairs. Legal counsel provided through the Attorney General's office helped to structure the Commission's decision-making process, and proved invaluable to the staff during the interim review period. As the Commission's activities grew more diversified, its level of interaction with other state agencies grew. These agencies include the Governor's Cabinet Committee on Atlantic City, the Casino Control Commission, and the New Jersey Departments of the Treasury, Defense, Energy, Labor and Industry, Agriculture, Transportation, and the Public Advocate.

The Commission also received extensive technical assistance from the Department of Environmental Protection. Four technical planning reports were prepared by the Department's Division of Fish, Game, and Wildlife, Bureau of Forest Management, Bureau of Forest Fire Management, and Division of Environmental Quality. The Office of Green Acres and the Office of Cultural and Environmental Services contributed to the Commission's assessments of recreational, scenic and cultural resources.

The Commission's study of the Pinelands required a great deal of coordination and cooperation with federal agencies. Within the Department of the Interior, the Heritage Conservation and Recreation Service (HCRS), the Fish and Wildlife Service, and the National Park Service provided detailed help relating to natural, cultural, and recreational issues. HCRS, in particular, assisted the Commission in developing its work program for the planning effort and its recreation study outline. It also provided advisory assistance on the cultural resources studies, and completed the first phase of a visual resources assessment in cooperation with the state's heritage program and the Commission.

Other federal agencies that provided information and assistance essential to the Commission's work were the Department of Agriculture, the Environmental Protection Agency, the Department of Housing and Urban Development, the Department of Commerce, and the Department of Defense.

One of the most important elements in the development of the Comprehensive Management Plan was coordination with the counties and municipalities of the Pinelands. These governmental units are in a unique position to advise the Commission on the issues, needs, and conflicts inherent in a planning effort of this magnitude. The cooperation and interaction which the Commission achieved with counties and municipalities contributed significantly to the planning process, first in the formulation of programs and then in the refinement of the plan. Prior to release of the draft in June, 1980, more than 35 meetings with municipal planning boards were held to exchange ideas and information. Dozens of other sessions with municipal officials, county planning boards, freeholders, and local agencies also contributed to the Commission's base of knowledge and understanding. Once the draft plan was available for review, the level of interaction intensified. In a series of meetings with municipal and county officials, many specific revisions to the programs and land capability map were suggested, and a number of these have been incorporated into the plan.

Several of the Commission's studies, particularly those dealing with financial issues and land management techniques, benefited from the experience of local and state officials. The in lieu of taxes program recommended in Chapter Nine is a direct outgrowth of the needs expressed by local officials who were interviewed during the financial evaluation. One phase of the land

management study analyzed state and local programs of relevance to the Pinelands plan, and relied heavily on contacts with state and local officials.

In addition, the seven county planning departments have participated in the Commission's work plan subcommittee meetings to review and comment on technical reports. Copies of the reports have been made available to the planning departments for ongoing review and for public access. Formal arrangements with the counties of Atlantic, Burlington, Camden, Cape May, and Cumberland have increased county and local contributions to the plan through reviews of the draft and provisions for technical assistance to municipalities. While Gloucester and Ocean Counties chose not to contract with the Commission, they also presented their views on the plan to the Commission, and Ocean County coordinated its review with its constituent municipalities.

Local Implementation

Because of the structure of planning and zoning authority in New Jersey, municipal governments exert the most direct influence over land uses within their jurisdictions. Over the last several years, state and federal governments have played an increasingly prominent role in setting growth policies for certain regions, and in specifying minimum standards for activities which take place in those regions. Nevertheless, the day-to-day administration and interpretation of land use policies remains concentrated at the local level, and it is here that the success or failure of policies will be realized.

The Pinelands Protection Act and this Comprehensive Management Plan envision that local governments will be the principal management entities for implementing the plan. In light of the substantial decision-making powers which are vested in municipal and, to a lesser extent, county governments, this method of implementation represents the most readily available course. While implementation is intended to take place predominantly at the local level, a system must be established so that policies are interpreted effectively and in a manner which best addresses the goals of the state and federal legislation.

The land management system outlined in this plan involves a tier of consistent comprehensive plans and ordinances at the municipal, county, and regional levels. The mechanism for attaining consistency among these plans is the conformance process, which is summarized below and described in detail in Part II. The Commission is responsible for ensuring that all relevant local plans and ordinances contain the procedural and substantive elements of the Pinelands plan. However, the Commission's ultimate responsibility for implementing and enforcing the plan necessitates that its involvement go beyond the certification of local plans. Under the Pinelands Act, the Commission is empowered to exercise all powers and duties necessary to implement the act's provisions. Other functions the Commission will perform in seeing that the plan is carried out include active participation in the local planning process, oversight of decisions relating to public and private development, interpretation of various provisions of the plan, and granting of waivers of strict compliance from the plan.

Review and Certification of Municipal and County Plans

The Pinelands Protection Act specifies the general procedures for local conformance with the Comprehensive Management Plan. Within one year of the plan's adoption, all municipalities and counties with land in the Pinelands jurisdictional area are required to bring their master plans and land use ordinances into conformance with the Comprehensive Management Plan through the certification process. Because the amended Pinelands Protection Act established two different deadlines for the Preservation and Protection Areas, the final date for receiving certification will differ as well. For municipalities with land in both the Preservation and Protection Areas, a dual timetable will be in effect. The procedures and specific time lines of the certification process are detailed in Part II.

The Pinelands plan will serve as a general guide for local authorities in revising their plans so that they may receive Commission certification. The Commission has identified several ways to aid municipalities and counties in this process. As a first step, local governments will receive

a handbook which outlines the steps for certification, procedures for development review, and elements to be included in local land use regulations. This handbook is intended to supplement Part II and to serve as a checklist for municipal officials to ascertain revisions necessary for compliance. By the end of 1980, the Commission will have selected the most appropriate sample ordinances for municipal use and made these available to interested boards. In addition, the Commission's extensive resource inventory data and factor maps will be available, if agencies wish to incorporate these directly into their plans. To the extent possible, the Commission's staff will advise local governments in interpreting this data. The Commission will also provide financial assistance to help offset the costs of the revisions. An initial sum of \$300,000 is available for local planning assistance grants, the distribution of which will be based on a formula developed with the input of local officials.

Once municipal and county plans and ordinances have been amended in recognition of the requirements of the Pinelands plan, they will then be submitted to the Commission's Executive Director, who will hold a public hearing on the revised documents. After this hearing the Executive Director will submit a recommendation to the Commission, with the following possible outcomes: 1) the Commission certifies the plan and ordinances as being in conformance with the Comprehensive Management Plan; 2) the Commission certifies the plan and ordinances with conditions; 3) the Commission issues a disapproval and specifies necessary changes. If any changes are required, local governments must modify their plans and ordinances within a specified time period. Amendments to certified plans and ordinances must undergo the same procedures unless the Executive Director notifies the municipality that "no substantial issue" is raised with respect to the conformance of the amendments with the Comprehensive Management Plan.

A variation in the procedures may occur if a county is delegated authority by the Commission to make a preliminary review of a municipality's plans and ordinances. For this to occur, a county must first be certified by the Commission as conforming with the comprehensive plan. The county planning board would then be authorized to conduct the preliminary review and public hearing and would report its findings to the Commission. The Commission then would render a decision on certification as described above. The delegation of preliminary local plan approval authority to a county is regarded as an additional opportunity to achieve greater coordination among the various levels of government with jurisdiction in the Pinelands.

Part II specifies the criteria to be employed in determining whether municipal and county plans conform to the provisions of the Pinelands Protection Act and the Comprehensive Management Plan. These standards are designed to allow local governments maximum flexibility and discretion in the design of their plans and ordinances while implementing the goals of the act. A local authority that incorporates all of the elements of the regional plan in its local plan and ordinances will be assured of certification. The fact that Part II offers specific standards and wording which can be readily integrated into local ordinances streamlines the conformance process for local governments which choose this route. However, municipalities and counties may also treat the regional plan as a guide, adopting the standards and programs in such a way that the resulting product reflects local needs and desires. In such cases, the Commission would issue a certification if it found that local ordinances contained minimum elements specified in the regional plan, and that the ordinances accurately reflected the intent of that plan.

Some elements of the Pinelands plan must be strictly followed. For example, the minimum density provisions in the designated growth areas and the density limitations in the other districts are critical to the overall objectives of the plan for the distribution of land uses. Similarly, all municipalities which contain regional growth areas or parts of rural development areas that have been approved for future growth must allow for density bonuses in the form of transferred Pinelands Development Credits. Other examples of items which must be closely adhered to include the prohibition of development on wetlands, standards for on-site wastewater treatment facilities, and procedures for review of forestry management plans.

Other elements of the comprehensive plan will depend on the discretion and judgement of local government. For example, municipalities will be responsible for translating the area boundaries into local zoning in a manner which will be most manageable for the town (e.g., according to block and lot, or natural divides such as rivers), for determining the distribution of housing densities within a given area, for delineating the areal extent of villages, for nominating additional villages, and for designating additional agricultural production areas and special agricultural production areas. Municipalities will also be afforded a degree of flexibility in selecting land uses which they feel are suitable in growth areas, towns, and villages; devising their own elements to regulate signs and to address energy considerations; and responding to situations which necessitate the expansion of growth areas. These situations may arise when a certain percentage of land in an existing growth area is committed to development or constrained by parcel assembly problems, or when the extension of services promotes the orderly development. Municipalities also choose the method to implement exemptions for "grandfathered" lots, which are not covered by the plan's density requirements. Under these exemptions, individuals who owned property as of February 7, 1979, may build a house for their own use provided that they meet the plan's environmental standards.

The conformance year is seen as a time of change, both for the Pinelands plan and for local plans. It provides the opportunity for local officials to translate the objectives and standards of the regional plan into their land use ordinances in a way that is sensitive to unique local conditions. It also provides a mechanism to reassess and refine the Pinelands plan in light of the varied local interpretations.

Amendments to the Comprehensive Management Plan

The Commission recognizes that it will be necessary to amend the plan from time to time, in light of changing conditions and as new information becomes available. Part II provides two approaches to the amendment process and sets forth the procedure by which local plans should be reviewed and amended to conform with changes in the Comprehensive Management Plan.

At least every three years after adoption, the Commission will review the plan and all actions taken under the plan during that time, and determine what changes should be made to best address the legislative mandates. Individual Commissioners, staff, local governments, and any other person may file a petition with the Executive Director seeking a determination by the Commission on any type of revision to the plan or land capability map. In either case, proposed amendments will be the subject of a public hearing, and will be reviewed by the Pinelands Municipal Council for sixty days. If adopted, the amendment is submitted to the Governor, Legislature, and Secretary of the Interior, and is filed with the Secretary of State.

Review of Private Development

Article 4 of Part II sets forth all the procedures governing review of development proposals in the Pinelands Area. These procedures reflect the distinction made in the state act between the Preservation and Protection Areas. Within the Preservation Area, review of development will continue to be conducted by the Commission until the local plans and ordinances are certified. In the Protection Area, initial approval authority will be returned to the local level, with the Commission retaining the authority to screen applications for completeness and to make the final determination that development approvals are consistent with the regional plan. Once a locality in the Preservation Area receives certification, development review proceeds as in the Protection Area.

The Commission expects that all counties and municipalities will choose to tailor their own plans and ordinances to incorporate the elements set forth in this plan. If a government does not assume this responsibility, or fails to prepare adequate plans or ordinances, the Pinelands Protection Act provides a fallback mechanism. In such localities the Commission will enforce the required minimum regulations contained in the Comprehensive Management Plan. Part II details the procedures the Commission will follow if it becomes necessary to enforce regulations in a locality.

In uncertified municipalities after the conformance year, development shall not be carried out until the developer has secured approval from the Commission. Applications for development approval will be submitted directly to the Commission, where the Executive Director will make the initial decision. If the applicant objects to the conditions of approval or is denied, he may appeal to the Commission after a hearing conducted by an administrative law judge. This requirement applies to any local approval or permit.

Public Sector Development Review

To achieve the goals of the Comprehensive Management Plan, it is essential that public sector development be carefully reviewed. Part II sets forth a detailed development review procedure by which public agency proposals are to be reviewed for consistency with the plan. Commission approval is required unless the agency has entered into a memorandum of agreement with the Commission, allowing the agency to carry out specified development activities without obtaining individual permission for each project.

The agency's first step is to schedule a pre-application conference with the Executive Director, who determines what information is necessary for the proposal to be reviewed for conformity with the plan's standards. Within a specified number of days, the Executive Director determines whether the proposed development raises a "substantial issue" with respect to conformance. A finding of potential nonconformity triggers the involvement of the Commission, which then must issue an order approving with conditions or disapproving the development.

Waiver of Strict Compliance and Binding Letter of Interpretation

The Commission recognizes that circumstances will arise in the development review process when it must play a direct role in interpreting the plan. Two mechanisms are provided within the plan to address these unusual circumstances. They should be considered as supplementary to the local review process.

The first mechanism is the procedure for obtaining a variance from the requirements of the plan. Waivers of strict compliance will be granted by the Commission if it finds that such relief is necessary to alleviate an extraordinary hardship or to serve a compelling public need. An applicant requests a waiver by applying to the Executive Director, who recommends a course of action to the Commission. An applicant who obtains a waiver may then proceed to request the necessary approval from the appropriate local agency.

The other mechanism designed to address unusual circumstances is the provision for binding letters of interpretation. This process entitles any person or municipality to obtain a clarification or interpretation of the meaning or applicability of any provision of the plan. Because of the complex management issues involved in many development proposals, deferring an interpretation of the plan to the last stage in the development review process may place an unwarranted burden on landowners. Therefore, Part II provides an opportunity for a landowner to secure a determination prior to submitting an application for development approval to local authorities. Although this process is optional, it is expected that landowners in some situations would routinely seek binding interpretations prior to proceeding with development applications.

For example, the Comprehensive Management Plan prescribes detailed regulations for the management of wetlands. There will undoubtedly be situations where the upland margin of wetland areas will be difficult to discern. The binding determination procedure will allow a landowner to secure the Commission's assessment of the boundary with which he is to comply. Part II prescribes the information which is to be submitted to the Commission as a basis for that determination.

Similarly, under this provision, the Commission would determine the existence of historical and archaeological values on a particular site if requested to do so. The Comprehensive Management Plan identifies a number of significant historical and archaeological resources. However, the plan also recognizes that there are additional resources which are not yet known. The binding determination provision permits a landowner to secure an evaluation of the

historical and archaeological constraints pertaining to his property before he initiates the formal development review process.

Commission Review of Local Development Approvals

Part II prescribes two opportunities for the Commission to review local decisions: review of final approvals and review of preliminary approvals. Review of final development approvals is authorized by Section 14(a) of the Pinelands Protection Act, and essentially reserves for the Commission a final voice in development review. Part II provides that all final decisions will be transmitted by local governments to the Commission. If the Commission's initial analysis indicates that a further review is appropriate, the approval will be called up for detailed review. The procedures for this review provide for a decision by the Commission's Executive Director, with an opportunity for dissatisfied applicants to have their cases heard by a state administrative law judge and then to appeal to the full Commission. The Commission is empowered to overturn final local approvals or to modify them as appropriate. No development will be permitted which is not in conformance with the approved permit.

Many local development review procedures provide for preliminary approvals of development proposals. Preliminary review is available so that a landowner can secure an initial determination of a project's acceptability without the expense of preparing final architectural and engineering plans. Part II makes available a binding Commission review of a preliminary approval so that the landowner can determine the proposed development's acceptability to the Commission before the final plans are prepared. The procedures for review of preliminary approvals are similar to those established for final approvals.

These administrative structures and procedures established in Part II are designed to meet the requirements of the Pinelands Protection Act that the Commission oversee the implementation of the Comprehensive Management Plan. A basic element of this process is the Commission's dependence upon county and municipal cooperation and participation. If local authorities fulfill their responsibilities under the act, the Commission's rule will be limited to reviewing public sector activities and providing interpretative assistance to landowners and local authorities. However, if the Commission finds that local governments are not administering their functions in accordance with the comprehensive plan's minimum standards, it may utilize procedures set forth in Part II for the decertification of local plans and ordinances.

The Role of State Agencies

Because of the broad range of state planning and regulatory responsibilities, it is essential that the Pinelands Commission take an aggressive role in ensuring that the actions of various agencies are consistent with the objectives of the Comprehensive Management Plan. Some state agencies, in particular the Department of Environmental Protection, have far-reaching powers in terms of both public and private land use decisions. While the Commission will remain the lead agency with regard to plan implementation, the most practical and desirable method to implement portions of the plan will be through existing state and regional channels. This section touches upon the major roles state agencies currently play in the Pinelands, and suggests ways for attaining greater consistency within the context of the Pinelands management program. Beginning with a discussion of policies relating to state-owned lands, it continues with a description of various agencies' activities which impact the Pinelands. It then addresses the issue of coordination with the Coastal Management Program for portion of the Pinelands National Reserve.

While the discussion of programs and agencies is not intended to be all-inclusive, it does pinpoint key areas where coordination must be achieved. For greater detail, the reader should refer to Table 8.1 and to narratives in other portions of the plan, particularly Chapter Seven.

Management of State-Owned Lands

The State of New Jersey owns approximately 240,000 acres within the Pinelands, or roughly 25 percent of the planning area. While several thousand acres are devoted to state colleges, hospitals, prisons, and other facilities, the majority of these lands are administered as recrea-

tional and wildlife management areas through the Department of Environmental Protection. Because of the extent of state land holdings and the importance of managing these lands properly, the Commission has adopted a policy to ensure that management practices on state lands are consistent with the Pinelands resource protection programs. The specifics of these programs are *discussed in their appropriate sections of Chapter Seven. Briefly, any development that takes place on state lands must comply with the Commission's standards, contained in Part II of this plan.

The Commission will also take steps to ensure that state agencies conduct their ongoing activities in ways that will not adversely impact the Pinelands resources. For example, attention must be paid to ensuring that all state facilities provide for adequate treatment of wastes and that any uses made of those lands, such as recreational uses, are compatible with the maintenance of the Pinelands character. Through its acquisition program, the Commission will have the opportunity to determine additional areas for public purchase and to advise on the most appropriate ways to manage those areas. State historic preservation authorities and other agencies will also be consulted to determine the feasibility of renovating or otherwise using historic structures to maximize their value and prevent their vandalism and deterioration. Another opportunity for using state-owned lands to promote the objectives of the Pinelands plan is to lease the lands for agriculture. State land managers should evaluate their practices, including the stocking of fish and wildlife, habitat manipulation, and timber harvesting, to ensure that these practices are consistent with the plan's overall policies.

Agriculture

The New Jersey Department of Agriculture has a wide range of regulatory and research responsibilities in fields such as agricultural marketing, plant industry, dairy industries and rural resources. The Secretary of Agriculture chairs the Rural Advisory Council, which makes studies and recommendations concerning social and economic conditions including land use in rural areas. This group has concentrated on farmland preservation over the past ten years. The Secretary also chairs the State Soil Conservation Committee, which coordinates the activities of the County Soil Conservation Districts and the U.S. Soil Conservation Service and administers the New Jersey Soil Erosion and Sediment Control Act. The department also participates in other state groups such as the Pesticide Control Council, Apple Industry Council, Asparagus Industry Council, Poultry Products Council, White Potato Industry Council, and Equine Advisory Board. The department coordinates its research efforts with Cook College, the New Jersey Agricultural Experiment Station, and the county agricultural agents who are associated with the Experiment Station.

Given the prominent position of agriculture as a Pinelands industry, it is expected that the department will remain active regarding Pinelands management issues. The Secretary of Agriculture chaired the Commission's Agricultural Advisory Committee, which recommended alternative strategies to best address the needs of the Pinelands agricultural interests. This or a similar group will continue to comment on the Comprehensive Management Plan in terms of its impact on Pinelands agriculture.

Community Affairs

The Department of Community Affairs has exerted substantial influence on Pinelands management issues in the past. This involvement is expected to continue during the implementation period. The department, particularly through its Divisions of Planning, Housing and Urban Renewal, and Local Government Services, administers several programs which can impact the Pinelands area. Because of the department's interest and positive influence, the coordination of efforts should prove beneficial to the Pinelands management program.

The Division of Planning has prepared a State Development Guide Plan whose major policies include maintaining environmental quality, preserving of open space necessary for an expanding population, providing land and services for economic expansion, and enhancing the quality of life

in urban areas. These policies, and the manner in which they are currently represented on the map which accompanies the guide, are consistent with the Pinelands plan. The guide is intended for use by state agencies in making investment decisions, which should also help carry out policies of the Pinelands plan if the current delineations remain. Other functions of the division which have some bearing on the Commission's activities include: providing financial and technical assistance to local governments for their planning activities; certifying land use elements and ordinances as being in compliance with the Municipal Land Use Act, and reviewing certain development proposals under that act; analyzing housing issues and preparing statements related to fair share and other housing programs; and serving as the A-95 clearinghouse for federal Office of Management and Budget project review.

The Division of Housing and Urban Renewal is responsible for administration of the Uniform Construction Code, and the educational and certification programs that are essential to its effectiveness. The division is also involved in programs to expand housing opportunities, neighborhood preservation, and the licensing of certain types of dwellings. The division is represented on the Cabinet Committee on Atlantic City. Other state agencies affiliated with the Department of Community Affairs which influence the housing market are the Housing Finance Agency, which provides financing for private housing, and the Mortgage Finance Agency. A coordinated approach by these agencies toward Pinelands housing issues may produce real benefits.

Among the Division of Local Government Services' functions are the responsibility for gathering information on municipal finances and approving municipal budgets for each fiscal year. The division is an important source of information which will be especially useful in monitoring the plan's impact.

Energy

The New Jersey Department of Energy is responsible for preparing and updating a state energy master plan which will consider the production, distribution, consumption, and conservation of energy in the state. State agencies are to give proper consideration in their administrative actions to the siting policies enunciated in the master plan. The Department of Energy is also authorized to participate with other state departments on any regulatory decisions affecting energy facilities. Furthermore, the Board of Public Utilities, which is in but not of the Department of Energy, is empowered to supersede local zoning decisions when a denial by a local board will affect state-permitted plans to provide services or conveniences for the welfare of the public.

A specific statement of Department of Energy siting policy with regard to the Pinelands is contained in the DEP's Coastal Management Program. These policies were jointly drafted pursuant to a 1978 memorandum of understanding, and are contained in the Coastal Management Program (August, 1980) and the New Jersey Energy Master Plan. Pipeline corridors for landing oil are prohibited in the 760-square-mile "critical area" and are discouraged in other undeveloped parts of the Pinelands. Natural gas pipelines are discouraged in the critical area unless the developer can show that the activity will meet the non-degradation water quality standards and cause no long-term adverse environmental impacts. While the document is silent about facilities other than pipelines, the Energy Use Policies require findings that: 1) the existing sources of supply will not be adequate to meet future levels of demand, including careful consideration of the potential effects of conservation; 2) no better technological alternative exists to meet future levels of demand; and 3) no better locational alternative to the proposed site exists.

The Department of Energy has provided the Commission with the opportunity to comment on proposed energy facilities in the Pinelands. Action should be taken to coordinate Commission and Department of Energy policy with respect to future energy facility siting decisions. Another role for the department is suggested in Chapter Seven. This entails providing general technical assistance to Pinelands communities and developers in promoting energy conservation, and identifying applicable, economically viable energy technologies.

Environmental Protection

The Pinelands Commission's attachment to the Department of Environmental Protection (DEP) for state budgetary and administrative purposes is a logical association, given the nature of the programs administered through the department. The DEP, more than any other single state agency, has contributed to the development of this management plan and will be instrumental in carrying out many of the program recommendations discussed in Chapter Seven. The department's key programs of relevance to the Pinelands are discussed below, along with an indication of the coordination which is envisioned between specific offices of the DEP and the Pinelands management program.

The Division of Water Resources is responsible for the planning and management of programs dealing with water quality and quantity. These include monitoring, surveillance and enforcement, floodplain management, and planning for public wastewater facilities. A program of special relevance to the Commission's planning function is the Central Pine Barrens critical area program, under which the division must approve all septic systems proposed for a 760-square-mile area somewhat coincident with the Preservation Area. The division is also responsible for supervising the development of a Water Supply Master Plan. This plan is to assess the state's short- and long-term water needs, evaluate alternative answers to those needs, and provide a framework for future planning and management of New Jersey's water supplies. The Commission has received a great deal of technical assistance from the division during the planning period, and expects this level of cooperation to continue during the plan's implementation.

The Division of Environmental Quality is responsible for air quality planning and monitoring and is the designated agency for administration of the federal Clean Air Act in New Jersey. The division currently reviews development applications under the Coastal Area Facility Review Act to determine consistency with state and federal air quality regulations. It has agreed to perform a similar function to implement the Comprehensive Management Plan. The division is also responsible for radiation, noise, pesticide control, and solid waste management programs.

A principal function of the Division of Parks, Forestry and Green Acres is the management of recreational lands. Additionally, it administers the state's forest fire management, forestry, land acquisition, and recreation planning programs. Programs of particular applicability to Pinelands management include the New Jersey Heritage Program, the Wild and Scenic Rivers Program, and the State Comprehensive Outdoor Recreation Plan (SCORP). The Commission has developed a close working relationship with individuals associated with the above programs, and with those involved in the management of forest resources. Both the Bureaus of Forest Management and Forest Fire Management will play active roles in implementing the Pinelands plan, including application review and program development.

The Division of Fish, Game and Wildlife carries out the state's fish and wildlife management programs. The division conducts research and education, enforces state fish and game laws, and maintains fish and wildlife management areas. It also administers the federal Endangered Species Act of 1973 which provides for the management of threatened, endangered, and non-game species and their habitats, the regulation of trade involving non-game and exotic animals, and educational programs. Under the Pinelands management program, the division will provide assistance to the Commission and municipalities in assessing the impact of various proposed activities on the region's fish and wildlife resources. The division and the Commission will also cooperate in the identification of appropriate management strategies for Pinelands protection.

The Division of Coastal Resources is the lead agency for the state Coastal Management Program. In addition to developing a plan for the state's coastal area, the division administers the Coastal Area Facility Review Act and the wetlands and waterfront development permit programs, and manages state-owned tidelands. The Commission's strategies for coordinating its activities with the Coastal Management Program are described in a later section.

In addition to these divisions, two offices within the Office of the Commissioner of Environmental Protection have provided and will continue to provide valuable assistance to the

Commission. The Pinelands Acquisition Office acts as the purchasing agent for the Commission's land acquisition program. Among its other duties, the Office of Cultural and Environmental Services maintains the State Register of Historic Places, suggests nominations for the National Register of Historic Places and provides technical advice and assistance to the Commission regarding appropriate strategies to protect the Pinelands' cultural resources.

Labor and Industry

The three program areas administered by the Department of Labor and Industry which are of greatest relevance to the Pinelands management program include planning and research, travel and tourism, and economic development. The Bureau of Planning and Research compiles and analyzes data on economic, demographic, and labor market statistics, produces population and employment projections, and tracks construction activities by preparing summaries of building permits issued and other data pertinent to planning programs. Coordination with the division will be an important element in the Commission's monitoring programs, and will be particularly useful in identifying trends which may necessitate reassessment of the management plan.

The Division of Travel and Tourism's major objectives are to promote and expand tourism in New Jersey in a manner consistent with the protection of the state's natural, cultural, and physical qualities. The division, in its ten-year master plan, gives full recognition to the value of the Pinelands as a recreational resource and to the region's contribution to the state's tourist industry. The Commission will work with the division to promote public awareness of the Pinelands' recreational opportunities, and will ensure that information provided through the division stresses uses compatible with protection of the region's resources.

Several offices within the department administer programs geared to promoting industry and other forms of business investment in the state, expanding job opportunities, and enlarging the tax bases of state and local governments. These offices include the Economic Development Authority (EDA), Division of Economic Development and Office of Business Advocacy (OBA). While the EDA arranges beneficial financial terms for investors and other such incentives, the Office of Business Advocacy assists developers in obtaining their necessary permits. The Commission will cooperate with the OBA in clarifying the standards and procedures for development review. At the same time the Commission and department should coordinate their plans regarding appropriate locations for future business developments.

Transportation

The New Jersey Department of Transportation is charged with planning and developing programs for efficient and economical public transportation and highway services in the state. Activities include maintenance and operation of the state highway system, roads on state properties, commuter railroad service, motor bus service and promotion of aviation improvements. The department also administers federal funds made available through the Federal Highway Assistance Program for construction, improvement, and beautification of primary, secondary, and urban highway systems.

Recognizing the significant influence that transportation facilities exert on land use patterns, the Commission is concerned that the department's priorities with regard to transportation improvement projects be consistent with Pinelands growth policies. In particular the Commission recommends that the department give priority to projects which facilitate access within and to the Atlantic City region. The Commission also urges the department to explore the feasibility of expanding mass transit in the Atlantic City area and along important corridors connecting it with other urbanized areas. Conversely, transportation projects which would generate growth within areas of the Pinelands slated for low densities should be discouraged.

Treasury

The New Jersey Department of the Treasury is responsible for a wide variety of financial operations, including developing and administering the state budget, administering state tax policies, assisting local boards of taxation in carrying out their statutory duties, and providing

advice regarding uniform appraisal of properties. Much of the information compiled by various divisions of the department is vital to the Commission's monitoring programs. In addition, the Comprehensive Management Plan identifies areas where amendments to certain tax laws would be advisable. The Commission will seek the advice of the department on these matters, and may request that it undertake studies related to taxation or appraisal programs. Additionally, the Commission may consult with the department to devise strategies for obtaining revenues for future administration of the the management programs.

Casino Control Commission

Established by the Casino Control Act of 1977, this commission licenses and monitors casinos and their employees, levies penalties pertaining to violations of the act, and conducts hearings on other matters relating to its operations. While the commission's mandate does not include comprehensive planning, its decisions exert a significant influence on the growth of the Atlantic City region, and thus have a direct bearing on the Pinelands management program.

The advent of casino gambling has generated unprecedented growth pressures in the Atlantic City region. In the absence of a coordinated approach to land use management, the impacts associated with this growth will cause a drastic alteration in the character of the area, particularly within the Pinelands. The rate at which new casinos are licensed, the conditions placed on those licenses in terms of the operators' alleviation of casino-related impacts, and the use of the 2 percent casino earnings reinvestment monies are important issues which must be evaluated in a regional perspective. The Pinelands Commission will promote a cooperative approach to addressing these issues, such as by thoroughly coordinating its policies with the Casino Control Commission and the Division of Coastal Resources. The Commission recommends that consideration be given to channeling some of the 2 percent reinvestment funds to the expansion of housing opportunities in the region or to the improvement of existing services.

Summary

The Commission recognizes the essential roles many state and regional agencies will have in implementing the Comprehensive Management Plan. In this section, these many roles are summarized in table form (Table 8.1).

Table 8.1—Recommended Involvement of New Jersey State and Regional Agencies in Implementation of the Comprehensive Management Plan

Program Area	Agency	Recommended Role or Action
Water Quality	Designated and Undesignated 208 Areawide Wastewater Management Agencies	Prepare and update Areawide Wastewater Management Plans consistent with the Pinelands Comprehensive Management Plan
	Department of Environmental Protection (DEP)	Adopt groundwater quality standards for Cohansey and Kirkwood outcrop areas lying outside the Pinelands National Reserve
	DEP	Adopt Commission's recommended water quality standards for surface and groundwater in the Pinelands
	DEP	Upgrade treatment requirements for centralized wastewater treatment facilities. Study feasibility of converting from direct discharge of treated wastewaters to land application
	DEP	Study feasibility of adding septage treatment facilities to selected wastewater treatment plants
	DEP	Require stringent protection of ground and surface waters in granting NJPDES permits

Table 8.1—Recommended Involvement of New Jersey State and Regional Agencies in Implementation of the Comprehensive Management Plan, *Continued*

Program Area	Agency	Recommended Role or Action
Water Quality (cont.)	DEP, Division of Water Resources	Utilize Commission's nitrate-nitrogen dilution model
		Investigate the feasibility of small community alternatives to conventional treatment plants in accordance with Section 205 (h) of the Clean Water Act of 1977
	DEP, Department of Health, (U.S. Geological Survey)	Monitor ground and surface water near landfills as early warning for nearby water supply wells
	DEP	Establish hotline for reporting spills or illegal dumping of toxic, hazardous materials
	DEP, Office of Pesticides	Require that commercial applicators of pesticides install control facilities to contain spills, leaks, and washwater
	New Jersey State Soil Conservation Committee	Adopt policy encouraging construction of erosion control devices at source and discouraging use of large structural measures
Water Quantity	Soil Conservation Districts	Review stormwater runoff management plans for new development
	State Soil Conservation Committee DEP (U.S. Soil Conservation Service)	Prepare handbook of recommended management practices for stormwater control and management in the Pinelands that emphasize retention techniques
	DEP	Complete delineation of flood hazard areas in the National Reserve
	DEP	Cooperate with Commission to implement provisions of the New Jersey Flood Hazard Area Control Act
	DEP	Discourage exportation of water from Cohansy or Kirkwood Formations
	DEP	Undertake a detailed study to determine current groundwater withdrawals from Pinelands aquifers in order to establish environmentally safe yields
	DEP (U.S. Geological Survey)	With the Commission, form a committee to coordinate all water quality and quantity monitoring activities in the Pinelands
Agriculture	Department of Agriculture Department of the Treasury	Investigate feasibility of changing the state income tax law to allow farmers in the agricultural production areas to deduct losses incurred through crop failure or vandalism
	Department of Agriculture	Institute an aggressive program to promote the sale of New Jersey agricultural produce

Table 8.1—Recommended Involvement of New Jersey State and Regional Agencies in Implementation of the Comprehensive Management Plan, *Continued*

Program Area	Agency	Recommended Role or Action
Agriculture (cont.)	DEP	Lease state-owned agriculturally productive land to farmers for a minimum of ten years
	DEP, Division of Environmental Quality, Bureau of Air Pollution Control	Issue open burning permits to facilitate land clearing for agricultural purposes in agricultural production districts and for forest management
	Pinelands Agricultural Task Force	Establish a Pinelands Agricultural Review Board to review complaints and conduct hearings on non-compliance with best management practices
	Department of Transportation	Require that airstrips used by aerial applicators of pesticides be required to have adequate buffer zones around the operation
Vegetation and Wildlife	DEP, Divisions of Fish, Game, and Wildlife, and Parks and Forestry	Evaluate management practices used on state lands, including the stocking of fish and wildlife, habitat manipulation, and timber harvesting to ensure that these practices are consistent with the overall policies of the plan
	DEP, Division of Water Resources	Conduct intensive aquatic surveys in the Pinelands which define relationships between land use, water quality and the composition of aquatic communities
Fire Management	Department of Insurance	Provide advice to insurers on fire hazards and appropriate mitigation techniques
	State Civil Defense Authorities	Develop or update wildfire evacuation plans for Pinelands municipalities
	DEP Bureau of Forest Fire Management	Develop long-range plans to implement a fire management program which will ensure the maintenance of the existing Pinelands landscape
Forestry	DEP, Bureau of Forest Management (U.S. Forest Service)	Review timber harvesting plans for sound management practices
	DEP	Identify strategies to encourage proper forest management
	DEP	Update forest resource inventory. Develop manual on recommended management practices for Pinelands forests, including guidelines for standards applicable to various resource situations
	DEP	Emphasize the use of biological controls in the gypsy moth control program
Air Quality	DEP, Bureau of Air Pollution Control	Expand air quality monitoring program in the Pinelands, especially in the Regional Growth Areas
	DEP	Consider Class I air quality designation for the Preservation Area

Table 8.1—Recommended Involvement of New Jersey State and Regional Agencies in Implementation of the Comprehensive Management Plan, Continued

Program Area	Agency	Recommended Role or Action
Natural Scenic Resources	Department of Transportation	Cooperate with Commission to designate areas where markers will be placed identifying specific scenic qualities
	Department of Labor and Industry, Division of Travel and Tourism	Cooperate with Commission in location, construction, and maintenance of tourist information centers along Pinelands highways as a substitute for directional billboards and signs
Historic and Cultural Resources	State Land Managing Agencies	Ensure that historic structures on state lands are renovated for occupancy and occupied to prevent vandalism and deterioration
	Historic Preservation Office	Periodically update list of properties on State and National Registers of Historic Places for changes in property condition
	Historic Preservation Authorities	Cooperate with Commission in disseminating information to local governments regarding conduct of cultural resources inventories, preservation techniques, and sources of funding for historic preservation projects
Recreation	DEP	Cooperate with the Commission in the designation of specific areas within the Pinelands suitable for use by off-road vehicles
	DEP, Green Acres Office	With the Commission, evaluate effectiveness of proposed rules and regulations concerning use and development within designated river segments
	DEP, Green Acres Office	Study Commission river list for inclusion into the state wild and scenic rivers system. Evaluate other rivers specified by the Commission to determine which are qualified candidates for more detailed study
	New Jersey Trails Council	Include Batona Trail in the statewide trail master plan
	DEP, Green Acres Office, Division of Parks and Forestry	Study Batona Trail alignment, potential extension, and support facility needs
Resource Extraction	DEP Department of Agriculture	Develop extraction site restoration programs to return restored sites to beneficial uses
Acquisition	DEP, Pinelands Acquisition Office, Office of Green Acres, Division of Fish, Game and Wildlife, Division of Parks and Forestry	Cooperate with the Commission in the selection of acquisition areas in the Pinelands
Energy	Department of Energy	Provide general technical assistance to Pinelands communities and developers in promoting energy conservation and in identifying applicable, economically viable energy technologies

Table 8.1—Recommended Involvement of New Jersey State and Regional Agencies in Implementation of the Comprehensive Management Plan, *Continued*

Program Area	Agency	Recommended Role or Action
Capital Improvements	DEP	Assure that wastewater facility planning is directed toward servicing the needs of Regional Growth Areas and Pinelands Towns and Villages
Housing	Casino Control Commission	Consider phasing in new casino development in a manner that is responsive to the adequate provision of infrastructure, housing, and community services
Solid Waste Management	DEP, Hazard Management Program, Solid Waste Administration	Implement institutional arrangements of the Governor's Hazardous Waste Task Force for hazardous waste disposal
	DEP	Promote bond issues to finance resource recovery facilities
Data Management	DEP	Cooperate with Commission to develop a computerized geological data base for land use planning and regulation in the Pinelands

Coordination with the Coastal Management Program

In responding to the federal legislation establishing the Pinelands National Reserve, the State of New Jersey, first through Governor Byrne's Executive Order 71, and then through the Pinelands Protection Act, charged the Pinelands Commission with preparing and implementing a Comprehensive Management Plan for the 1.1-million acre region. However, the Pinelands Area as delineated in the state act is approximately 150,000 acres smaller than the Reserve. It contains all or portions of 52 municipalities compared to the Reserve's 55. Because the Commission's direct administrative authority is limited to the Pinelands Area, an alternative approach to implementing this plan is necessary for those portions of the Reserve lying outside the Area. The lands in question fall within the state's coastal zone, and as such are within the purview of the New Jersey Coastal Management Program. The following discussion sets out the framework for realizing the objectives of the state and federal Pinelands laws through coordination with the Coastal Management Program.

Section 22 of the Pinelands Protection Act provides a mechanism for attaining consistency of plans and programs in that portion of the coastal area within the Reserve. This section directs the Department of Environmental Protection, "in addition to the functions required pursuant to the Coastal Area Facility Review Act," to "review the environmental design for the coastal area as it affects the planning and management of the development and use of any land in the coastal area which is also within the boundaries of the Pinelands National Reserve, make any necessary revisions to such environmental design as may be necessary to effectuate the purposes of the (state and federal Pinelands acts), and prepare and transmit to the Commission a report detailing the provisions of the environmental design as so revised and as applicable to such land." This process is to take place in consultation with the Commission and within 18 months of the effective date of the Pinelands Act, therefore by December 28, 1980.

The environmental design referred to above was originally prepared as required by the Coastal Area Facility Review Act of 1973 (N.J.S.A. 13:19-10). The design is now incorporated into the New Jersey Coastal Management Program in which the state elected to participate pursuant to the federal Coastal Zone Management Act of 1972 (amended in 1976). The intent of this program is to protect the state's coastal resources while accommodating needed development. Responsi-

bility for the program was assigned by the Governor to the Department of Environmental Protection (DEP). The lead agency for the program within that department is the Division of Coastal Resources (DCR), which also administers the CAFRA, wetlands, and waterfront development permit programs.

The coastal zone as defined by the DEP extends from the New York border south to Cape May, west to the Delaware Bay area, and then north to Trenton. The planning and management area pertinent to the Pinelands is the Bay and Ocean Shore Segment, which is the 1,376-square-mile land and water area under the jurisdiction of CAFRA. In 1978 the management program for this area was approved by the federal Office of Coastal Zone Management. It has been updated and incorporated into the program for the entire coastal area ("New Jersey Coastal Management Program," August, 1980). This document was approved by Governor Byrne and has been submitted for federal approval.

Coastal Management Policies

The Coastal Management Program enunciates eight basic policies which give recommended objectives for all public and private land and water use decisions in the coastal zone. These policies are:

1. Protect and enhance the coastal ecosystem;
2. Concentrate rather than disperse the pattern of coastal residential, commercial, industrial and resort development and encourage the preservation of open space;
3. Employ a method for decision-making which allows each coastal location to be evaluated in terms of both the advantages and disadvantages it offers for development;
4. Protect the health, safety and welfare of people who reside, work and visit in the coastal zone;
5. Promote public access to the waterfront through linear walkways and at least one waterfront park in each waterfront municipality;
6. Maintain active port and industrial facilities, and provide for necessary expansion in adjacent sites;
7. Maintain and upgrade existing energy facilities, and site additional energy facilities determined to be needed by the New Jersey Department of Energy in a manner consistent with the policies of the Coastal Management Program; and
8. Encourage residential, commercial, and recreational mixed-use redevelopment of the developed waterfront.

The eight policies summarize the direction of the more detailed Coastal Resource and Development Policies. These are the substantive and legally binding policies which guide public decisions about significant proposed development and resource management in the coastal zone. Originally employed in the Bay and Ocean Shore Segment, the policies were revised as of September 26, 1980 for application to the total zone. They are now the criteria for permit decisions under CAFRA, the Wetlands Act, and the Waterfront Development Act. The policies will also guide DEP recommendations to the Tidelands Resource Council and management actions anywhere in the coastal zone.

Application of the Coastal Resource and Development Policies consists of measuring a proposed action against component sets of location, use, and resource policies. All policies are stated in terms of actions that are encouraged, required, acceptable, conditionally acceptable, discouraged, or prohibited. The decision on any proposed use rests on a consideration of all relevant policies in the three areas, and a weighing of the various interests in light of the goals of the Coastal Management Program. The Coastal Resource and Development Policies are intentionally very specific to minimize arbitrary decision-making. Where administrative discretion is necessary, however, decision-makers are guided by the eight basic policies listed above.

Among the coastal policies which are of particular relevance to the Pinelands management program are the special areas policies, a subset of the location policies. These are areas which are "so naturally valuable, or so important for human use, or so hazardous or so sensitive to impact,

or so particular in their planning requirements, as to merit focused attention." Types of resources or areas in this category include estuarine or marine sanctuaries, floodplains, wetlands, farmland conservation areas, and historic and archeological resources.

The Coastal Management Program identifies the Pinelands as a special area. Part of the rationale for this designation is the impact which upstream water quality has on the living marine resources in the bays and estuaries of the coastal zone. Thus any protective actions which are taken within the context of the Coastal Management Program would serve that program's objectives as well as the purposes of the Pinelands Plan. The adopted special areas policy regarding the Pinelands (N.J.A.C. 7:7E-3.39) specifically states that coastal development "shall be consistent with the intent, policies, and objectives" of both the federal and state Pinelands legislation. It can be argued that this policy makes the Coastal Management Program and the Comprehensive Management Plan consistent. But to more fully analyze the level of consistency and potential conflicts between the two, the Commission and the DEP Program undertook a detailed comparison.

Consistency Between Coastal Program and Comprehensive Management Plan

Physically, two types of overlap occur between the coastal zone and the Pinelands region as defined by the federal and state acts. The first is the overlap between the Pinelands National Reserve and the coastal zone, which involves portions of 29 municipalities in Atlantic, Burlington, Cape May, Cumberland, and Ocean Counties (see Figure 8.1). The second type of overlap, between the state's Pinelands Area and the coastal zone, occurs only in a portion of the Mullica River watershed which is within both the Preservation Area and the coastal zone. Development projects in this area required both Pinelands and coastal permits during the interim Pinelands review period. Interestingly, the Division of Coastal Resources has never received a "major facility" application under CAFRA here. The coastal program identifies this area as one where future growth would be limited, which is consistent with the Preservation Area goals.

The consistency assessment carried out by the two agencies involved a comparison of the Pinelands land capability map and standards contained in Part II, Article 6 of this plan, with the Coastal Management Program's growth region delineations and relevant Coastal Resource and Development Policies. While the Pinelands land allocation program designates eight types of areas, the coastal program uses three broad regional growth strategies and applies these to 13 distinctive areas within the coastal zone. These regional growth strategies are set forth in N.J.A.C. 7:7E-5.3 and include:

- *Development Region:* Areas which are largely developed, where development is generally preferred over any other type of region, and where infill would be consistent with the policy of concentrating development.
- *Extension Region:* Areas where development should be channelled after full development of the Development Region. Infill and some extension of development is generally acceptable here.
- *Limited Growth Region:* Regions which contain large environmentally sensitive areas, where only infill development is acceptable.

In making decisions on proposed developments, the coastal program uses the regional growth strategies for different land areas as a base, then applies factors relating to the site's environmental sensitivity and development potential. The resulting densities which will be allowed in any given area are thus the product of a determination of general growth policy and the application of specific standards.

The August, 1980 Coastal Management Program states that the Coastal Resource and Development Policies contained in that document are "basically consistent with federal and state Pinelands objectives and with the draft Pinelands Comprehensive Management Plan." The Pinelands Commission agreed, and continued to work with the Division of Coastal Resources during the fall of 1980 to attain an even greater level of consistency. In addition to evaluating the

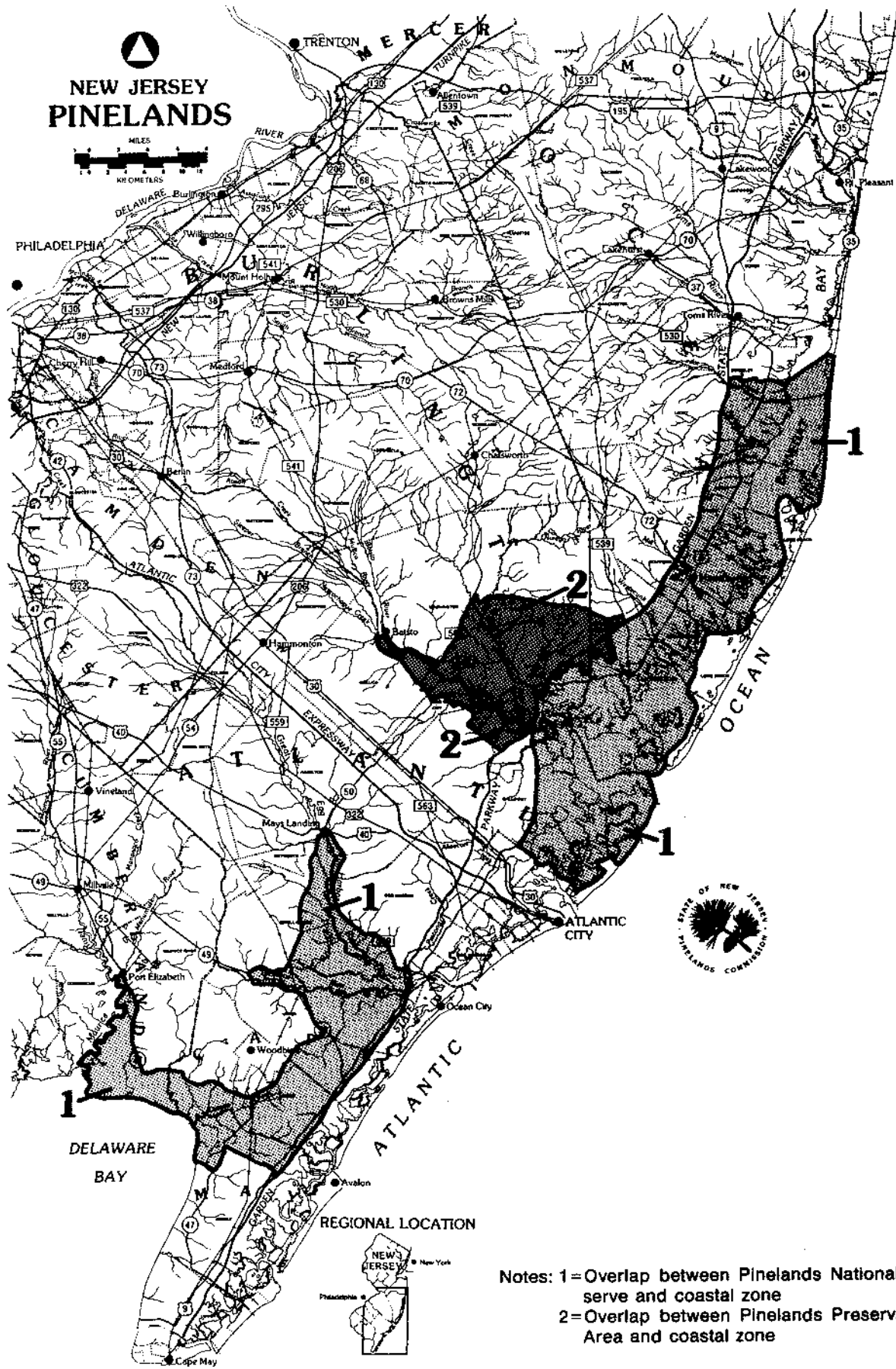


Figure 8.1—Overlaps Between Pinelands Region and Coastal Zone

growth designations of each program, the two groups compared specific standards which are applied in each agency's decision-making process. Policies relating to special areas such as habitats for threatened and endangered plants and animals, wetlands, and historic sites and uses such as resource extraction operations are similar and at times identical.

Once a determination of consistency was made, the next step was to assess the Department of Environmental Protection's ability to administer the programs contained in the Comprehensive Management Plan. This assessment was accomplished through a series of meetings and memoranda between the two agencies, and focused on the Division of Coastal Resources' authority to enforce the Commission's standards through the CAFRA permit process.

The Coastal Area Facility Review Act authorizes the DEP to regulate and approve the location, design, and construction of major facilities within a 1,376-square-mile coastal region encompassing portions of Middlesex, Monmouth, Ocean, Burlington, Atlantic, Cape May, Cumberland and Salem Counties. Except for the Mullica watershed overlap mentioned above, CAFRA and the state Pinelands Area generally share a boundary. Individuals whose properties lie within the Pinelands National Reserve portion of the coastal zone have been and will continue to be under the jurisdiction of CAFRA. Vesting a portion of the authority for implementing the Pinelands Plan in the CAFRA administering agency therefore uses existing channels and avoids duplication of the permitting process.

CAFRA requires that applicants obtain permits from the Division of Coastal Resources when they are proposing the following major facilities:

1. Electric power generation facilities, including oil, gas, coal-fired, or nuclear;
2. Public facilities, including housing developments of 25 or more dwelling units, roads, airports, parking facilities of 300 spaces or more, wastewater treatment systems and components, and sanitary landfills;
3. Facilities for producing food and food by-products, paper, and agri-chemicals;
4. Facilities for mineral products, chemical and metallurgical processes, and inorganic salt manufacture; and
5. Marine terminals and cargo handling and storage facilities.

All requests for permits must be accompanied by an environmental impact statement and an application which, among other items, includes a statement of the project's consistency with relevant state and local plans. Both the DEP and other state agencies review the application. A public hearing is held prior to a decision by the director of the Division of Coastal Resources, who has the decision-making authority. The applicant and any interested party may then appeal the decision to various bodies on the grounds that it is inconsistent with the Coastal Resource and Development Policies.

Program Comparisons

The following is a program-by-program discussion of the Division of Coastal Resources' ability to implement the Pinelands management programs within the division's current jurisdiction. The New Jersey Administrative Code citations refer to the appropriate Coastal Resource and Development Policies.

- **Wetlands:** The DCR's definition of wetlands is similar to the Commission's, as is its approach to protecting these special areas. Although the Pinelands 300-foot buffer policy is more specific than the DCR policy, the Pinelands program treats this distance as an impact area. Therefore there is no inconsistency in practice, and the coastal policy would adequately cover the concerns of the Commission in protecting wetland areas (N.J.A.C. 7:7E-3.23).
- **Vegetation:** The coastal policy is to preserve existing vegetation within the development site to the maximum extent possible. While the DCR would not receive an application for every occasion when more than 1,500 square feet would be cleared, the Commission's

policy to minimize clearing will be implemented within the limits of DCR's jurisdiction. Additionally, the coastal policy is to prohibit development that would adversely impact the habitat of threatened and endangered plants (N.J.A.C. 7:7E-8.9 and N.J.A.C. 7:7E-3.33).

- **Wildlife:** The two agencies' definitions of wildlife habitat and the policies pertaining to their protection correspond (N.J.A.C. 7:7E-8.10).
- **Forestry:** The permitting process for commercial harvesting could not be implemented under coastal policies. However, forestry is no longer considered a coastal industry and the Commission's restrictions are generally not applicable.
- **Agriculture:** The coastal policies do not pertain to agricultural practices, except where uses such as food processing are involved. As the Pinelands plan regulates agricultural activities only when water quality has been identified as substandard, there is no substantial conflict between the two programs.
- **Resource extraction:** Both agencies regulate mining operations, although the Commission is more specific from the standpoint of resource protection. The objectives of the two programs are similar, and the DCR's policies should effectively address the Commission's intent (N.J.A.C. 7:7E-7.8).
- **Waste management:** The coastal program requires conservation techniques to be explored before a new or expanded landfill is affirmed. The coastal policy discourages landfills in special areas, which would presumably include the Pinelands. However, the DCR primarily defers to the Solid Waste Administration (now part of the DEP's Division of Environmental Quality) on such matters, in whose decisions the Commission could take part (N.J.A.C. 7:7E-7.6c).
- **Water quality:** The Comprehensive Management Plan recommends that the DEP's Division of Water Resources adopt the Central Pine Barrens water quality standards for the entire Pinelands National Reserve. This would impose a two parts per million nitrate-nitrogen standard in the coastal portion of the Reserve. The standard would therefore be incorporated into the DCR's permitting procedures. The Commission has also used 0.17 parts per million of nitrate-nitrogen as a regional planning guideline to determine overall housing densities in the Forest Area. The DCR could use the same guideline when reviewing development applications.
- **Air quality:** The DCR and the Commission presently use the same procedure for obtaining an analysis of a development's air quality impact. Applications involving 100 or more units or 250 or more parking spaces are transmitted to the Bureau of Air Pollution Control for review.
- **Scenic:** The Pinelands Plan is generally consistent with DCR's policy on visual impact. The fact that the Commission's 200-foot setback pertains only to certain areas, and that the setback is required only where feasible, makes it implementable through the coastal permitting process. As the Commission's sign requirements are to be interpreted at the local level, the DCR would not have to administer this portion of the program (N.J.A.C. 7:7E-8.14).
- **Fire management:** The DCR presently forwards applications to the Division of Parks and Forestry for review. That division's Bureau of Forest Fire Management could review the application in terms of potential fire hazard. The Bureau will be performing this function for the Commission. Regarding design requirements and fuel breaks, the coastal program does not explicitly contain such standards, but these could be incorporated by reference.
- **Landscaping:** Landscaping requirements have been incorporated into the Commission's vegetation program, and the DCR will have no difficulty implementing the standards.
- **Housing:** Coastal zone practices and Commission policy on ensuring adequate housing

opportunities for a range of income groups are similar, as they were both developed with the assistance of the New Jersey Department of the Public Advocate. Recent coastal permit decisions have addressed the issue of developers' responsibility to meet their "proportionate share" of the regional housing need. The Commission offers guidelines to municipalities and has the towns design their own housing elements.

- *Energy conservation:* The Commission treats this program as another element to be designed by the municipality. Therefore, it is not essential that the DCR administer it. However, the coastal policies might be amended in the future to require energy conservation plans for developments greater than 25 units, if the DCR finds such amendments necessary and reasonable.
- *Recreation:* The coastal policies encourage recreational facilities within large developments. For smaller developments, consideration is given both to whether a public park is nearby and to the impact on unit cost which the provision of on-site recreational facilities would have. Since this program is another instance where the Commission provides guidance to the local government, there is no conflict in the way the two programs would be carried out.
- *Historical, archaeological, and cultural preservation:* The coastal policy presently discourages development in Special Areas of Historic and Archaeological Resources if it "detracts from, encroaches upon, damages or destroys (their value)." These resources are defined similarly to those sites designated by the Commission. The guidelines for a cultural resource inventory are consistent with those presently used in the CAFRA review process (N.J.A.C. 7:7E—3.31).

Conclusions

As noted earlier, the DEP has adopted the general policy that all development occurring within the Pinelands portion of the coastal zone will be consistent with the policies and objectives of the state and federal Pinelands laws. It is conceivable, however, that standards under the Coastal Management Program may in some cases be stricter than those under the Pinelands Plan. In this event, the Program's standards would be used. This procedure is analagous to the Pinelands policy whereby local governments may adopt stricter standards than those contained in the Comprehensive Management Plan, but cannot use weaker standards.

Another instance where standards in the two programs might be interpreted differently is when each agency finds it necessary to exercise administrative discretion. Both programs recognize that circumstances will arise when strict application of a requirement is either inappropriate or would cause an undue burden on the applicant. The Commission provides for waivers of strict compliance for these occasions, and has designed several programs where the town's judgment on a case-by-case basis is implicit. The coastal program also contains opportunities for the reviewer to recommend waiving certain requirements when a literal interpretation would prove unreasonable. Since it is assumed that such instances will be the exception rather than the rule, the overall performances should be consistent.

The one potential difficulty in implementing the Pinelands Plan through the Coastal Management Program lies in the coastal program's higher threshold level for reviewing applications. CAFRA specifically excludes residential developments of less than 25 units from the DCR's permitting process. The exception is where proposed uses fall within the jurisdiction of the Wetlands Act (N.J.S.A. 13:9A-1) or the Waterfront Development Law (N.J.S.A. 12:5-3) which have significantly lower thresholds and also very restrictive permitting processes. Considering that the combined jurisdiction of the three programs will encompass a great deal of the proposed development in the coastal area, and that these applications will be reviewed in light of Pinelands management objectives, it is evident that the purposes of the Pinelands acts will be served.

While the Commission and the Division of Coastal Resources have determined that the Pinelands policies may be effectively administered through the coastal policies at this time, future changes in one or both programs may alter this level of consistency. Therefore, it is imperative

that the agencies maintain constant communication, and that they consult with each other before amending any portion of their respective programs. To establish a framework for this communication, and also to clarify the terms by which the Coastal Management Program will respond to Section 22 of the Pinelands Protection Act, the Commission and the DEP propose to enter into a Memorandum of Understanding. The memorandum is expected to address the following points of agreement:

1. The Pinelands Commission and the Department of Environmental Protection agree that the Pinelands Comprehensive Management Plan and the Coastal Management Program are generally consistent with respect to those portions of the Pinelands National Reserve which lie within the coastal zone.
2. The Department of Environmental Protection, Division of Coastal Resources, agrees to implement the Pinelands programs within the coastal zone to the extent of its administrative capabilities.
3. In the event that the coastal policy is more stringent than the Pinelands standard, the more stringent policy shall prevail.
4. The Division of Coastal Resources may utilize administrative discretion in reviewing applications as long as the resulting decision is consistent with the intent of the state and federal Pinelands acts.
5. The Division of Coastal Resources will consider the Pinelands Commission as a reviewing agency for any CAFRA or wetlands permit applications affecting the Pinelands National Reserve. Specifically, the DCR will provide the Commission the opportunity to comment on all applications which are located outside of the Pinelands' designated Regional Growth Areas, and Towns i.e., applications in the Rural Development and Forest Areas and in Pinelands Villages.
6. The Commission and the DEP acknowledge that the Commission cannot overturn a denial of a coastal permit application. However, the Commission should be allowed to suggest conditions on the approvals of applications when it takes part in the review process and where the conditions are considered necessary in order to effectuate the purposes of the state and federal Pinelands acts.
7. The Commission and the DEP acknowledge that approval of the New Jersey Coastal Management Program by the federal Office of Coastal Zone Management requires other federal agencies' programs to be consistent with the coastal program. Therefore the Pinelands Commission will suggest that the Department of Interior consider entering into a similar Memorandum of Understanding with the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, to ensure that both agencies are apprised of and in agreement with the Pinelands-DEP memorandum.
8. The DEP agrees to consider adopting the entire set of Pinelands programs as an appendix to the Coastal Resource and Development Policies, and the Commission will consider adopting those relevant portions of the coastal policies by reference in the Pinelands Comprehensive Management Plan.
9. In the event that one or both agencies propose to amend their adopted standards, they will consult with each other, determine how the amendments will effect the administration of their respective programs, and reach an understanding on the changes before taking action. Amendments to either program will be duly reflected within a reasonable period of time.

The Pinelands Commission and the Division of Coastal Resources have worked closely in the past. This interaction is expected to continue as the Commission begins to implement the plan for the Pinelands National Reserve. Because of the common interests which will be served by coordinating efforts in the Pinelands, the Commission looks forward to a constructive relationship with the Division.

The Federal Role

Federal policies and programs have substantial impacts on the Pinelands. The federal government plays many roles in the region including land owner, regulator, employer, technical advisor, financier, policeman, and planner. The total annual dollar outlay of federal funds in the Pinelands Area excluding military expenditures is estimated to be upwards of \$500 million, based on 1978 data. This does not include indirect federal support through various loan, loan guarantee, and insurance programs. A general overview of the distribution of funds by county and funding agency is presented in Tables 8.2 and 8.3.

Key programs and responsibilities of selected federal and regional agencies with specific land use impacts are described below in order to provide a better understanding of the nature of federal activities in the Pinelands, and of potential areas of federal involvement in the future.

Agriculture

The U.S. Department of Agriculture exerts a major influence on land use activity in the Pinelands through the programs of the Soil Conservation Service (SCS), the Agricultural Stabilization and Conservation Service (ASCS), the Science and Education Administration (SEA), and the Farmers Home Administration (FmHA).

Table 8.2—Estimated Distribution of Federal Funds by County in the Pinelands Area, Fiscal Year 1978

County	Total Expenditures			Total Non-military Expenditures		
	County total	Pinelands portion (est.)	Balance (est.)	County total	Pinelands portion (est.)	Balance (est.)
Atlantic	\$ 358.6	\$ 185.9	\$ 172.7	\$ 341.6	\$ 178.7	\$ 162.8
Burlington	908.6	709.2	199.4	262.4	78.7	183.7
Camden	727.6	57.8	669.8	522.7	41.4	481.3
Cape May	133.4	20.9	112.4	130.0	20.4	109.6
Cumberland	182.2	6.6	175.6	156.5	5.6	150.9
Gloucester	181.2	28.4	152.7	168.1	26.4	141.7
Ocean	481.5	192.6	288.9	409.4	163.8	245.6
Total	\$2,973.0	\$1,201.5	\$1,771.6	\$1,990.6	\$515.1	\$1,475.5

Table 8.3—Estimated Distribution of Federal Funds by Agency in the Pinelands Area, Fiscal Year 1978

Department or Agency	(in millions)		
	Seven County Total	Pinelands Area (est.)	County Balance (est.)
Agriculture	\$ 68.4	\$ 15.7	\$ 52.6
Commerce	4.1	1.3	2.8
Defense	982.4	686.4	296.0
Energy	1.3	.2	1.1
HEW	1,318.4	323.0	995.4
HUD	25.3	2.8	22.5
Interior	.9	.2	.7
Transportation	120.5	75.4	45.1
EPA	20.1	2.5	17.6
Other	431.6	93.9	337.7
Total	\$2,973.0	\$1,201.5	\$1,771.6

Note: Detail may not add to total due to rounding

Source: U.S. Community Services Administration, *Geographical Distribution of Federal Funds in New Jersey, FY 1978*

The SCS is an important source of technical data and technical assistance for soil and water conservation activities. Through county Soil Conservation Districts and the South Jersey Resource Conservation and Development Council, SCS aids private landowners and operators, community groups, and public agencies in resource management and conservation. The Resource Conservation and Development Program, administered by SCS, provides financial assistance for the planning and development of land and water resource projects. Other SCS programs are directed to the control of non-point sources of pollution, flood control, and watershed improvements.

The ASCS administers a cost-sharing program with farmers for the implementation of conservation measures and improved land management practices. It is also responsible for the Rural Clean Water Program, whereby special funds have been authorized for the control of non-point sources of pollution from agricultural uses in designated project areas. The latter program is not operating in New Jersey at the present time but may be of potential benefit in the Pinelands.

The SEA is the research arm of the Department of Agriculture. Its activities are directed in part to improving agricultural productivity and alleviating adverse environmental impacts from agriculture.

The Farmers Home Administration has responsibility for a broad range of agricultural and rural development programs. Its major programs include: 1) loans for purchase and repair of single family homes and the construction of rural rental housing for persons of low and moderate income; 2) farm operating and ownership loans and various types of emergency loans; 3) loans and grants for water and waste disposal systems and other community facilities; and 4) loan guarantees for up to 90 percent of the total loan amount for new or expanding businesses in rural areas. In addition, FmHA administers a rural development planning program. The impact of these programs on the Pinelands has been substantial. During the two-year 1978-79 period, \$31.3 million in loans and grants were provided for water and waste disposal systems in ten Pinelands communities. In the seven-county area which includes the Pinelands, housing loans amounted to \$33.7 million and farm loans totalled \$4.1 million in 1978.

Commerce

The Department of Commerce, through the Economic Development Administration (EDA), provides loans, grants, and technical assistance for public works and business development focusing on economically distressed urban and rural communities. During 1978 it allocated \$865,000 to projects within the Pinelands.

The National Oceanic and Atmospheric Administration (NOAA) within the Department of Commerce is responsible for the administration of the Coastal Zone Management Act of 1972, which provided the impetus for state coastal management programs. As noted in the proceeding section, portions of the Pinelands Area fall within the jurisdiction of the New Jersey Coastal Management Program. While basically a state land regulatory program, federal funding is available to assist in the administration of the coastal zone program, the acquisition of estuarine sanctuaries, and planning for the impact of coastal energy facilities.

Defense

Major military installations in the Pinelands include Fort Dix, McGuire Air Force Base and the Lakehurst Naval Air Station (see Chapter Four). The impact of these facilities on the economy of the Pinelands is substantial. Total Department of Defense outlays within the seven Pinelands counties amounted to \$982 million in 1978, including military and civilian payrolls and prime construction, supply, and service contracts. Furthermore, the location and extent of these facilities within the Pinelands gives them a critical role with regard to the integrity of the area's natural resources and certain archaeological, historic, and cultural landmarks and resources.

The Air Force is currently considering major land acquisitions in the vicinity of the Warren Grove practice bombing range in the Pinelands. These acquisitions are being studied in accordance with policy guidelines established for Air Installation Compatible Use Zones (AICUZ). The AICUZ program seeks to resolve land use conflicts and hazardous situations in the

vicinity of air bases through various techniques, including land use regulations and acquisition of easements and fee simple interests.

The Army Corps of Engineers has broad regulatory responsibilities for the waters of the United States. Pursuant to the Rivers and Harbor Act of 1899, it exercises permit powers over the construction of dikes and dams, structures, and other work in or affecting navigable waters. The role and geographic jurisdiction of the Corps was further expanded by the Federal Water Pollution Control Act of 1972 and subsequent legislation to include granting permits for the discharge of dredged or fill material in coastal and inland navigable waters, tributaries and adjacent wetlands, and any other waters the degradation of which could affect interstate commerce. Policies for the evaluation of permit applications include a broad range of public interest and environmental criteria.

Federal Emergency Management Agency

The Federal Emergency Management Agency is responsible for the administration of the National Flood Insurance Program, under which flood insurance coverage is made available to property owners located in municipalities which have adopted approved flood plain management measures. All but two municipalities in the Pinelands are participating in the National Flood Insurance Program.

Housing and Urban Development

Although the grant programs of the Department of Housing and Urban Development (HUD) are directed principally to the needs of urban and urbanizing areas, Pinelands counties and municipalities have received over \$10 million in community development grant funds during the past several years. Burlington County and Camden County qualify as "urban" counties and are entitled to receive grant funds in accordance with the established block grant formula. Other counties and municipalities have competed successfully for grants under the Small Cities Program, which is available for cities with populations under 50,000 and for rural counties. Community development funds may be used for a variety of projects including housing, neighborhood and public improvements, and economic development. To qualify, a locality must have a Housing Assistance Plan (HAP) to meet the needs of low and moderate income persons and must satisfy other eligibility criteria. Financial assistance for local planning activities is provided under HUD's Section 701 Comprehensive Planning Assistance Program. For municipalities with less than 50,000 population, grants are passed through state planning agencies. Funding for this program, however, has been limited in recent years.

There has been only limited utilization of HUD housing subsidy programs in the Pinelands. But a number of projects are now either under construction or in planning. It is expected that the number of HUD-assisted units will increase by more than 700 within the next two years. Of these, approximately 600 units are intended for the elderly. HUD offers a number of different housing programs to meet a wide range of housing needs. The programs can be utilized to promote balanced housing development in the Pinelands growth areas in keeping with local conditions and regional planning objectives. Homeowner and rental assistance, new construction, rehabilitation and home improvement, and housing for special groups such as the elderly, the handicapped, or students, can be combined as part of an overall community housing program.

Interior

The Department of the Interior is responsible for the administration and management of public lands through the Bureau of Land Management, the National Park Service, and the Fish and Wildlife Service. The Brigantine National Wildlife Refuge is the only land area within the Pinelands National Reserve which is directly administered by the Department. The Bureau of Land Management also has authority over the leasing of mineral rights, including gas and oil, within the Outer Continental Shelf.

The Pinelands as a whole have been brought into a special and unique relationship with the Interior Department as a result of the National Parks and Recreation Act of 1978 which

established the Pinelands National Reserve. Pursuant to the federal law, the Secretary of the Interior appoints one member of the Pinelands Commission, and is responsible for the ultimate decision to approve or disapprove the Comprehensive Management Plan. The Heritage Conservation and Recreation Service serves as the day-to-day liaison between the Interior Department and the Pinelands Commission. It also administers grant-in-aid programs for historic preservation, resource conservation, and outdoor recreation, and maintains a list of natural and historic landmarks.

The Federal Wild and Scenic Rivers Act of 1968, also administered by the Interior Department, provides for the protection of rivers or portions of rivers that are designated as part of the National Wild and Scenic River System. The Mullica River and its tributaries have been designated by the Congress for study for possible inclusion in the system. Federal designation would impose limits on the actions of other federal agencies which might otherwise impact the rivers. HCRS has also identified a number of rivers and streams in the Pinelands which might be eligible for study in the future.

Transportation

The Federal Aviation Administration (FAA) owns and operates the Federal Aviation Administration Technical Center in Atlantic County, one of the major federal installations in the Pinelands. Expenditures connected with this facility amounted to approximately \$63 million in 1978. The FAA also provides assistance for airport planning and the construction of airport improvements. The U.S. Coast Guard, which also falls within the Department of Transportation, has responsibility for enforcement of federal laws on waters subject to federal jurisdiction. It also has authority over the location and clearance of bridges and causeways on navigable waters.

The Federal Highway Administration and the Urban Mass Transit Administration administer a number of loan and grant programs. Highway planning and construction grants in the seven Pinelands counties amounted to \$31.3 million in 1978.

Environmental Protection Agency

The Environmental Protection Agency (EPA) has prime responsibility for the administration of federal pollution control statutes, including programs for controlling air, water, and noise pollution, and the disposal of solid and toxic wastes. These programs, implemented in large measure at the state level by the New Jersey Department of Environmental Protection, play a crucial role in controlling adverse environmental impacts in the Pinelands.

In the area of air quality, the EPA has established national ambient air quality standards which are to be attained (or maintained) for the protection of public health. States are required to prepare implementation plans for the achievement of these standards within a specified time, and to adopt laws and procedures to ensure control over new sources of pollution and to prevent significant deterioration of air quality.

Pursuant to the Federal Water Pollution Control Act, the EPA has developed water quality standards and effluent limitations for discharges into the nation's surface and groundwaters. The EPA also has overall authority for the National Pollutant Discharge Elimination System (NPDES), which requires permits for the discharge of pollutants from point sources. Under its construction grants program, the EPA provides up to 85 percent of the eligible cost of sewer and wastewater treatment plant construction. Determination of awards under the Section 201 facility planning process of the Clean Water Act significantly influences the location and extent of new development. As part of this program, the EPA has specified certain land use restrictions and guidelines which apply to Pinelands areas receiving 201 funds. Financial assistance is also provided by the EPA to the state and local areas for the development of comprehensive water quality plans (Section 208). Water quality plans have been completed for all areas of the Pinelands. Effective coordination with the EPA requires that the population projections adopted as part of the Section 208 plans be reconciled with the Comprehensive Management Plan.

National drinking water standards have been established by the EPA. The standards

particularly protect from contamination those aquifers used as sources of drinking water. If the Cohansey aquifer in the Pinelands were to be designated as such a "sole source" aquifer, federal funding could be withheld from any project which would endanger it.

The EPA's efforts in the area of solid waste management and the control of hazardous wastes have lagged behind its efforts in air and water pollution control. Planning and construction grants have been available to assist the development of areawide waste disposal systems. Regulations for the implementation of the Resource Conservation and Recovery Act of 1976, which imposes mandatory standards, have recently been published. This statute and parallel toxic substance control efforts will provide new momentum for the management and control of solid waste, landfills, and hazardous materials.

Council for Environmental Quality

The Council for Environmental Quality within the Executive Office of the President is responsible for the administration of the National Environmental Policy Act of 1969. This legislation introduced the requirements that environmental impact statements be prepared in connection with the planning of federally sponsored or federally assisted activities and projects.

Delaware River Basin Commission

The Delaware River Basin Commission is a regional agency comprised of the Secretary of the Interior or his designee and representatives of the States of New Jersey, Pennsylvania, New York, and Delaware. Coordination between the Basin Commission and the Pinelands Commission is necessary to ensure that the management of water quality and quantity in the Delaware River Basin will not have an adverse impact on water in the Raritan-Magothy aquifer, which is recharged by the river.

Federal Conformance Issues

The foregoing review of federal government programs helps to identify some of the policy and procedural issues which need to be addressed to achieve federal conformance with the Comprehensive Management Plan. These include:

- Restrictions on federally assisted programs in environmentally sensitive portions of the Pinelands. To a maximum extent the program objectives of the respective agencies should be pursued within the context of the management plan.
- Availability of federal funds to promote the balanced and orderly development of growth areas as designated in the Comprehensive Management Plan, with priority to financing of sewers and waste treatment facilities.
- Consistency of federal standards and regulatory programs with the plan's regulatory elements. Procedures are needed to ensure adequate coordination of the similar functions of various agencies.
- Status of plans for military and civilian installations located in the Pinelands. Plans to increase or decrease facility operations or functional changes at the installations may have impacts on the Pinelands.
- Resolution of conflicts that may arise with regard to federally assisted or sponsored activities to prevent adverse impacts on the Pinelands. Techniques and processes must be developed and implemented to resolve policy differences and program conflicts.

Recommendations for Federal Programs

The following program recommendations are aimed at promoting the conformance of federal government activities with the Comprehensive Management Plan. They are primarily procedural in nature, and supplement the various recommendations for coordination of specific policies and programs which were presented in Chapter Seven.

Continuing representation of the federal government on the Pinelands Commission: The federal law establishing the Pinelands National Reserve provides that a representative of the Secretary of the Interior will serve as a member of the Pinelands Commission. This representa-

tion should be continued during the Comprehensive Management Plan's implementation to promote intergovernmental coordination and the national interest in protecting and preserving the Pinelands.

Participation of the Pinelands Commission in the A-95 review process: Circular A-95 of the Office of Management and Budget sets forth procedures for state and local review of applications for federal assistance under various loan and grant programs. The Commission currently reviews and comments on A-95 applications through the state A-95 clearinghouse, located in the Department of Community Affairs. It is recommended that the Governor of New Jersey designate the Commission as an "obligatory referral" for applications affecting the Pinelands National Reserve. Similar status currently is given to coastal zone management agencies.

While the recommendations of review agencies under the A-95 process are advisory only, it is recommended that when a funding agency is at variance with the Commission, the agency should consult directly with the Commission before approving the project in controversy. Furthermore, it is recommended that the Commission be authorized to appeal directly to the Federal Regional Council, or to an appropriate impartial body, for mediation in cases of continuing conflict.

Participation in Memoranda of Agreement with Federal Agencies: In order to comply with certain requirements of the National Historic Preservation Act of 1966, particularly those dealing with impacts on sites either on or eligible for the National Register of Historic Places, the Commission is entering into a memorandum of agreement with federal and state historic preservation authorities. The purpose of the agreement is to clarify the provisions of the Comprehensive Management Plan for protecting and managing cultural resources in the Pinelands National Reserve. The memorandum also indicates the areas of responsibility for each participating agency, which includes the Commission, the Department of the Interior (Heritage Conservation and Recreation Service), the Advisory Council on Historic Preservation, and the State Historic Preservation Officer. This agreement is regarded as a vehicle for a cooperative effort to further the protection of the Pinelands' cultural heritage. It is recommended that this type of arrangement be considered with other federal agencies, such as the Environmental Protection Agency and Department of Agriculture.

Coordination with Federal Installations: The land allocation program discussed in Chapter Seven delineates the Pinelands National Reserve into several types of areas, one of which is military and federal installations. Part II sets out requirements pertaining to new development at these installations. The Commission's intent is to enter into agreements with the installations to formalize standards and procedures for their compliance with the Comprehensive Management Plan. An agreement has been reached with Fort Dix which is expected to serve as the prototype for understandings with McGuire Air Force Base and Lakehurst Naval Air Station.

It is recommended that additional memoranda of agreement on planning and development coordination be executed between the Commission and other federal installations located in the Pinelands area, including the Federal Aviation Administration Technical Center and the Brigantine National Wildlife Refuge. The intent of these agreements would be to outline arrangements for coordinating planning, land management, and development activities. These agreements should also provide for the development of plans for recreation, fish and wildlife management, and historic preservation.

The possible acquisition of up to 40,000 acres by the Department of Defense within the Warren Grove region to provide a buffer around the existing target area would have major impacts on the Pinelands. It is recommended that the U.S. Air Force prepare, in cooperation with the Department of the Interior, an environmental impact statement addressing the proposed Warren Grove land acquisition. The environmental impact statement should consider the potential multiple uses of the area, including natural resource preservation and public access for compatible recreation. The Commission should be designated a cooperating agency in the preparation of the environmental impact statement.

Continuation of the Federal Advisory Committee: Upon request of the federal representative on the Commission, a Federal Advisory Committee has been established to provide a forum for the participation of federal agencies in the Pinelands planning process. The primary focus has been on the evaluation of existing federal programs and policies and their effects on the Pinelands environment. The committee has also coordinated discussions relating to the federal Environmental Impact Statement on the Pinelands plan, which was prepared by the Department of the Interior in accordance with federal requirements.

It is recommended that the Federal Advisory Committee continue to exist during the plan implementation period as a vehicle for intergovernmental communication and coordination. The membership should include representatives of all federal agencies with involvement in the Pinelands. These agencies include but are not limited to the following:

- Department of Agriculture
 - Soil Conservation Service
 - Forest Service
 - Agricultural Stabilization and Conservation Service
 - Farmers Home Administration
 - Science and Education Administration
- Department of Commerce
 - Economic Development Administration
- Department of Defense
 - Army Corps of Engineers
- Environmental Protection Agency
- Department of Housing and Urban Development
- Department of Interior
 - Bureau of Land Management
 - Fish and Wildlife Service
 - Heritage Conservation and Recreation Service
 - National Park Service
- Department of Transportation
 - Federal Aviation Administration
 - Federal Highway Administration

Following the Commission's adoption of the Comprehensive Management Plan, it is proposed that the Federal Advisory Committee undertake responsibility for review of the plan by all affected federal agencies to determine how the operations of the respective agencies would be impacted and how the individual agencies can assist in implementing the proposed programs. It is suggested that each agency respond in the form of a detailed report identifying areas of potential conflict as well as areas of potential support. Among other factors, the individual agency reports should address ways in which direct or indirect assistance might be provided to help channel or accommodate development in the Pinelands growth areas. These agency reports will provide a basis for detailed evaluation of potential interactions of federal programs with the Comprehensive Management Plan and a basis for future cooperative efforts with the Commission.

CHAPTER NINE

Financial Program

The Pinelands Protection Act provides that the Comprehensive Management Plan include a financial component which: (1) details the cost of implementing the management plan, including payments in lieu of taxes, acquisition costs, and general administrative costs; and (2) identifies sources of revenue for covering these costs. This chapter describes the various elements of the financial program and funding strategy adopted by the Pinelands Commission to fulfill its legislative mandates and to meet other financial requirements. An analysis of economic aspects of the Comprehensive Management Plan is presented as a preface to the financial program.

One of the basic policies adopted by the Commission is to devise and recommend an equitable new system of and resources for payments in lieu of taxes to municipalities which have conformed to the Comprehensive Management Plan. The need for a program of payments to local governments to compensate for the loss of property tax revenue caused by public land acquisition is specifically recognized in the Pinelands Protection Act and is a major concern of residents and local government officials. The discussion of the Commission's payment in lieu of tax program includes an overview of existing in lieu programs in the state, and a review of principles considered in the evaluation of an in lieu of tax payment program for the Pinelands.

The second financial policy adopted by the Commission is to identify existing and, where appropriate, recommend new financial incentive programs to promote land management practices that further the goals of the Comprehensive Management Plan. A number of financial incentive programs are incorporated in the program elements described elsewhere in this document. These include recommendations for favorable tax treatment, loan and grant assistance for specific land management practices, and the Pinelands Development Credit System.

Recognizing the important role of the private property owner in the implementation of the management plan, the Pinelands Commission explicitly acknowledges the limits of regulatory techniques in accomplishing the goals of the plan. A third financial policy has been adopted to reiterate the basic constitutional guarantees. It states that no provision of the Comprehensive Management Plan shall deprive an owner of property without due process of law, nor shall private property be taken for public use without just compensation. The acquisition program and the regulatory framework which are described in previous chapters incorporate these most fundamental concepts. As indicated in Chapter Eight, the Commission has established special procedures and criteria for addressing the issue of vested rights.

Potential revenue sources to support the implementation of the Comprehensive Management Plan are presented in the third part of the chapter. Elements of a balanced funding program for the Pinelands are described, including the role of state and federal financing and other possible revenue sources.

The discussion of revenues is followed by a detailed review of the major cost elements of the Pinelands protection program including acquisition costs, in lieu of tax payments, and general

administrative costs. The basic assumptions and methodologies used for the preparation of the cost projections are also described.

It should be especially noted that the estimates of both costs and revenues presented in this chapter are intended to be used for fiscal planning purposes only and not for budgetary purposes.

The chapter concludes with a summary of the Commission's overall financial program in the form of a five-year projection of revenues and costs for each major program element.

Economic Analysis of the Comprehensive Management Plan

The Comprehensive Management Plan prepared by the Pinelands Commission is an effort to balance the environmental and economic objectives contained in both the state and federal legislation. These include the legislative direction "to protect, preserve and enhance the significant values of the resources" of the Pinelands, while recognizing existing economic activities within the area. The Commission is also to "provide for the protection and enhancement of such activities as farming, forestry, proprietary recreation facilities, and those indigenous industries and commercial and residential developments which are consistent with such purpose and provisions" of the legislation. It is believed that the Comprehensive Management Plan accomplishes the difficult task of balancing environmental and economic objectives. Indeed, it will generally protect and enhance the economic viability of the Pinelands region.

Since the Commission's plan restricts unconstrained growth and redirects planned growth into more suitable locations, some localized impacts will, of course, occur. While certain of these impacts may be viewed as negative, certain others, including the reduction of the myriad costs of development sprawl, must be viewed as positive aspects for the region's future. As with all plans which seek to redirect growth, shifts will occur in the region's economy from the growth patterns resulting from an unplanned and unconstrained situation. Because of the historic nature of development in the Pinelands (a tendency to locate at the fringes of the region), the shift is not as significant as in areas where pressure for land utilization is relatively uniform. An analysis of those locations presently under intense development pressure was a factor in selecting regional growth areas to accommodate future development.

Impact on the Economy

The Pinelands are not an isolated economic region. Rather, they are part of a broader South Jersey region which in turn has intra- and interstate economic relationships. Within the South Jersey economic region, the major activities are agriculture, manufacturing, government (military), services and trade (tourism and retirement industries), and construction.

The Comprehensive Management Plan seeks to protect and enhance agriculture in the Pinelands by preserving land for future expansion, and through a variety of programs and recommendations including the "right to farm." It should be noted that agriculture in the region has been expanding in the recent past. While there may be increased development pressure on farmland outside of the Pinelands due to less restrictive land use policies, recent efforts on the part of the state to devise programs for farmland preservation may offset much of the potential decline in active agricultural areas.

Manufacturing is mainly found in the western portion of the region with the vast majority being outside of the Pinelands. Nevertheless, the Pinelands must be viewed as a potential expansion area for manufacturing. There is no impediment in the plan to the growth of light manufacturing in areas where such activities would be likely to locate. The plan would appear to negatively impact the growth of heavy manufacturing if suitable alternative sites outside the Pinelands are not available. The industry which is the most likely to expand into the Pinelands is glass manufacturing. This industry utilizes sand mined within the area and elsewhere. Since the plan provides an exception for resource-related industries in portions of the Pinelands, an opportunity for such expansion in an environmentally acceptable manner exists. Mining, particularly sand and gravel extraction, will continue to be viable in major areas of the Pinelands.

Economic activity related to the extensive military and federal installations in the Pinelands is primarily influenced by considerations of national defense or other federal policies, rather than local development policies. The effect of the plan will be to accommodate expansion and continued use of such facilities while providing development in selected adjacent areas for the provision of necessary local services.

Tourism is rapidly expanding in the region due to the advent of casino gambling in Atlantic City and convenient access to the area's natural resources. By providing growth areas adjacent to Atlantic City, the plan is generally expected to accommodate development generated by the casino influence and should not affect this industry. Preservation of the natural resources of the Pinelands, while allowing low-intensive and intensive use recreation facilities, will enhance this portion of the tourist industry. It is anticipated that the plan will allow the latter to reach its fullest potential by limiting the competition from land uses which would adversely affect the industry. By accommodating growth in the eastern portion of the Pinelands, the plan should not increase the conversion of seasonal shore housing beyond the pace already precipitated by casino-related housing demands.

The retirement industry, particularly that related to retirement housing, may be impacted by the plan. It should be noted, however, that a major factor promoting retirement housing in the Pinelands was a lack of competition with demand for more conventional housing types. With the advent of casino development, many former retirement units are being converted. This trend, it is believed, would continue in the absence of a comprehensive plan.

Contrary to what may have been anticipated, the impact of the Comprehensive Management Plan is not expected to have a major impact on the construction industry. While land availability for housing has been limited by the plan, growth, as projected, may be accommodated in Regional Growth Areas, Towns, and Villages, as well as Rural Development Areas. Additionally, the municipal reserve areas serve as a reservoir for growth should the plan's allocations fall short of accommodating projected demand. Since the plan contains provisions relating to low, moderate, and middle income housing, it may be anticipated to result in more such units than would have occurred. The major impact will be locational in nature due to the redistribution of growth. It should be noted again that growth areas correspond greatly to the analysis of anticipated growth pressure. Continued monitoring of growth demand in the region, and an on-going amendment procedure contained in the plan, provide the flexibility to respond to localized and regional growth pressures as they arise.

Of additional interest from an economic standpoint is the shellfish industry, which is located in the bays and estuaries adjacent to the Pinelands. This Pinelands-related industry accounts for approximately 40 percent of the total dockside value for the state or approximately \$2 million in 1978. Total commercial value is approximately 2.5 times higher than dockside value. The plan is expected to have a favorable impact upon the shellfish industry because of the industry's dependence upon protected waters emanating from within the Pinelands.

Impact on Land Values

By restricting unconstrained land use in portions of the Pinelands and redirecting growth to others, the plan will affect land values both positively and negatively. The economic value of land is, of course, directly proportional to the intensity of the use to which it can be put. No existing uses of land in the Pinelands will be restricted by the plan. In certain areas the intensity of future, but not present, use will be reduced. In other areas the future intensity will be increased. Owners of land in more restricted areas of the Pinelands, who intended to convert to a more intensive use in the future, may well not realize their increased value. The restrictions on use within certain areas of the Pinelands are necessary to achieve the objectives of both the federal and state legislation. It is believed that these restrictions are the minimum necessary to protect the nationally recognized resources of the Pinelands.

The laws of the United States and of the State of New Jersey protect a property owner from a "taking" of property by government. The Pinelands Plan cannot modify this protection, and

indeed does not attempt to. However, an issue is raised of whether a property owner should be supported or not supported by government in the attainment of his or her investment objectives. This dilemma is not unique to the Pinelands Plan or to any plan at the local or regional level.

An analysis of the potential impacts of the plan on land values reveals that the plan's effect will be highly variable depending on a number of diverse factors. These include the relative location of a property in relation to existing growth areas and development pressures, the highest and best use of the property in the pre-plan and post-plan situations, the natural characteristics of the property, its suitability for agriculture, the parcel size and configuration, road frontage, and availability of utilities, as well as general market conditions. Property values in the Pinelands prior to the plan have been estimated to range from an average of about \$300 per acre for properties under no current development pressure, upwards to an average of about \$3,600 per acre in areas under strong development pressure in immediate proximity to growth centers. Land values for the low and moderate development pressure categories, which are perhaps the most reflective of the majority of lands in the areas to be restricted under the plan, range from an average of \$600 per acre to an average of \$1,200 per acre respectively. The plan will affect some parcels of land more adversely than others. In general, values in areas which are currently under low or no development pressure will not be affected since their current values fall within the range of values estimated for passive recreation and agricultural uses. Properties in areas subject to moderate to strong development pressures may be subject to some diminution in value depending on the extent to which the respective development rights are actually restricted by the plan. It should be noted, however, that those areas which are subject to the strongest development pressures have been delineated as growth areas in the plan. As a result, land values are likely to be enhanced in these areas due to the greater intensity of development that will occur.

The Pinelands Plan provides an additional use benefit to property owners in more restricted areas in the form of Pinelands Development Credits (PDC's). The allocation of credits is based upon the amount and nature of the lands owned. For property owners in a growth area to utilize the increased intensity allocated, they must acquire PDC's from the owners of more restricted lands. In this manner the plan distributes the value benefits and costs among all property owners. Whether the value of the PDC will equal the value of any reduction will, of course, depend upon individual and market situations. However, in discussions regarding loss in value, the PDC's value must also be considered.

Although some consider development credits an experimental technique, there has been a great deal of experience with such systems, and with varying degrees of success, around the country. The major fault of most development credit plans has been that there was no area to which the development credit could be transferred. The Pinelands Plan provides receiving areas in its Regional Growth Areas. While the use of development credits is an evolving technique, it has had frequent successes and has proven itself in the marketplace. The experience of the PDC's will be a significant step in the evolution of this means of redistributing the benefits from planning. The plan also recommends a Development Credit Bank to guarantee the value of credits for loan purposes.

Additionally, the plan provides for the accomplishment of final subdivisions and owner-occupied housing on land purchase prior to the institution of the Pinelands moratorium. Hardship provisions are also incorporated to protect certain property owners. All of these will tend to mitigate any negative impact upon the owners of regulated properties.

While it cannot be stated that some property owners will not suffer a depreciation in the value of their assets even after these factors are taken into consideration, a similar planning experience offers a valuable comparison. Under the Adirondack Park Plan, even more restrictive land use policies are in effect than in some areas of the Pinelands. After several years of implementation of this plan, recent studies indicate that there is insufficient evidence of any significant reduction in property values in the area due to the restrictive land use policies.

The true answer to the question of the Pinelands Plan's impact on local land values must await a similar period of years of implementation. Continuous monitoring of land value and

impacts, and adjustments in the plan to respond to potential adverse impacts, are important components of future Commission activities.

Impact on Local Property Taxes

Since the Comprehensive Management Plan regulates the use of land within the Pinelands, it will affect changes in the tax base of certain municipalities. The impact on the private property tax base will be only on vacant land, however, as the plan does not regulate developed land. Positive impacts are likely to occur on developed lands.

Communities containing large amounts of agriculturally assessed lands will not be significantly impacted, particularly where such lands are located in Agricultural Production Areas. Approximately 14 percent of the vacant land in the Pinelands is assessed as qualified farmland. The direct impact on the property tax base in the Pinelands will be in the category of vacant, non-agricultural private lands.

An analysis was undertaken to determine what might be the best case, medium case, and worst case impact on the property tax base of local governments, and the estimated property tax increase to restore lost revenues. Under the best case, no local governments would have any depreciation in their tax bases. Thus, no tax increases would result from the implementation of land use areas provided in the Pinelands Plan. Under the medium or average case, a mixture of appreciation and depreciation in property value was hypothesized. Under the worst case, 30 percent depreciation and no appreciation was assumed for the vacant, non-agricultural private lands which would be in restricted areas, a highly unlikely event yet one which clearly demonstrates the maximum negative impact which can be expected. Significantly, only three jurisdictions would experience a decline in their total tax base of 10 percent or more under this improbable assumption. Under the medium or average case, a mixture of appreciation and depreciation in property valuation is assumed. No local governments experienced a decline in total tax base of 10 percent under these assumptions, although the same three jurisdictions affected in the "worst case" passed a 5 percent threshold. The corresponding estimated total tax base reductions are:

	Average Case	Worst Case
Estell Manor City	-7.92%	-15.84%
Bass River Township	-5.30%	-10.75%
Woodland Township	-9.48%	-18.96%

If the negative property tax impacts are measured by a 10 percent depreciation in the vacant, non-agricultural private acreage tax base, only sixteen jurisdictions within the Pinelands would be adversely affected. These are shown below, with the corresponding estimated percentage reduction in their total property tax base:

	Percent		Percent
Atlantic County		Burlington County	
Corbin City	2.10	Bass River Township	5.30
Egg Harbor City	.20	Shamong Township	1.92
Estell Manor City	7.92	Washington Township	1.84
Folsom Borough	1.16	Woodland Township	9.48
Hammonton Town	.42	Cape May County	
Mullica Township	3.27	Middle Township	1.29
Port Republic City	2.10	Cumberland County	
Weymouth Township	3.90	Maurice River Township	3.04
		Ocean County	
		Barnegat Township	2.19
		Lacey Township	2.78

In general, the property tax changes necessary to absorb the negative impacts are not major. Even if the three jurisdictions noted earlier were to increase their respective tax rates to affect the possible revenue losses, their post-plan tax levies would fall well below state averages. In conclusion, the fiscal impacts are not expected to be significant. It is likely that they will be manageable through reasonable implementation of the Pinelands Plan by each local government.

Impact on Local Government Public Costs

Under the Comprehensive Management Plan, local governments are required to develop and implement their own plans so that they are consistent with the Pinelands Plan. This activity will involve a public expenditure of funds in order to carry out the planning and financial management activities necessary to bring existing planning and zoning into conformance with the plan, and to reassess the property tax base to reflect current market valuation. However, the actual additional cost to each government will vary according to the character of the affected communities, the resource capacity of the municipality and/or county, and the condition of its planning, zoning, and tax information.

The existing planning staff and technical resources in each county and municipality and at the Pinelands Commission can be used to minimize the costs and duplication of these activities. Reliable estimates of the planning costs to the medium-size Pinelands local government range from \$12,000 to \$20,000 for full development and adoption of a new master plan and zoning ordinances. Using an average cost of \$16,000, the total cost for 52 local government units can be estimated at \$832,000. Currently, \$23,000 in planning assistance monies have been given to five counties, and approximately \$300,000 remains available to distribute to the area's municipalities and counties. A current request for an additional \$300,000 is pending in the legislature. The formulae for the distribution of these funds may vary, but assuming a division into 52 equal parts, approximately \$11,538 would be provided to each community, an amount that would adequately cover the required one-third local government matching cost as provided under federal grants such as the Comprehensive Planning Assistance Program. The requirements for—and thus the cost of—undertaking much of this work for the Pinelands Plan should be additionally diminished because of similar updating and conformance requirements under the Municipal Land Use Act of 1976 which these activities will absorb.

Due to the modifications in permitted land uses, local governments may well need to reassess the properties within their jurisdiction. Even without the Pinelands Plan, however, many of the districts' revaluations and reassessments are overdue by state Division of Taxation standards. Thus, as with planning costs, the costs associated with these activities should not be solely related to plan implementation, but rather to the short and long-term costs common to local government operations and revenue collecting activities. The revaluation of a typical municipality will usually cost \$30 per improved property inspected, on a per parcel pricing basis, and less for the valuation of unimproved (vacant) properties. Assuming that half 26 of the Pinelands communities will require revaluations in the near future at an average cost of \$35,000 per taxing district would render a \$910,000 total cost. For the other taxing districts within the Pinelands, it is anticipated that the costs of most annual reassessments associated with the plan's implementation can be met with existing staff resources, or, if necessary, with minimal temporary or part-time additional resources.

The plan proposes a development configuration which will tend to reduce local capital costs. The most expensive form of urban development in terms of costs to local government is low density sprawl—the typical form of fringe suburban development. Redirecting this development into the Regional Growth Areas will save over 40 percent in public capital outlay costs. Thus, the use of Regional Growth Areas will tend to reduce the public source of the capital cost of urban development.

Payments in Lieu of Taxes

The Pinelands Protection Act makes three specific provisions relating to in lieu of tax payments. First, the act provides that the financial component of the plan take into account the cost of these payments. Section 25 of the act establishes a fund "to defray the costs of payments in lieu of taxes," and Section 20 required the Commission, within one year of the effective date of the act, to prepare and submit to the Governor and Legislature a report concerning state payments in lieu of taxes to municipalities in the Pinelands area where the state owns any land or interests. This report on in lieu payments, including the Commission's recommendations, has been submitted as a separate document.

While the act is silent on the specific objectives and criteria to be incorporated into an in lieu of tax program, there is evident concern about the impact of the Comprehensive Management Plan and the adequacy of existing in lieu of tax programs.

The Commission believes that there is strong justification for the adoption of a special program of in lieu of tax payments for the Pinelands. Future state land acquisitions in the Pinelands, as distinguished from acquisitions elsewhere in the state, will be undertaken as part of a comprehensive land management plan. The regulatory elements of the plan will limit the expansion of tax ratables in extensive portions of the Pinelands area. To prevent erosion of the local tax base and to maintain fiscal solvency and independence at the local level, it is important to prevent the removal of lands from the tax rolls without a long-term program of in lieu of tax payments to replace the lost revenue.

The underlying principle of payments in lieu of taxes is that by acquiring real property, government assumes a responsibility borne generally by private property owners. Accordingly, it should make payments in lieu of taxes on much the same basis that owners of private property pay real estate taxes. Equity issues are the cornerstone upon which payment in lieu of tax programs have been established.

There may be considerable debate as to what extent the tax-exempt status of public lands should be offset by in lieu of tax payments. In this context it is useful to consider the general conditions under which full or partial tax exemptions for various types of properties may be warranted. Some of the common justifications are: (1) the hardship circumstances of the individual owner justifies some tax relief; (2) the property is used for a socially meritorious, economic development, or non-profit purpose, or as farmland; or (3) the property provides service which otherwise would have to be offered by the government, such as a hospital or school. The first reason generally conforms to an ability-to-pay criterion relating to individual owners. The others reflect certain policy decisions, typically made at the local government level, regarding the distribution of tax burdens in conjunction with the benefits received.

One reason that higher levels of government do not reimburse municipalities for the costs of services is the benefit received by a municipality from the presence of the higher government within its boundaries. However, the same argument can be made regarding certain local residents and tax-paying business firms which generate economic benefits for a community. It should be noted that in cases where partial tax exemptions are allowed for private business concerns, it is generally at the option of local government. From an overall equity standpoint, failure to treat public and private properties in a similar manner violates a basic concept of public finance that "equals be treated equally," with the index of equality in this case being the value of real property which is owned.

According to other principles of public finance, fiscal programs should be designed to accomplish intended policy objectives. Beyond this, their impact on other economic activities should be minimal or neutral. The principal goal of an in lieu of tax program for the Pinelands ought to be to prevent erosion of the tax ratable base of local municipalities due to state land acquisitions. It is recognized that municipalities have different concerns which they would like to see addressed through an in lieu reimbursement formula, reflecting the different impacts from state holdings in different areas. At the same time, experience has shown that the more complex

a formula, the greater the tendency for unintended effects in the distribution of resources. The in lieu of tax program is not viewed as an appropriate vehicle for the remedy of all intergovernmental fiscal disparities.

In order to minimize the distortion of an in lieu of tax payment and thereby maximize its neutrality, the payment should reflect the foregone property tax payment as closely as possible. This method of payment not only best serves the common need of municipalities but can be administered efficiently and meets certain equity criteria.

New Jersey's In Lieu of Tax Programs

Four state in lieu of tax programs are presently operating in New Jersey. Payments made under three of these programs amounted to a total of \$412,737 during calendar year 1979 for 26 of the 52 municipalities located within the Pinelands Area. Table 9.1 summarizes the payments made under each program in 1979. The following section describes the basic features of all four state programs in historical order of their enactment, gives a comparative analysis of their rationales and provisions, and concludes with a summary of the current direction of state policy.

Table 9.1—State Payments to Pinelands Area Municipalities In Lieu of Taxes: Calendar 1979

	Municipalities Located in Pinelands Area		Payments to All Municipalities, Statewide	Pinelands Payments as Percent of Total, Statewide
	Payments	Municipalities		
State Parks and Forests: 10¢ per Acre	\$ 15,708	21	\$ 22,726	69.1%
State Water Resource Projects	None	None	259,954	0.0
Green Acres: 1971 and 1974 Bond Acts	37,026	10	567,605	6.5
For Local Services on State Exempt Properties	360,003	13	10,677,836	3.4
TOTAL: All State In Lieu Programs	\$412,737	26	\$11,528,121	3.6%

State parks and forests: The first of New Jersey's in lieu of tax programs was enacted in the early 1900's. It provides that the Division of Parks and Forestry in the Department of Environmental Protection pay each municipality the annual sum of ten cents per acre for the indefinite future for acquired forest lands, provided that the total area of such lands in the municipality exceeds ten acres. Twenty-one Pinelands municipalities received \$15,708 under this program during 1979, or 69.1 percent of the payment program statewide.

Whatever the original rationale for the ten cents per acre payment, it is clear that the level bears no current relationship to the real estate taxes that would be owed if these properties were in private ownership. The payment is very low, and being fixed, does not reflect differential property values or taxation rates. The program is important, however, in that it created an early precedent in New Jersey for the state to compensate municipalities for tax losses caused by the establishment of state parks and forests.

The Pinelands municipalities' relatively high share of this program (almost 70 percent of the statewide total) reflects the early date of acquisition of a large number of acres (157,000) in the area, before more generous in lieu of tax provisions applicable to similar properties were enacted beginning with the 1971 Green Acres bond acts.

State water resource projects: Water Resource Bond Acts of 1969 and 1970 authorized \$2.25 million and \$27.0 million, respectively, for state acquisition of properties for a specified set of water supply projects. (None of these projects happen to fall in the Pinelands area.) The provisions for in lieu of tax payments to the affected municipalities are contained in the legislation authorizing the bonds. The formulae are more sophisticated than the early ten cents per acre approach.

Specifically, the laws provide for in lieu of tax payments calculated on the basis of taxes

actually paid on the acquired properties for the year prior to acquisition by the state. Payments equivalent to the taxes paid on land during that period are then paid by the state in full for the indefinite future. Payments associated with the prior taxes on improvements, however, are paid on a declining percentage basis. They are phased out entirely after 13 years from acquisition (in the case of the 1969 act) or after 12 years from commencement of construction of the water facilities (in the case of the 1970 act.) The latter accounts for the bulk of the property acquisitions under this program.

It is important to note that the water resources program contains a revenue source to finance the payments. This is a combination of rentals from the state properties acquired during the period before construction of water facilities began, and user charges for the water provided in the period after the project is completed.

During calendar 1979, payments to the 13 municipalities involved totaled about \$260,000. Revenues to the state from rentals of the properties acquired totaled about \$250,000 in the year ending June 30, 1979 (the state's fiscal year). Thus, in this period prior to commencement of construction, property rentals have roughly covered the state's obligations in payments to municipalities in lieu of taxes.

Green Acres program: The first Green Acres Bond Act, in 1961, made no provision for state payments to municipalities in lieu of taxes. All the subsequent bond acts—1971, 1974, and 1978—have made explicit provision for in lieu of tax payments in the legislation authorizing the respective public referenda. The formula, which is virtually identical in the three acts, provides for a declining percentage payment over a 13-year period based on the taxes actually paid in the year prior to acquisition. The schedule is calculated as follows:

1st Year (year of acquisition)	100%
2nd Year	92%
3rd Year	84%
4th Year	76%
5th Year	68%
6th Year	60%
7th Year	52%
8th Year	44%
9th Year	36%
10th Year	28%
11th Year	20%
12th Year	12%
13th Year	4%
Thereafter	None

Obviously, Green Acres legislation was influenced significantly by the water bond acts, as the base and declining percentage formula for the 13-year period are identical. There are important distinctions, however. Because the Green Acres acquisitions, unlike the water resource properties, were not expected to generate any significant revenues, the state declined to make any indefinite commitment. The thrust of the payment in lieu of taxes is to cushion the immediate shock of removing the properties from local tax rolls. After 13 years, the state admits to no obligation, and its effective contribution in the latter years is quite minimal.

With payments of \$37,026, Pinelands communities received only 6.5 percent of all Green Acres in lieu of tax payments during 1979. The state uses Green Acres monies to match federal acquisition funds, and has committed itself to in lieu payments in accord with the Green Acres formula on all acres acquired, regardless of the original source of funds. Hence, the state's in lieu of tax commitment becomes much greater than would have been assumed for state-financed acquisitions alone.

State payments for local services: Comprehensive legislation obligating the state to make payments for local services on its tax-exempt properties (other than those covered by the preceding programs) is the closest thing New Jersey has to a "full tax equivalency" in lieu program. It is the most generous to the municipalities affected, and the most recent of New Jersey's in lieu programs (1977).

The clear and explicit rationale of the 1977 act is to compensate municipalities for the cost of local services, such as fire and police protection, for state facilities which generate demand for these services but pay no local taxes. Since the bulk of the state facilities generating a demand for local services are also located in urban areas, the in lieu of tax payment program to municipalities for services may also be viewed as a vehicle for state aid to urban areas. This point is illustrated by the fact that municipalities in the non-urban Pinelands area received only 3.4 percent of the \$10.7 million paid to municipalities statewide in 1979.

A key feature of this in lieu of tax program is the method of calculating the state's liability. Unlike any of the in lieu programs previously described, the base is the current assessed value of the exempt property, rather than the prior tax payment at the time of acquisition or an arbitrary, flat amount. Thus, the in lieu payment is designed to keep abreast of reassessments over time. To that base is applied the effective local purpose tax rate for the municipality, which is the tax rate derived after equalization of assessments by jurisdictions across the state to "true value." Thus, the formula is equitable among municipalities with respect to valuation of the tax base. Differences in the cost of services from municipality to municipality are reflected in different effective tax rates.

Finally, it should be noted that the state pays only the municipal share of the effective local purpose tax rate, not the shares apportioned to local school district and county purposes. Presumably, the rationale here is that state-exempt properties of the types included generate demand primarily for the services provided by municipalities, not those provided by school districts or counties.

All state properties not covered by other in lieu of tax programs qualify for this program, except those used or held for highways, bridges, or tunnels. No payment is made to municipalities where the state liability is less than \$1,000 or to municipalities when the effective local tax rate for municipal purposes is less than \$.10 per \$100 of equalized value. In addition, no municipality receives an in lieu of tax payment from the state greater than an amount equal to one quarter of the local purpose tax levy for the relevant year. It should be noted that these threshold and ceiling provisions are questionable from the standpoint of equity.

When the state appropriation is less than the amount provided by the applicable formula, the reductions are distributed proportionally among eligible municipalities. However, as long as the legislation remains in effect, payments on this basis continue indefinitely. Unlike the declining formula and flat rate programs, the potential pressures for increasing the state's liability under the local services program over the long run are significant. In this sense, the legislature's option to appropriate less than the calculated full liability may be regarded as a countervailing safety valve.

Current Direction of State Policy

The four programs described above are disparate in their rationales and provisions in many respects. A comparison of the key features of each is summarized in Table 9.2. Nevertheless, an overall New Jersey state policy emerges with considerable internal consistency.

First, New Jersey's assumption of an explicit liability for payments to municipalities in lieu of taxes on various types of state-owned property has become more generous over time, consistent with national trends. (In this sense, the 10¢ per acre program is an anachronism.) Second, the historic trend toward increased generosity has been effectively tempered by strong, explicit fiscal considerations, both from the perspective of the costs incurred by municipalities for services, and from the perspective of the revenues available to the state.

The Green Acres in lieu of tax payment program thus exemplifies current state policy with respect to acquisitions which will tend to generate minimal demand for local services. In this case, the policy is to cushion the impact, providing municipalities with the time to adjust their assessments and budgets to reflect a reduced tax base, but providing for a distinctly limited stream of replacement revenues and no long-term solution to erosion of the local tax base.

Table 9.2—Comparison of Key Features of New Jersey's In Lieu Payment Programs

Payment program feature	In Lieu Payment Program			
	State parks and forests: 10¢ per acre	State water resource projects	Green Acres: 1971, 1974 and 1978 bond acts	For local services
Type of land exempt from local taxes by virtue of state ownership	Parks and forests	Predominantly rural/agricultural	Parks, forests, open-space, and other environmentally sensitive areas	Property to accommodate structures and other improvements required for the conduct of state functions
Base for calculation	Arbitrary	Taxes paid during year prior to acquisition	Taxes paid during year prior to acquisition	Current assessed value
Level and duration	10¢/acre indefinitely	For land: 100% indefinitely For improvements: declining rate phased out over 13-year period from acquisition or commencement of construction	Declining rate phased out over 13-year period from acquisition	Up to 100% of the effective local purpose tax rate of the municipality, subject to variable appropriation
Source of revenue indicated	General state funds, required by legislation	Property rentals and water user charges	General state funds, required by bond acts	General state funds, subject to variable appropriation
Discretion in administration	Virtually none	Virtually none	Virtually none	Some inherent in annual certification and appropriation process

Proposed Payment In Lieu of Taxes Program for the Pinelands

The foregoing review of current state policy serves to point out the inadequacy of current in lieu of tax programs to meet the objectives of the Pinelands protection program, or to address major equity, efficiency, and administrative considerations. It is the specific recommendation of the Pinelands Commission that the payment in lieu of tax program adopted for the Pinelands area provide full tax equivalency payments to local governments on a long-term basis to compensate for the loss of taxes on properties acquired pursuant to the Comprehensive Management Plan.

The proposed full tax equivalency program would provide payment based on the full amount of real property tax which would be due were the property fully taxable in private ownership. The payment would provide 100 percent compensation for a property's tax liability, using the taxing authority's normal valuation or assessment practices, as well as tax rates appropriate for that type of property.

If administrative considerations dictate some sort of plan to minimize the cost of the payments to municipalities in lieu of taxes, the Commission recommends that the in lieu program be funded at some amount less than 100 percent, and that payments to all governments be reduced on a pro rata basis. No threshold or ceiling provisions are recommended.

As described in the preceding section, the Green Acres in lieu payment program provides a partial tax equivalency payment, based on the taxes paid for a property in the year prior to its

acquisition. Green Acres does not fully address the equity and revenue problems created by extensive state land acquisition and at best provides only transitional assistance. Green Acres alone is not recommended as an appropriate in lieu of tax payment program to satisfy the Pinelands Protection Act. However, it is proposed that the Green Acres program continue to be utilized for Pinelands acquisitions to the extent that funds are available. The Green Acres in lieu formula would be operative when its funds were used, but the Pinelands program would supplement those payments so that local governments would receive the amount they would have received under a full tax equivalency program.

Proposed Revenue Framework

The structure of revenues in support of government activities ought to bear a relationship to the nature of the public services and benefits being provided. Historically, financial policies at the state and local levels have reflected a linkage between the source of funds and the services rendered. For example, the property tax was conceived as a levy against the value of property for protection of the property in the form of police services, fire services, street lighting, and other related activities. Similarly, gasoline taxes and auto license fees have been used for highway purposes.

As the scope of governmental services has expanded to include broader social programs, the use and source of revenues have become more generalized. Local governments have applied property taxes in support of all forms of local services including welfare, health, education, and recreation. At the same time, state and local governments have widened the range of taxes employed to include sales taxes, income taxes, excise taxes, and other broad-based levies. Hence, while dedicated revenues continue to be used for certain purposes, there has been a trend towards more general levies for broader public ends. There is a place for both approaches, with revenue sources linked to services rendered and with broad revenues applied to generalized public purposes, in the Pinelands Commission's overall revenue structure.

Several additional basic concepts need to be considered to develop a revenue structure. These include:

- *Administrative efficiency:* The revenues employed ought to be easily accounted for and collected. This means that the revenue yield ought to be sufficient to justify the cost of collection and administration.
- *Equity:* The revenue system ought to ensure that no political subdivision or significant group within the taxing area (statewide or Pinelands) is either forced to carry an extraordinary tax burden or is shortchanged with respect to services.
- *Fiscal balance:* The assignment of revenue sources and expenditure responsibilities ought to balance the pleasure of public expenditure with the pain of taxation so that the degree of political risk is borne at the appropriate level.
- *Decision level balance:* The revenue structure ought to reflect the degree of centralization or decentralization of responsibility (state level vs. local level) for deciding program activities and revenue requirements.

Within this framework, the programs and purposes of the Pinelands Commission must be viewed as being essentially state-level activities with statewide benefits, yet causing substantial impact in local areas. The Commission's foundation is the belief that the protection and preservation of a unique natural, ecological, agricultural, scenic, and recreational area is in the interest of the people of the state and nation. In keeping with this basic public policy, the Commission's overall revenue structure will include federal fiscal assistance, state financial support, and "own source" revenues initiated for the benefit of the Commission.

Federal Assistance

Section 502 of the National Parks and Recreation Act of 1978, which establishes the Pinelands National Reserve, authorized a total of \$26 million for the support of the Pinelands Commission's activities. The authorization included a maximum of \$3 million for planning (\$800,000 has been allocated) and \$23 million for property acquisition (\$11.2 million has been allocated). In addition

to the Section 502 monies, \$500,000 was allocated from the Secretary of the Interior's contingency reserve (Land and Water Conservation Fund) for general planning activities. The Department of the Interior also provides annual funding to New Jersey for land acquisition under the Land and Water Conservation Fund, and a portion of this has been generally allocated for use in the Pinelands area. Unlike the Section 502 monies, which can be used to fund 75 percent of acquisition costs, funds from the Land and Water Conservation Fund require a 50 percent state matching contribution.

Inasmuch as the U.S. Congress has established the Pinelands National Reserve through public law with the intent of protecting and preserving the natural character of the area for the benefit of residents and visitors, it is reasonable to assume that federal funds will be made available primarily for land acquisition purposes. Beyond the \$2.2 million of additional authorization that remains available for planning, major federal support for planning and administration is not envisioned. Nor is it anticipated that allocations from the Secretary of the Interior's contingency fund will be a source of regularly recurring revenue. However, it is expected that the Commission will from time to time secure specific project grants under various federal programs to supplement its resource planning and program activities. A number of federal grant programs with particular relevance to the Pinelands are cited in the review of federal programs in Chapter Eight.

State Financial Support

New Jersey has provided financial support to the Commission for both land acquisition and operations, administration, and planning. During the Commission's initial planning period, approximately \$500,000 was provided through matching Green Acres funding, and an additional \$175,000 in general budgetary appropriations were made through the Department of Environmental Protection. Both of these allotments were applied to operations and administration. In anticipation of the Commission's second year of operation, a general treasury appropriation of \$1,226,200 was requested. The initial budgeted amount was \$700,000, including \$300,000 to be distributed to municipalities for planning purposes. The state has also made \$23,750,000 available for land acquisition through the Green Acres bond acts, of which \$12,250,000 has been appropriated.

Certain costs associated with Pinelands activities will be borne by the state as "indirect" support. In other words, payments will be made on behalf of the Pinelands program but will not be a direct responsibility of the Commission. These include payments in lieu of taxes made to municipalities when the state acquires land under the Green Acres program. Since it is likely that most Pinelands acquisitions will be made under the auspices of the Green Acres program, the in lieu of tax payments provided under the Green Acres formula will be made through the established Department of Environmental Protection budgetary mechanisms. Likewise, when the property is acquired through the Green Acres program and title vests in the state, the DEP assumes operational and maintenance responsibility for the property. Accordingly, costs associated with this responsibility will be borne by appropriations to state agencies other than the Commission. To the extent that Green Acres funds are used for land acquisition, any revenues gathered from these properties, such as leaseback revenues or revenues from the sale of natural resources (wood), will be applied to the costs incurred by the agencies, and will not be considered as a source of funds for the Commission.

Since the Commission was created as a subdivision of the state, without taxing authority, it is expected that the state will continue to meet a substantial portion of the Commission's budgetary requirements. General treasury revenues of a broad-based nature are in fact a preferred source of funding for Pinelands activities. This is because the programs and purposes of the Commission are designed to a significant degree for the benefit of all the state's citizens, and for the purposes of attaining statewide land use objectives. However, the Commission's overall revenue structure should also contain "own source" revenues.

Potential "Own Source" Revenues

The term "own source" revenues refers here to potential sources which might be earmarked to support the Commission's programs and operations. In several cases, the sources that have been identified are linked in some way to economic activities within the Pinelands.

The Pinelands Fund: Section 25 of the Pinelands Protection Act authorizes the Commission to adopt rules and regulations which impose a surcharge of up to \$1.00 upon any fee currently levied and collected, pursuant to law, for the use of state-owned lands within the Pinelands area. The law further specifies that these monies, if and when levied and collected, shall be deposited in the "Pinelands Fund." The money shall be reserved to defray the costs of payments in lieu of taxes, pursuant to a formula that the Commission may adopt. Fees and charges for the use of state-owned properties in the Pinelands in 1979 are summarized in Table 9.3 along with revenue estimates for various types of use of these properties.

The potential yield of the proposed \$1.00 surcharge can only be approximated since detailed data on the utilization of state properties is lacking and since the definition of what constitutes the "use" of state-owned lands is subject to debate. The aggregate receipts during 1979 from day use and night use fees and charges amounted to \$277,109. Clearly, a \$1.00 fee could not be added to each and every service activity. For instance, the organized group picnic fee is \$0.25 per person, and it is impractical to expect to increase the charge to \$1.25 per person. The addition of a full \$1.00 fee for each person camping or using a cabin would have only a minimal yield. It is estimated that the annual incremental yield from the Pinelands surcharge would not exceed \$28,000, a 10 percent increase over current collections.

Table 9.3—Fees and Charges For the Use of State-Owned Land in the Pinelands Area, 1979

	Walk in Entry	Parking		Tour	Boating	Rides	Cabins & Night Use	Other Fees*	Leases	Con- cessions	Fines
		Week- day	Week- end								
Atsion	\$0.50	\$1.00	\$3.00								
Bass River	0.50	1.00	3.00				\$22.00/ 6 persons		U N A V A I L A B L E		U N A V A I L A B L E
Belleplain		1.00	2.00				15.00/ 4 persons	V A R I E S	V A R I E S		V A R I E S
Lebanon		1.00	2.00				15.00/ 4 persons				
Batsto				\$1.00	\$1.00	\$0.50	25.00/ 8 persons				
Wharton							60.00/ 24 persons				
Estimated Revenue, 1979				\$32,535			\$218,615	\$25,959	\$11,286	\$5,327	\$5,490

* Bathhouse, laundry, boat platforms, etc.

Source: New Jersey Division of Parks and Forestry

Campgrounds and marinas: The logic of the Commission's authority to assess a levy on the use of state-owned land can be extended to the use of privately-owned properties, such as Pinelands campgrounds and marinas, since the influx of people to these facilities also increases the need for government services. If a tax on admissions, amusements, or space rental were authorized by state law in the form of a selective (excise) sales tax on the gross receipts from certain recreational functions, substantial revenues might accrue for use in supporting the overall Pinelands program. Based upon preliminary estimates, a 5 percent levy on private campground utilization within the seven Pinelands counties may yield as much as \$1,374,000 annually. A similar levy on the space rental of berths at both public and private marinas may yield approximately \$706,000. The tax might also be applied to other appropriate recreation industry activities.

Transfer tax: The state applies a realty transfer tax to the recording of deeds which transfer title to real property. The tax is collected by each county at the rate of \$1.75 per \$500 of value. Of the \$1.75, \$0.50 is retained by the county and \$1.25 becomes revenue to the state treasury. The yield from this land-based tax reflects changes in property values. Since the Commission's activities are also land-based, the realty transfer tax could be used as an appropriate and equitable source of revenue. Based on 1979 collections, an additional 25¢ per \$500 of value imposed on statewide real estate transactions would yield approximately \$3,970,000.

Fees for development application reviews: Since a substantial portion of the Commission's workload will be directed toward development review and land use plan enforcement, the costs associated with these programs may be recovered, either in whole or in part, through fees charged at the time applications are submitted for authorization to develop property. Fees at this stage are more appropriate than later fees associated with building permits, since the Commission's role is in the initial approval stage, whether or not the application ever results in a building permit. Depending upon the level of application activity, the mix of applications filed, and the fee structure adopted, the revenue estimate from this source could range from \$60,000 to \$120,000 annually.

Grants and Donations

Grants and donations from private organizations, foundations, or individuals may provide a significant additional source of funds for Pinelands activities and programs. During its first year, the Commission received a \$200,000 grant from the Geraldine R. Dodge Foundation to help finance its development review functions. Private sources of funds are particularly appropriate to support special programs which could not be undertaken within the limits of the Commission's ordinary revenue sources. The Commission will study methods for encouraging gifts and donations to determine the most effective and suitable approach.

One mechanism which has been utilized in other states is a check-off provision on the state income tax form to permit a taxpayer to allocate some amount of his or her tax refund to a specific purpose, such as wildlife preservation. The role of in-kind gifts and donations in the form of property (fee simple or conservation easements) will also be examined. Although not directly relevant to the revenue structure of the Commission, gifts of property interests may assist in the implementation of the overall land management program.

Revenue Summary

Revenues to cover the costs of implementing the Comprehensive Management Plan ought to be derived from a combination of federal and state resources and "own source" funds in accordance with established principles of equity, efficiency, and fiscal balance. Given the avowed state and federal interest in the Pinelands, a long-term state and federal commitment to the Pinelands program is justified. It is specifically proposed that the federal government fully allocate the funds that have already been authorized for the Pinelands, and that it provide additional money to the State of New Jersey from the Land and Water Conservation Fund to enable the Pinelands acquisition program to be completed. The Commission also recommends that New Jersey provide the balance of funds needed to finance the acquisition program through Green Acres bond issues and, if and when necessary, a future bond authority. Furthermore, the Commission proposes that New Jersey provide the funding for a full tax equivalency program of payments in lieu of taxes for Pinelands municipalities as recommended in the previous section. Some form of broad-based state revenues are judged the most appropriate means of supporting such an in lieu of tax program.

Several possible "own source" revenues have been identified as additional sources of support for the Commission's activities. Estimates of the revenue-producing ability of these respective fees and taxes at certain assumed rates are summarized below:

- Pinelands Fund (as provided by Pinelands Protection Act)
 \$1.00 surcharge on use of state lands in the Pinelands \$28,000.

- Excise tax of 5 percent on private campgrounds and marinas in Pineland counties \$2,080,000.
- Realty transfer tax—surcharge of additional \$0.25 per \$500.00 of value (statewide) \$3,970,000
- Development review fees \$60,000—\$120,000.

In evaluating these revenue sources, the incidence of the tax or fee should be considered as well as the amount of revenue to be generated. The Commission recommends that a combination of these or similar mechanisms be adopted so as to achieve an appropriate and equitable distribution of impacts. Surcharges on public recreation fees and development review fees, while perhaps minor in terms of their revenue productivity, may be justified in terms of their incidence on users of the Pinelands, including both state and out-of-state residents.

In order to provide adequate and continuing funding for the overall Pinelands program, it is recommended that legislation be enacted to provide additional, self-generating sources of revenue. It is specifically proposed that the Pinelands Fund be reconstituted, and that the \$1.00 surcharge allowed by the Pinelands Protection Act on existing user fees for state properties be supplemented with a combination of other revenues.

It is further recommended that the Pinelands Fund be converted into a "general" fund for the receipt of all revenues, appropriations, grants, etc., and that it be available for all the Commission's purposes, including payments in lieu of taxes.

Acquisition and Other Projected Cost Elements

Property acquisition represents the major program cost associated with implementation of the Comprehensive Management Plan. The acquisition program, presented in Chapter Seven, envisions the purchase through 1985 of approximately 100,000 acres, including both fee simple and less than fee simple interests. Two-thirds of the land to be acquired, or about 67,000 acres, are situated in the designated acquisition areas. The location of the remaining one-third will be determined on the basis of continuing planning.

The costs of the acquisition program were estimated on the basis of a detailed study of land sales from 1977 through 1979 in a broad sector of the Pinelands. Sales transactions were analyzed and followed, in many instances, by site inspections and direct contacts with the purchasing parties to verify the facts or circumstances of sales.

Utilizing a modified appraisal technique, value estimates were derived on the basis of data for comparable sales, taking into account such factors as general geographic location, natural characteristics (wetland or upland), road frontage, proximity to growth, and predominant land use. This methodology has produced acquisition cost estimates which are judged to be quite valid in terms of average cost per acre of typical properties in the specified areas. At the same time it should be noted that the cost factors cannot be applied to any specific parcels because of the range of individual factors which may ultimately influence a particular sale, such as size, configuration, or highest and best use.

The initial land value estimates assumed that no structures would be acquired, and that most acquisitions would be in the form of entire takings so as to minimize the issue of severance damages. It is recognized, however, that purchases of some improvements and certain severance damages may be unavoidable. A contingency factor of 10 percent has been incorporated in the projections to account for these and other extraordinary costs.

For planning and budgeting purposes a level annual acquisition effort has been assumed. This approach maintains a constant number of acres purchased over the five-year projection period with approximately 18,800 acres acquired each year. Actual experience, however, may result in a peaking of activity in certain years because of variables such as condition of title, number of parcels, availability of owners, and the status of negotiations.

The overall average cost per acre for projected acquisitions in the designated areas is estimated currently to be \$636 per acre. This figure incorporates specific assumptions regarding

the combination of easements and fee simple purchases, mix of uplands and wetlands, geographical location, etc. It is assumed that after 1981 the overall average cost per acre will rise by about 5 percent per year, although it is recognized that actual cost increases will vary among different parts of the Pinelands. A summary of projected acquisition costs is presented in Table 9.4.

Table 9.4—Projected Cost of Pinelands Acquisition Program

	Fiscal Years (beginning July 1, 1979)						
	1980	1981	1982	1983	1984	1985	1980-1985 Total
Average Cost/Acre	\$713 ¹	\$636	\$668	\$701	\$736	\$773	—
No. of Acres to be Acquired ²	6,000	18,800	18,800	18,800	18,800	18,800	100,000
Land Acquisition Cost (000's)	\$4,292.2	\$11,956.8	\$12,558.4	\$13,178.8	\$13,836.8	\$14,532.4	\$70,355.4
Contingencies @ 10% (000's) ³	— ¹	\$1,195.7	\$1,255.8	\$1,317.9	\$1,383.7	\$1,453.2	\$6,606.3
Settlement Costs @ 5% (000's) ⁴	\$214.6	\$657.6	\$690.7	\$724.8	\$761.0	\$799.3	\$3,848.0
Total Program Cost (000's)	\$4,506.8	\$13,810.1	\$14,504.9	\$15,221.5	\$15,981.5	\$16,784.9	\$80,809.7

1) This figure reflects actual 1980 costs. It is relatively high because it includes properties with structures and consists entirely of fee simple acquisitions. It also includes two acquisitions with higher than average costs. These factors are taken into account in future years under contingencies.

2) Total acreage includes a combination of fee simple and easement acquisitions.

3) Contingency costs include necessary purchases of structures or other improvements, possible severance damages, and other unanticipated costs.

4) Settlement costs include appraisals, surveys, title searches, title insurance, and legal fees.

In Lieu of Tax Payments

The case for making a payment in lieu of taxes (PILOT) based on full tax equivalency has been set forth earlier in this chapter. Estimates of the cost of implementing an in lieu payment program in connection with the Pinelands acquisition program are presented below. It should be noted that payments in lieu of taxes are warranted only in the case of fee simple purchases since acquisition of less than fee interests does not render a property tax exempt.

The computation of the estimated liability for payments in lieu of taxes due to fee simple acquisitions is based on estimates of an average PILOT per acre for acquisitions in the designated areas of the Pinelands. These estimates were computed by identifying the approximate number of acres to be acquired in each Pinelands jurisdiction, and multiplying the estimated assessed value (based on estimated purchase price) of the acquisitions in each locality by the actual 1979 tax rate for each respective area. This yielded an estimated full tax equivalency payment averaging \$16.67 per acre.

The average PILOT per acre was assumed to remain constant through 1981, and thereafter to increase at a rate of 5 percent per year to reflect inflationary pressures and the maximum budget increase allowed under New Jersey's municipal cap law. The resulting estimated payments per acre were applied to the projected number of acres to be wholly acquired each year to derive annual estimates of the cost of the payment in lieu of tax program. These estimates are shown in Table 9.5.

For projection purposes, it is assumed that New Jersey Green Acres bond funds will be used to help finance most of the fee simple acquisitions anticipated in the plan. Accordingly, a portion of the cost of the in lieu payment program will be paid automatically by the state under the Green Acres formula. Estimates of the potential Green Acres share of the in lieu costs are presented in Table 9.6.

Table 9.5—Estimated Gross Payments In Lieu of Taxes (PILOT) for Pinelands Acquisitions, 1980-1985

	Fiscal Years					
	1980	1981	1982	1983	1984	1985
No. of acres owned ¹	6,019	22,083	38,147	54,211	70,275	86,339
PILOT/acre	\$16.67	\$16.67	\$17.50	\$18.38	\$19.30	\$20.27
New PILOT	\$100,337	\$267,787	\$281,120	\$300,076	\$310,035	\$325,617
Existing PILOT with Adjustment ²		100,337	386,530	701,033	1,051,164	1,429,259
Total PILOT payments	100,337	368,124	667,650	1,001,109	1,361,199	1,754,876

1) Annual increase of 16,064 per year (fee simple) is assumed

2) 5% adjustment for 1982-85 only

Table 9.6—Estimated Payments in Lieu of Taxes for Pinelands Acquisitions Under Green Acres in Lieu of Tax Formula

(Fiscal Years)	Payment Schedule (in thousands)					
	1980	1981	1982	1983	1984	1985
Year of Acquisition						
1980	\$100.3	\$ 92.3	\$ 84.9	\$ 78.1	\$ 71.9	\$ 66.1
1981		267.8	246.4	226.7	208.5	191.8
1982			281.1	258.6	237.9	218.9
1983				300.1	276.1	254.0
1984					310.0	285.2
1985						325.6
Total	\$100.3	\$360.1	\$612.4	\$863.5	\$1,104.4	\$1,341.7

Note: This analysis assumes that first-year payments under Green Acres are the same as full tax equivalency. In reality, first-year payments would be equal to the previous year's taxes and would therefore tend to be lower, assuming normal tax increases.

As noted previously, since Green Acres payments for particular parcels would be phased out over a 13-year period, the supplemental amount required to achieve full tax equivalency increases each year until it reaches 100 percent. Estimates of the supplemental in lieu payment liability through 1985 are shown in Table 9.7.

Table 9.7—Pinelands Supplemental In Lieu Payment Liability (1980-1985 Estimates)

	1980	1981	1982	1983	1984	1985
Total PILOT	-0-	\$8,027	\$55,241	\$137,612	\$256,750	\$413,166

In summary, for this five-year planning period, only an estimated \$870,807 beyond the anticipated Green Acres share is specifically required to implement the in lieu payments based on full tax equivalency. Yet the cost will rise each year thereafter, as Green Acres payment schedules expire and local tax rates and/or assessments increase. To illustrate, if it is assumed that the total payment obligation under full tax equivalency were to increase by 5 percent each year between 1985 and 1995, it would amount to approximately \$2.9 million by the end of the ten-year period. The Green Acres share would have fallen to under 28 percent and more than \$2.0 million would have to be provided through a supplemental grant.

General Administrative Costs

The role and responsibilities of the Pinelands Commission and its administrative staff can be expected to change as the focus of effort shifts from planning to implementation during the course of the 1981 fiscal year. Major concurrent demands will be placed upon the Commission's planning, public involvement, and development review functions following the adoption of the

Comprehensive Management Plan. A major mobilization of effort will be needed to bring about consistency with the plan on the part of local governments in the Pinelands Area. Given these immediate demands on the Commission, total administrative costs are projected at slightly under \$3.0 million for fiscal year 1981. This estimate includes \$350,000 for planning assistance grants to local governments. It is anticipated that in some cases these funds could be used as the required local shares for federal matching grants. In the event that appropriations do not meet the projected costs, the commission will have to adjust its programs to reflect the lower level of funding. After fiscal year 1982, general administrative costs are projected to decrease to about \$1.6 million in 1984, and then to increase by about 5 percent annually. After 1982, budget needs are expected to reflect an internal shift of effort towards the development review function. The projected cost of the Commission's administration and operations are summarized in Table 9.8.

Table 9.8—Projected Cost of Pinelands Commission Administration and Operations

Fiscal Year	Total	(in thousands)		
		Planning and Public Involvement	Development Review	Planning Grants to Local Governments
1981	\$ 2,959.5	\$2,257.1	\$ 352.4	\$350.0
1982	2,480.0	2,036.0	444.0	—
1983	1,554.0	1,010.1	543.9	—
1984	1,631.7	979.0	652.7	—
1985	1,713.3	1,028.0	685.3	—
1981-85 Total	\$10,338.5	\$7,310.2	\$2,678.3	\$350.0

Financial Program Summary

The Commission's overall financial strategy is summarized in Table 9.9 in the form of a cost projection with specific sources of funding identified to meet the various revenue requirements during this 1980-85 period.

The acquisition program, which represents by far the largest cost element of the Comprehensive Management Plan, is expected to total approximately \$80.8 million by the end of the five-year projection period. Given the strong federal commitment to this aspect of the program, as well as the availability of state funds from the most recent Green Acres bond issues to provide most of the local matching share, revenue sources to support the acquisition program are judged to be well established and generally adequate. It is anticipated that the federal government will pay about 60 percent of total property acquisition costs.

The cost of payments in lieu of taxes based on full tax equivalency will amount to an estimated \$5.3 million over the course of the 1980-85 period. Funding to cover the majority of the cost of these payments is expected to be provided through the Green Acres in lieu formula. It is anticipated that resources will be adequate in the near term to provide supplemental funds to bring these payments up to the level of full tax equivalency. To provide long-term funding of this important element of the Pinelands Plan, the Commission recommends a broad-based, statewide revenue source.

The Commission's general planning and administrative costs are projected at slightly under \$3 million for fiscal year 1981 and at approximately \$2.5 million for fiscal year 1982. Planning needs are expected to lessen substantially after fiscal year 1983, and the need for administrative funds is expected to decline to the \$1.6-2.0 million level. The Commission believes that as a subdivision of the state without taxing authority, its activities will continue to warrant general state appropriations. The Commission also recommends that the New Jersey Legislature enact additional revenue measures as "own source" revenues for the support of Commission programs and operations. These new revenue mechanisms should be in place by the end of fiscal year 1983. While several potential "own source" revenues have been identified, the recommendation of

Table 9.9—Overall Financial Program: Summary of Projected Costs and Revenue Requirements

	(in thousands)						
	Fiscal Years (beginning July 1, 1979):						
	1980	1981	1982	1983	1984	1985	1980- 1985 Total
ACQUISITION PROGRAM							
Source of Funds:							
1. State of New Jersey							
a. Green Acres Bond Issues of 1974 and 1978	\$2,253.4	\$4,202.5	\$4,376.2	\$5,522.8	\$7,395.1	—	\$23,750.0
b. Future bond authority	—	—	—	—	595.6	8,392.5	8,988.1
Subtotal	2,253.4	4,202.5	4,376.2	5,522.8	7,990.7	8,392.5	32,738.1
2. U. S. Dept. of the Interior							
a. Section 502	—	8,107.6	8,628.7	6,263.7	—	—	23,000.0
b. Land and Water Conservation Fund (regular funds)	2,253.4	1,500.0	1,500.0	3,435.0	2,750.0	2,311.6	13,750.0
c. Land and Water Conservation Fund (additional need)	—	—	—	—	5,240.8	6,080.8	11,321.6
Subtotal	2,253.4	9,607.6	10,128.7	9,698.7	7,990.8	8,392.4	48,071.6
Acquisition Program Costs	\$4,506.8	\$13,810.1	\$14,504.9	\$15,221.5	\$15,981.5	\$16,784.9	\$80,809.7
IN LIEU OF TAX PAYMENTS							
Source of Funds:							
State of New Jersey							
a. Payments under Green Acres	\$100.3	\$360.1	\$612.4	\$863.5	\$1,104.4	\$1,341.7	\$4,382.5
b. Supplemental grant from broad-based revenue source	—	8.0	55.2	137.6	256.8	413.2	870.8
Cost of In Lieu Payments	\$100.3	\$368.1	\$667.7	\$1,001.1	\$1,361.2	\$1,754.9	\$5,253.3
ADMINISTRATION							
Source of Funds:							
1. U.S. Dept. of the Interior		\$1,733.3	\$1,000.0	—	—	—	\$2,733.3
2. State of New Jersey general appropriation		1,226.2	1,380.0	1,404.0	407.9	428.3	4,846.4
3. "Own Source" revenues		—	100.0	150.0	1,223.8	1,285.0	2,758.8
General Administrative Costs		\$2,959.5	\$2,480.0	\$1,554.0	\$1,631.7	\$1,713.3	\$10,338.5

specific fees and taxes should be made with regard to broader state fiscal considerations and, accordingly, should be the responsibility of the State Treasurer.

The Commission recognizes that the overall financial impacts of the Comprehensive Management Plan cannot be anticipated in any quantifiable way at this time, and that the nature of these prospective impacts may indeed be subject to debate. The financial program presented here

does not address the indirect fiscal effects on municipalities of land use controls under the Comprehensive Management Plan, or the inequities of past in lieu of tax payment programs. At the same time it is acknowledged that some type of program is appropriate in the future to alleviate any specific fiscal hardships (as well as to moderate possible "windfall" situations), and to address any other economic problems which may emerge following implementation of the Comprehensive Management Plan. The Commission will monitor the plan's financial impacts on a regular basis to identify potential fiscal problems at an early date so the appropriate resources may be brought together for their resolution.

CHAPTER TEN

Public Participation

The success of any land management plan is related to the level of understanding and cooperation of those affected by it. Ensuring that opportunities for public participation are provided at every decision point must be a concern of all planning and regulatory agencies. A successful public participation program results in a higher level of communication and a more equitable plan.

The importance of involving the public in the Commission's activities has been stressed in both the federal and state Pinelands legislation. These acts direct the Commission to provide the greatest possible role for the public while the Comprehensive Management Plan is being developed and implemented. In response, the Commission has tried to enhance public awareness of Pinelands issues, and has encouraged public comment on all matters relating to the development of this plan. The Commission's objectives have been: (1) to foster public involvement in developing the Comprehensive Management Plan; (2) to provide the public with an awareness of and sensitivity to the natural and cultural resources of the Pinelands; (3) to ensure that the key issues are identified and that acceptable solutions are included in the plan; and (4) to gain the assistance of the public in disseminating information and implementing the plan once it is completed.

The public participation program has included a range of activities such as a conference on cultural resources, public workshops on specific topics, personal communications and meetings with persons interested in the Commission's work, and the use of knowledgeable private individuals for guidance in research areas of interest to the Commission. Every effort was made to identify and clarify those issues which were of concern to the public so conflicts could be resolved prior to the plan's completion. At the same time, meetings were held to explain the Commission's policies. The goal has been to produce a plan protecting and enhancing the Pinelands' resources in a manner sensitive to the needs of the region's people. A summary of the activities carried out during the planning process follows.

Following the establishment of the Commission by Governor Brendan T. Byrne's Executive Order 71 in February 1979, an extensive public information campaign took place. The objectives of this campaign were to publicize the creation and function of the Commission, the goals of the planning program, and the restrictions which would apply to development during the planning period. The Commission initially relied on the Department of Environmental Protection for public information services. The Department's press office wrote general news releases related to the Commission's activities, informed municipalities and the public of Commission meetings, and distributed information on the Pinelands to interested parties throughout the state. As the Commission became more established, these functions were assumed by its own staff.

The subject of greatest public concern during those early months were the development restrictions instituted by Governor Byrne's executive order. To promote greater awareness and

understanding of the "moratorium," notices of the Governor's action as well as copies of the order were sent to all municipalities and counties within the Pinelands. A summary sheet explaining development application requirements and those uses which were automatically exempted was prepared and distributed. The staff responded to telephone calls and letters from local officials and individual property owners on a daily basis. As guidelines for reviewing applications were formulated, these were also distributed on request and through the Department mailing lists.

The first major public involvement activities of the Commission dealt with the proposed standards for development review. Drafts of the standards were prepared by the Commission's standards subcommittee and were mailed to hundreds of individuals and interest groups. The drafts were discussed at several public meetings of the subcommittee and the full Commission, and at three meetings arranged to elicit public response. Public comment was received through both oral and written statements. These comments were considered by the Commission while revising the proposed standards.

Efforts to inform the public of the overall planning program also began shortly after the Commission's organization. The work plan subcommittee prepared a list of goals and objectives for the Comprehensive Management Plan, and distributed these for comment. Individual commissioners took an active role in disseminating information to interested citizens and groups. Commissioners spoke at conferences and at meetings of professional and service organizations. The objective during this period was to generate a high level of awareness of the Commission's mandate and activities.

The public participation program evolved over the months from one concerned mainly with distribution of information to one which actively involved the public in the planning process. One example of the Commission's approach was its direction to consultants to utilize the expertise of knowledgeable local individuals. Each contract contained a proviso that the consultants would maintain "a responsive and ongoing public involvement throughout the performance of the agreement."

The Commission now uses a number of methods to ensure that the public has a voice in its decision-making and to keep the public current on planning issues. They range from regular comment periods at Commission meetings to informal discussions with groups and individual communications.

Commission Meetings

Notice of all Commission meetings is widely distributed. The meeting agenda is sent to the Commission's five official newspapers and to all municipalities and counties within the Pinelands. The meeting schedule is also printed in the Commission's newsletter, which has a distribution of approximately 2,000. All Commission meetings are open to the public, in keeping with New Jersey's Open Public Meetings Act, and opportunity for public comment is always provided on the agenda. Printed materials related to Commission activities are available at every meeting, and the staff answers questions and takes requests for additional materials. While the Commission has often met at the Pemberton Township Municipal Building or at Burlington County College, near its headquarters in New Lisbon, it has also met at least once in each of the seven Pinelands counties to facilitate attendance for all Pinelands residents. The Commission met biweekly until March, 1980, when it began meeting weekly.

Subcommittees

The Commission has established six subcommittees whose subject areas include acquisition, bylaws, personnel, public involvement, standards, and the work plan. The standards and work plan subcommittees have met most frequently and have generated the greatest levels of public interest.

The standards subcommittee was the center of attention during the Commission's early months when the interim development standards were being formulated. This group met frequently while revising the draft of the standards. All meetings were open to the public, and the

public aided the subcommittee greatly in refining the various drafts. This subcommittee was responsible for conducting the public comment meetings, which were attended by hundreds of people. The subcommittee considered all of their comments before making its final recommendations to the Commission.

In later months, public attention focused on the work plan subcommittee, whose responsibilities included development of the work plan, recommendations to the Commission on consultants' scopes of services, and general monitoring of the planning program. Persons who attended this subcommittee's meeting were able to participate in the discussions, helping the Commission identify issues.

The public involvement subcommittee includes members of the public as well as commissioners. This group's major objectives are to monitor the Commission's public participation activities and to recommend methods most effectively addressing the public's needs. Because the purposes of the public involvement and work plan subcommittees are interrelated, they have often met jointly. Commission members responsible for public involvement were thus in a position to give that activity a top priority during the plan's formative stages. These subcommittees are expected to continue to operate following adoption of the plan. Because public awareness will be essential during this period, the public involvement subcommittee will maintain a high level of activity.

Conferences and Workshops

The Commission has arranged and participated in a number of conferences and workshops. The format for these activities has included formal presentations, question-and-answer sessions, and small discussion groups. In several instances, the public was directly involved in planning these activities.

The Commission's first public workshop took place in August, 1979. Its subject was the Comprehensive Management Plan's work plan, which was then in preliminary draft form. Notices were sent to public and private groups and to individuals who had expressed an interest in Pinelands activities. Over 150 people responded to this invitation.

The workshop began with a summary of the work plan outline. Participants then separated into discussion groups according to their areas of interest. These sessions were intended to identify gaps in the work plan, to recommend additional study areas, and to establish priorities among these areas. Many suggestions made at this workshop were incorporated into the final work plan. The public involvement component was in fact an outgrowth of workshop recommendations.

To compile the data base needed for the Comprehensive Management Plan, the Commission contracted for studies with over 20 public agencies and private consultants. The initial products of many of these contracts were completed by mid-January, 1980. During February and March, the findings were presented to the public by consultants and staff members at a series of workshops. The workshops were arranged according to topical areas, and were held on Saturdays to promote attendance. The response demonstrated the high level of public interest in the Commission's activities. Those who attended were briefed on the wealth of information being used to develop the plan, were asked to help identify subjects on which more research was needed, and were given a chance to express any concerns relating to how the data would be used. Considerable press coverage of these workshops enabled the Commission to share some of its basic information with the general public at an early stage.

As described in Chapter Six, the collection and analysis of natural, cultural, and physical resource data led to the identification of critical areas in the Pinelands. The public was actively involved in this decision-making process through three workshops held during March, 1980 in Burlington, Atlantic and Ocean Counties. At these sessions, the public nominated areas of critical concern and participated in the identification and ranking of ecologically critical areas. Another exercise entailing active public involvement was the visual preference study, which was often conducted as part of the critical areas workshops. The purpose of this study was to assess general

preferences relating to natural and physical landscape types. As in the critical areas analysis, the public was asked to make choices among a number of factors and to nominate areas which it felt were representative of the Pinelands' scenic qualities. Results of this study were considered in developing the Commission's programs on scenic resources.

March was a period of critical planning decisions. Events designed to expand public involvement during this time were a series of meetings to discuss the Commission's proposed policies and programs, and the Pinelands cultural conference. The policy and program workshops were organized to give the public an opportunity to comment on staff recommendations before the Commission acted. Five of these meetings were held within a two-week period in Egg Harbor City, Stafford Township, Pemberton Township, Chatsworth, and Galloway Township. The attendance demonstrated again a remarkably high level of interest in the Commission's activities. The public's comments were considered and reflected in the final policy language adopted by the Commission.

The Third Annual Pine Barrens Conference at Stockton State College was co-sponsored by the Commission and the college's Center for Environmental Research. The focus of this two-day conference was the development of public awareness of the region's prehistoric, historic, and cultural resources. Over 300 people attended the conference, hearing talks on Pinelands history, culture, and archaeology and participating in discussions of strategies to protect these resources. The recommendations made at the conference were helpful in developing the programs included in this plan.

In June, following release of the draft plan, the Commission held workshops in Stafford and Hamilton Townships, and in Hammonton and Whitesbog, to explain the draft to the public and to begin collecting public response. Participants were divided into interest groups to discuss topics such as the plan's implications for property owners, businessmen, and municipal officials, and the plan's various resource programs. These sessions generated much valuable comment in an informal, give-and-take setting.

The workshops described above were designed to share information and to obtain public comment at specific points in the planning process. The Commission also held development review workshops throughout the year which served an ongoing educational function. Their purpose was to explain the Commission's guidelines and procedures for reviewing development applications during the interim period. Another area of discussion was the relationship between development review and the planning activities of the Commission. These workshops have taken place throughout the region and have involved the public, municipal and county officials, builders and other interested groups. They were particularly helpful in dispelling misunderstandings about the Commission's purpose, and in making the staff and Commission more sensitive to the needs of applicants and governmental officials.

Hearings

The Commission was required by the Pinelands Protection Act to hold hearings on the Draft Comprehensive Management Plan prior to its adoption. Six hearings were held in July, 1980 in Galloway, Winslow, Manchester, and Pemberton Townships, at Rutgers University in New Brunswick, and at the State House in Trenton. Far from being routine exercises, these hearings elicited a wealth of valuable testimony about the plan's potential impacts. The Commission also invited the submission of written and telephone comments on the draft, and it received hundreds of replies. These comments were all catalogued and summarized for efficient review by commissioners and staff members. Substantive comments were routed in full to staff members with the relevant program responsibilities.

The Commission continued to invite comments on the Protection Area portion of the plan after the Preservation Area portion was adopted. In October, public hearings were held in Woodbine and Medford Lakes on the Protection Area draft.

Advisory Committees

Throughout its development of the plan, the Commission has called upon many groups and

individuals for their advice and assistance. It has also helped organize formal advisory committees, including the Technical Advisory Committee, the Agricultural Advisory Committee, the Federal Advisory Committee, and the Pinelands Municipal Council, which is the only one of these groups specifically provided for in the Pinelands Protection Act.

The Technical Advisory Committee consists of approximately 30 scientists and other specialists possessing expertise in a range of Pinelands topics. Their areas of specialization include aquatic and terrestrial ecology, hydrology, geology, economics, archaeology, and the social sciences. Several of the committee's members were involved in the study prepared for the National Park Service which was influential in the establishment of the Pinelands National Reserve. Many members also contributed to the book, *Pine Barrens: Ecosystem and Landscape* (New York: Academic Press, 1979) which is a comprehensive treatise on the region's natural resources.

The technical committee was organized in the spring of 1979. During the first six months, it concentrated on formulating guidelines for the Commission's land acquisition program. These findings were included in an August, 1979 report to the Commission, entitled "Goals and Actions for the Pinelands Preservation and Land Acquisition Program." This report detailed a methodology for selecting and giving priorities to lands to be protected either through acquisition or other land use control techniques. These criteria have proved extremely useful to the Commission in developing its land use capability map and in identifying critical areas for acquisition and other types of protective measures.

Commissioners and staff members communicate frequently with the technical committee. Representatives of the group often attend Commission meetings and report on topics relevant to the Pinelands planning effort. In addition, individual members and subgroups of the committee have served as consultants for selected technical assessments. It is expected that this mutually beneficial association will continue, particularly as the Commission seeks ways to refine the Comprehensive Management Plan.

The state and federal acts specify that among its other objectives, the Comprehensive Management Plan is to promote the continuation and expansion of Pinelands agriculture. To adequately address this charge, the Commission organized the Agricultural Advisory Committee. Comprised of operating farmers and representatives of agri-business, farm organizations, and public agricultural agencies, the group is chaired by the New Jersey Secretary of Agriculture.

The committee advises the Commission on issues which may affect the viability of agriculture. These issues were summarized in a position paper presented to the Commission in February, 1980. The paper stressed the importance of effective anti-trespassing measures, regulation of nuisance ordinances, and compensation for restrictions on the use of lands. Several of the committee's suggestions have been incorporated into the Commission's management programs.

The agricultural community's advice and comments will be especially helpful as the Commission moves into the implementation stage of the plan. The committee has expressed an interest in remaining intact. This continued dialogue will be useful in assessing the plan's effectiveness in meeting the objectives of the act with respect to agricultural issues.

The Federal Advisory Committee is made up of representatives from a number of federal agencies, such as the Departments of the Interior, Housing and Urban Development, and Transportation, and the Environmental Protection Agency. The committee was organized by the Department of the Interior and is chaired by the Secretary's appointee to the Commission. This group's role is discussed in greater detail in Chapter Eight. The significance of the committee in terms of public participation is that it indirectly gives the public constituencies of other agencies some contact with the Commission, and promotes and generates a greater overall level of awareness of the Commission's purposes.

As specified in the state Pinelands law, the Municipal Council consists of the mayors or mayors' designees of the 52 municipalities within the Pinelands area. Its chief responsibility was

to review the Draft Comprehensive Management Plan. Under the Pinelands Protection Act, the Commission was required to submit the draft plan to the Council for a 60-day review before the plan could be adopted. This requirement determined the draft plan's release date of June 6, 1980. The Council also comments on any revisions to the plan, on the minimum standards for adoption of municipal land use plans and ordinances, and on any other matter which the Council or Commission deems advisable.

The Council met for the first time in October, 1979, at the call of the Commission's chairman. At this meeting, a steering committee was formed to make recommendations regarding the Council's role. The mayor of Evesham Township was selected as chairman of the steering group, which has been concerned with increasing interest and attendance at Council meetings. The law requires the Council to convene a majority of the 52 municipal representatives before it can officially conduct business, and as of this writing only one quorum had been obtained. Nevertheless, the group has met regularly, with staff support provided by the Commission. The Commission also financed the Council's hiring of professional help to review the draft plan. The Council's comments were presented prior to the Commission's adoption of the Preservation Area Plan in August. Despite its failure to obtain a quorum during the earlier planning phase, the Council has enhanced the Commission's understanding of municipal concerns about the plan's possible impact.

Coordination with Local and County Governments

In December, 1979, the Commission's staff initiated a program to establish working relationships with all municipal planning boards in the Pinelands. The initial objective of these meetings was to inform the boards of the plan's status and direction, and discuss planning uses in the respective municipalities. During the next few months members of the staff attended over 30 planning board meetings. Potential conflicts between the local and comprehensive plans and strategies for resolving these conflicts were discussed. The municipal role in plan implementation was also addressed. The meetings continued at a stepped-up pace following release of the draft plan. The Commission considers these meetings among the most productive of the planning year.

The Commission has also taken part in several meetings with county freeholders and planning board representatives. The major topic at these meetings has been the counties' role during the planning and conformance years. Representatives of several county planning boards have expressed an interest in having their agencies serve as the liaison between the Commission and their constituent municipalities. Atlantic and Camden counties appointed staff members to serve in this liaison role. County staffs have also provided technical assistance to the Commission, reviewing consultant reports and evaluating the Commission's policies in light of county plans and programs. The Commission has entered into contracts with some counties for these services.

Interest Groups and Coalitions

A number of groups are actively involved in monitoring or participating in the Commission's planning program. Several of these groups, such as the Pine Barrens Coalition, the Association of New Jersey Environmental Commissions, the New Jersey Conservation Foundation, the New Jersey chapter of the Sierra Club, and national conservation organizations, were instrumental in raising the public's consciousness concerning the significance of the Pinelands. Other groups monitor the Commission's activities because of their concern over the plan's potential economic impacts. These include the Coalition for the Sensible Preservation of the Pinelands, representing builders, contractors, banks, and real estate interests, and the Coalition to Save Agriculture. Both the builders' and the farmers' groups, represented by their own attorneys and planners, made detailed written and oral presentations to the Commission prior to adoption of the Comprehensive Management Plan for the Preservation Area and for the Protection Area. The Pine Barrens Coalition made similar presentations.

Commissioners and staff members have spoken at many events both within and outside the Pinelands, responding to invitations from a wide range of organizations. In other cases, speaking engagements were initiated by the staff on the Commission's behalf. Groups which commissioners

and staff members have addressed include service organizations such as the Rotary, the League of Women Voters, professional societies, businessmen's associations, nature clubs, university classes, and organizations of local and state officials.

Communications

While public events are effective means of disseminating information, the Commission has recognized the importance of establishing relationships with individual members of the public who may be interested in or affected by its activities. The public involvement program promotes these one-to-one contacts in several ways, including responding to requests for information, distributing cards and brochures which invite the public to meet with the staff, and informing interested persons of the Commission's activities.

Printed materials have been an important element in increasing public awareness of the planning program. Four thousand copies of the Draft Comprehensive Management Plan itself were printed, with approximately 2,500 made available to the public. Copies were also sent to libraries and municipal offices throughout the Pinelands for ongoing public review. The Commission's newsletter, *The Pinelander*, was first published in December, 1979 and is now distributed to a mailing list of approximately 2,000 individuals, agencies, and interest groups. The newsletter highlights the Commission's activities and includes a schedule of upcoming events. The mailing list used for the newsletter and other materials has been computerized through an arrangement with Burlington County College.

Another publication provided answers to questions most frequently asked about the development review process. A brochure entitled "You Can Help Plan the New Jersey Pinelands' Future" recommended ways the public could become involved. Additional printed materials available to the public included a summary of the draft plan, descriptions of the consultants' work efforts, and outlines of programs and policies discussed at Commission meetings. Copies of consultant reports have also been made available for public review, both at the Commission offices and at county planning board offices.

The Commission has also relied on the print and electronic media to communicate its activities to the public. The five New Jersey newspapers with the largest daily circulations in the Pinelands serve as the Commission's designated newspapers for public notices. They are the *Asbury Park Press*, *The Press of Atlantic City*, *The Burlington County Times*, the *Courier-Post* of Camden, and the *Ocean County Times-Observer* of Toms River. These newspapers often carry articles concerning the Commission's activities, as do papers in Trenton and Philadelphia and many local weeklies.

The region's radio and television stations have paid increasing attention to the Commission as its planning proposals were made. Radio stations have carried public service announcements, and persons associated with the Commission have participated in broadcast interviews and panel discussions. The staff has provided assistance to television stations which were preparing documentaries on the Pinelands. Recently aired programs include productions by WNEW-TV (Channel 5 in New York), and "Joe Albert's Fox Hunt," prepared by a private group and aired on public television stations. This film described the attitudes of Pinelands residents toward encroaching development and the Pinelands protection effort.

CONTINUING PROGRAMS

Implementation of the Comprehensive Management Plan is envisioned as a combined effort on the part of various levels of government, the private sector, and the general public. Protection of the area's sensitive land and water resources will require the active involvement of all affected parties. The high levels of public interest and participation during the planning period resulted in a constructive working relationship between the public and the Commission. The challenge now

facing the Commission is to ensure that this necessary involvement continues and is in fact increased during the implementation period.

The Commission is pledged to an aggressive program of public participation which ensures that the continuing planning and management of the Pinelands is responsive to the needs and concerns of an informed public. In light of this goal, the Commission has adopted the following policies: to provide information to the public regarding the Pinelands, appropriate uses of its resources and the means by which individuals can assist in their protection; and to provide for active involvement of the public in the implementation of the Comprehensive Management Plan.

In developing the plan's public use and involvement components, which are required by both the federal and state Pinelands legislation, the Commission was guided by a number of considerations. The public has to be kept informed of the Commission's activities and the purpose of the Comprehensive Management Plan. Public information efforts must reach as wide and diverse an audience as possible. Educational materials have to be provided, emphasizing the sensitive nature of the Pinelands' resources and detailing critical issues related to their protection. Points at which public involvement is most meaningful have to be highlighted, with a range of opportunities provided for both active and passive involvement. The overall program must be visible, continuous, and responsive.

A program consisting of three major components has been developed to carry out the Commission's adopted policies. The components are public information, education, and involvement. In practice, overlap will occur among these three components; all information is educational in nature, and education requires involvement. For purposes of presentation, however, these categories are used in the following description.

Public Information

Public information is an essential element in any planning and regulatory program. It is also a prerequisite to both public education and public involvement. To be able to participate and to sense when that participation will be most effective, individuals must first become aware of the issues and critical decisions to be made. The objectives of the Commission's information program are to reach as large and diverse an audience as possible, to increase public interest in and support for the Pinelands management program, and to maintain this interest and support throughout the implementation period.

The Commission's public information activities, and the news coverage given to this important regional topic, have heightened public understanding of the issues related to Pinelands preservation. The Commission will now focus its public information efforts on explaining the programs which are being employed to maintain the Pinelands' special qualities. The effort will be both aggressive and responsive, and will include expanded contacts with the media, new Commission publications, and personal communications.

The Commission will continue to publish its newsletter on a regular basis. Brochures covering several topics will also be prepared. Examples of topics include summaries of various aspects of the Comprehensive Management Plan, and special subjects such as fire safety, water quality, and alternative on-site wastewater disposal systems.

A travel guide to points of interest in the Pinelands will be designed. The guide will provide suggested routes for visiting sites of historic and natural significance, and will describe facilities and services.

The Commission will expand its reliance on the print and electronic media to inform the public of its activities. The strategy will include press releases, radio public service announcements, efforts to increase radio and television coverage, and contacts with specialized publications such as environmental magazines. The staff will respond promptly to oral and written requests for information, and will publicize telephone numbers which people may call to help solve specific problems.

Education

Greater public awareness of the Pinelands' resources, the appropriate use of these resources, and the issues and conflicts which arise when planning for the protection of this large and diverse region are the major objectives of the Commission's education program. Increasing awareness is the first step in enhancing the public's commitment to Pinelands protection.

The Pinelands are a living laboratory which presents many opportunities for school curricula. The study of natural, physical, and cultural resources can be pursued individually or integrated to provide a multi-disciplinary program. The Commission will cooperate with the New Jersey Department of Education and regional Educational Improvement Centers to develop curriculum material for elementary and secondary school students and teachers. It will also encourage the Department of Higher Education to promote courses dealing with the Pinelands. In addition, the Commission will be involved in the presentation of curriculum workshops for teachers from the region and the state.

The Commission has had over 20 studies completed for the Comprehensive Management Plan. The topics include hydrology, geology, wildlife, vegetation, archaeology, culture, and regional growth. These planning reports provide a valuable data base for government agencies at all levels. In addition, they contain a great deal of information which may be of interest to the general public. The Commission will develop a reference library to house these reports and other literature on the Pinelands for use by the public. Resource booklets will also be prepared, which will include a Pinelands bibliography, a list of films related to the Pinelands, and other sources of information about the region.

The Comprehensive Management Plan has identified the critical resources of the Pinelands and the factors which may have a negative impact on them. The legislation requires the Commission to inform the public in its plan about uses which are compatible with the maintenance of the region's natural resources. As part of this commitment, the Commission will prepare a user's guide to the Pinelands. This publication will inform residents and visitors about the area's significant resources and the measures which must be taken to protect them. To this extent, interpretative programs dealing with topics such as recreational areas and historic sites will also be developed for use on state-owned land in the Pinelands. This feature is discussed in more detail in Chapter Seven's section on recreation.

Many Pinelands residents have expertise on a number of subjects, including history, archaeology, and natural history. The Commission will sponsor lecture series and short courses to share the knowledge of these persons with the general public. Commission staff members will participate in these presentations, which will be held in the Commission's office and at other Pinelands locations. A Speakers Bureau will also be established to provide speakers for specific topics. The Commission will prepare a list for distribution which identifies these individuals and their areas of expertise.

The Commission will cooperate with private non-profit and public organizations such as the 4-H, Boy Scouts, Girl Scouts, garden clubs, environmental groups and agencies, and community associations in developing educational programs for the public.

Several educational projects have been identified which the Commission intends to initiate if funds become available. One of these projects is a mobile classroom equipped with a variety of educational materials, including audio-visual aids, learning kits, and examples of Pinelands plants and animals. This classroom will be made available to schools and for other events such as conferences.

Public Involvement

Public involvement in the planning program has been of great benefit to the Commission. Public and private agencies, groups, and individuals have provided valuable information and guidance. Their efforts have improved communication and helped to focus attention on issues of major concern.

The Commission will continue to use the techniques that have promoted this level of public involvement. It will also seek to expand the public's opportunities to affect the decision-making process. Methods will include improving access to the Commission's data base and increasing the level of response to suggestions from the public.

Opportunities for public comment will continue to be provided at every Commission meeting as a designated item on the agenda. This allows all commissioners to hear members of the public voice their concerns and to respond directly to these concerns.

Subcommittee meetings will continue to be open to the public except in those instances when the law provides for closed sessions. Public comment at these meetings will be encouraged. While all existing subcommittees are expected to continue operating, the role of the public involvement subcommittee will increase during implementation of the plan. The Commission's staff will assist this subcommittee in disseminating information and in arranging workshops and meetings.

During the planning period, several groups were organized to provide advice to the Commission. These included the Agricultural Advisory Committee, Technical Advisory Committee, and Federal Advisory Committee. The recommendations made by these groups were especially useful in the comprehensive planning effort. The Commission will seek ways to increase their involvement as the plan takes effect.

The continued cooperation of the agricultural committee will be valuable in assessing the plan's effects on agriculture in the Pinelands. The Commission desires this group to monitor these effects and to suggest any alternative strategies for achieving the plan's objectives. The committee may also act as a liaison between the agricultural community and the Commission. As described in the section on agricultural programs, the Commission also recommends the formation of county Pinelands Agricultural Review Boards.

The Technical Advisory Committee will assist the Commission in evaluating the effectiveness of the plan and in identifying continuing research needs. The committee will be asked to establish priorities among these research areas and to coordinate some studies, to the extent practicable.

The Federal Advisory Committee will play an important role as the Commission refines the Comprehensive Management Plan for submission to the U.S. Secretary of the Interior. Representatives of this committee will advise the Commission of federal programs which may affect the Pinelands. They will also serve as liaison between their agencies and the Commission to make certain that federal actions are consistent with the plan.

Relations with the Municipal Council will be strengthened. The Commission will solicit the Council's review of any revisions which are made following the plan's adoption. At the Council's request, the Commission's staff will continue to provide assistance in terms of organizing meetings and distributing information to all Pinelands mayors.

The formation of additional boards and committees will be explored. One interesting possibility is the development of a structure for subregional committees, which would interact with the public involvement subcommittee. The role of these subregional boards would be to distribute information on the Commission's planning activities, to assess the effectiveness of various programs in their respective areas, and to act as sounding boards for public comments on implementation of the plan. They would report these findings and any additional suggestions to the Commission on a regular basis, and could call upon staff support from the Commission if desired.

The subregions would be identified according to common interests rather than necessarily representing political boundaries. As an example, corridor communities could form one subregion, nearby growth area communities another, and predominantly agricultural areas another. While committee membership would include elected officials, representatives of the business community, and environmental groups, the membership could be weighted toward the major land users in the subregion. Each board would elect a chairman who would also serve as that subregion's representative on the public involvement subcommittee. The establishment of

subregional boards is considered a promising approach for ensuring active and positive public involvement in the plan's implementation.

The Commission has assigned a staff member as a liaison to the county planning boards. This liaison function will be expanded during the implementation period, enabling the counties to assist their constituent municipalities in conforming to the requirements of the Comprehensive Management Plan.

The Commission will also expand the working relationship it has established with representatives of the Pinelands municipalities. Workshops will be organized to provide local officials with guidelines for attaining consistency between their plans and the Comprehensive Management Plan. These workshops may be extended to involve the general public so that residents can be updated on the status of their municipalities' conformance activities.

Finally, the Commission and its staff will continue to meet with special interest groups such as those described in this summary. Efforts will be made to identify additional groups and to encourage their active involvement in carrying out the plan. These may include planning officials, conservation associations, and service organizations. The Commission will encourage these groups to act as vehicles for the distribution of information about the Comprehensive Management Plan, about the Commission's ongoing activities, and about the significance of the Pinelands to New Jersey and the nation.

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Part II



ARTICLE 1
General Provisions

**PART 1—TITLE, AUTHORITY, PURPOSE,
APPLICABILITY, FEES AND SEVERABILITY**

Section 1-101.

Title

This element, Articles 1 through 8, shall be known as the Implementation Element of the Pinelands Comprehensive Management Plan.

Section 1-102.

Authority

These regulations are adopted pursuant to the Pinelands Protection Act, N.J.S.A. 13:18A-1 to 29, as amended by Laws of 1980, Chapter 65, adopted on July 10, 1980.

Section 1-103.

General Purpose and Intent

This element of the Pinelands Comprehensive Management Plan is adopted in order to implement, and is an exercise of the powers granted to the Pinelands Commission by, the Pinelands Protection Act and the Federal Act. The regulations and standards it contains are designed to promote orderly development of the Pinelands so as to preserve and protect the significant and unique natural, ecological, agricultural, archaeological, historic, scenic, cultural and recreational resources of the Pinelands.

Section 1-104.

Applicability

The regulations contained in this element shall apply to all development within the Pinelands Area and shall supersede the in-

terim rules and regulations adopted by the Pinelands Commission contained in N.J.A.C. 7:1G-1.1 et seq. and 2.1 et seq. and the Plan for the Preservation Area adopted by the Pinelands Commission on August 8, 1980. It shall be unlawful for any person to carry out any development in the Pinelands Area which does not conform to the minimum standards of this Plan.

Section 1-105.

Effective Date

This Comprehensive Management Plan for the Pinelands shall take effect as provided in Sections 5h and 7 of the Pinelands Protection Act, N.J.S.A. 13:18A-1 to 29, as amended by Laws of 1980, Chapter 65, adopted on July 10, 1980.

Section 1-106.

Fees

All applications required or permitted by any provision of this Plan, other than applications filed by a public agency, shall be accompanied by a nonrefundable application fee, in such amount as shall from time to time be established by the Commission, to defray the actual costs of processing such application. No application filed pursuant to this Plan shall be considered complete unless all fees required by this Part have been paid. The Commission shall maintain a schedule of such fees and make such schedule available to all persons upon request. Such schedule shall, in addition to application fees, estab-

lish such other fees for Commission services or documents as are required by this Plan or determined by the Commission to be necessary or appropriate to equitably apportion the costs of such services or documents to the users thereof.

**Section 1-107.
Severability**

If any section, part, phrase, or provision of

this Plan or the application thereof to any person be adjudged invalid by any court of competent jurisdiction, such judgment shall be confined in its operation to the section, part, phrase, provision, or application directly involved in the controversy in which such judgment shall have been rendered and it shall not affect or impair the validity of the remainder of this Plan or the application thereof to other persons.

PART 2—DUTIES AND POWERS OF THE COMMISSION

**Section 1-201.
Duties and Powers**

The Commission bears the ultimate responsibility for implementing and enforcing the provisions of the Pinelands Protection Act and this Plan. In addition, it constitutes the planning entity provided for in the Federal Act and is responsible for achieving the purposes and provisions of the Federal Act. The Commission shall exercise the powers necessary to implement the objectives of the Federal Act, the Pinelands Protection Act and this Plan.

**Section 1-202.
Meetings, Hearings and Procedures**

A. The Commission shall fix the time and place for holding its regular meetings. Special meetings may be held at the call of the Chairman. All meetings of the Commission shall be held in accordance with the provisions of the "Open Public Meetings Act,"

N.J.S.A. 10:4-6.

B. All hearings of the Commission shall be set, noticed and conducted in accordance with the provisions of Section 4-103 of this Plan [COMMISSION HEARING PROCEDURES].

C. The Commission shall adopt its own rules for the conduct of its business, meetings and hearings not inconsistent with the Pinelands Protection Act and this Plan. All rules shall be adopted pursuant to the Administrative Procedures Act, N.J.S.A. 52:14B-1 et seq. and shall be filed with the Executive Director. Copies thereof shall be available to any person upon request.

D. A true copy of the minutes of every meeting of the Commission shall be delivered to the Governor. No action taken by the Commission shall have force or effect until ten days, exclusive of Saturdays, Sundays and public holidays, following delivery of the minutes to the Governor.

PART 3—DUTIES AND POWERS OF THE EXECUTIVE DIRECTOR

**Section 1-301.
Duties and Powers**

The Executive Director shall be the chief administrative officer of the Commission and, subject to the approval of his actions by the Commission as provided herein, shall be charged with the administration and enforce-

ment of this Plan. He shall supervise, manage and be responsible for the affairs and activities of the Commission staff, including, but not limited to, the exercise of the following duties and powers:

A. Rules and Regulations

The Executive Director shall, consistent

with the express standards, purposes and intent of this Plan, establish administrative procedures and forms as are in his opinion necessary to the effective administration and enforcement of the provisions of this Plan and the rules and regulations of the Commission.

B. Records.

The Executive Director shall maintain:

1. Permanent and current records of this Plan including all maps, amendments, development approvals and denials, interpretations and decisions rendered by the Commission or by the Executive Director together with relevant background files and materi-

als.

2. A current file of all certificates and approvals issued pursuant to this Plan for such time as necessary to ensure continuous compliance with the provisions of this Plan and such certificates and approvals.

3. A current file of all letters of interpretation issued pursuant to Article 4, Part 6, of this Plan [LETTERS OF INTERPRETATION].

4. Permanent and current records of all meetings, hearings and proceedings, and the minutes and transcripts taken therein, held by the Commission or the Executive Director pursuant to this Plan.

ARTICLE 2

Interpretations and Definitions

PART 1—INTERPRETATION

Section 2-101. Provisions are Minimum Requirements

In their interpretation and application, the provisions of this Plan shall be held to be the minimum standards for the preservation of the Pinelands, as set forth in the provisions of this element. Where the provisions of this Plan are more restrictive than those of any other statute, ordinance or regulation, the provisions of this Plan shall control.

Section 2-102. Construction

This Plan, being necessary for the protection and preservation of the resources of the Pinelands, shall be construed liberally to effect the purposes of the Federal Act and the Pinelands Protection Act.

Section 2-103. Word Usage

In the interpretation of this Plan, the provisions and rules of this Section shall be observed and applied, except when the context clearly requires otherwise:

1. Words used or defined in one tense or form shall include other tenses and derivative forms.
2. Words in the singular shall include the plural and words in the plural shall include the singular.
3. The masculine gender shall include the feminine and the feminine gender shall include the masculine.
4. The word "shall" is mandatory.
5. The word "may" is permissive.
6. In case of any difference of meaning or implication between the text of this Plan and any caption, the text shall control.

PART 2—DEFINITIONS

Section 2-201. Definitions

When used in this Plan, the following terms shall have the meanings herein ascribed to them:

A-1. Accessory Structure or Use.

An accessory structure or use is a structure or use which:

1. Is subordinate to and serves a principal building or a principal use, including but not limited to the production, harvesting, and storage as well as washing, grading and packaging of unprocessed produce grown on-site;
2. Is subordinate in area, extent and purpose to the principal structure or principal building or a principal use;
3. Contributes to the comfort, convenience

or necessity of the occupants, business or industry of the principal structure or principal use served; and

4. Is located on the same lot as the principal structure or principal use served, except as otherwise expressly authorized by the provisions of this Plan.

A-2. Advanced Wastewater Treatment.

Treatment processes above and beyond conventional preliminary, primary, and secondary treatment with chlorination.

A-3. Affordable Housing.

Housing for which a household will not have to spend more than 30% of their annual income for shelter.

A-4. Agricultural Employee Housing.

Residential dwellings, for the seasonal use of employees of an agricultural or horticultural use, which because of their character or location are not practical for and cannot be transformed into permanent house-keeping units for non-agricultural employees.

A-5. Agricultural or Horticultural Purpose or Use.

Any production of plants or animals useful to man, including but not limited to: forages or sod crops; grains and feed crops; dairy animals and dairy products; poultry and poultry products; livestock, including beef cattle, sheep, swine, horses, ponies, mules or goats, and including the breeding and grazing of any or all of such animals; bees and apiary products; fur animals; trees and forest products; fruits of all kinds, including grapes, nuts and berries; vegetables; nursery, floral, ornamental and greenhouse products; or any land devoted to and meeting the requirements and qualifications for payments or other compensation pursuant to a soil conservation program under an agency of the Federal Government.

A-6. Amendment.

A means for making changes in this Plan as expressly authorized by the provisions of Article 7 of this Plan or any change to a certified local master plan or land use ordinance.

A-7. Animals, Threatened or Endangered.

See Section 6-302 [FISH AND WILDLIFE].

A-8. Application for Development.

Any application, filed with any permitting agency, for any approval, authorization or permit which is a prerequisite to initiating development in the Pinelands Area, except for an application for approval, authorization or permit for:

1. The improvement, expansion or reconstruction of any single family dwelling unit or appurtenance thereto;

2. The improvement, expansion, construction or reconstruction of any structure accessory to a single family dwelling;

3. The improvement, expansion, construction or reconstruction of a structure used exclusively for agricultural or horticultural purposes;

4. The repair of existing utilities and the installation of utilities to serve existing or approved development; and

5. The clearing of less than 1500 square feet of land that is not located in a wetland or within 200 feet of a scenic corridor.

B-1. Building.

Any structure, either temporary or permanent, having a roof and designed, intended or used for the sheltering or protection of persons, animals, chattels or property of any kind.

C-1. Campsite.

A place used or suitable for camping.

C-2. Certificate of Appropriateness.

See Section 6-1404^{6-1404A} [HISTORICAL, ARCHAEOLOGICAL AND CULTURAL PRESERVATION].

C-3. Certificate of Conformity.

See Sections 4-401-7 [PUBLIC DEVELOPMENT].

C-4. Certificate of Filing.

See Section 4-304 [CERTIFICATE OF FILING] and Section 4-702 [COORDINATED STATE PERMITTING].

C-5. Certified County Master Plan or Ordinance.

Any county master plan or ordinance certified by the Commission pursuant to Article 3, Part 2, of this Plan as being in conformance with the minimum standards of this Plan.

C-6. Certified Municipal Master Plan or Land Use Ordinance

Any municipal master plan or land use ordinance certified by the Commission pursuant to Article 3, Part 4, of this Plan as being in conformance with the minimum standards of this Plan.

C-7. Commencement of Construction.

Actual construction on a parcel of land in accordance with a permit issued by the applicable jurisdiction if the cost of the physical improvements completed constitutes at least twenty-five percent of the projected total cost of the development or the completion of all required foundations, of a form and character such that the foundations are not useable for any other form of development except that authorized by the issued permit.

C-8. Commission.

The Pinelands Commission created pursuant to Section 5 of the Pinelands Protection Act.

C-9. Comprehensive Management Plan.

The plan adopted by the Commission pursuant to Section 7 of the Pinelands Protection Act as amended.

C-10. Construction.

The construction, erection, reconstruction, alteration, conversion, demolition, removal or equipping of buildings or structures.

C-11. Contiguous Lands.

Land which is connected or adjacent to other land so as to permit the land to be used as a functional unit; provided that separation by lot line, streams, roads, rights-of-ways, and easements shall not affect the contiguity of land.

C-12. County.

The New Jersey counties of Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester and Ocean.

C-13. County Master Plan.

A composite of the master plan for the physical development of a New Jersey county with the accompanying maps, plats, charts and descriptive and explanatory matter adopted by the county planning board pursuant to N.J.S.A. 40:27-2 and 40:27-4 or their successor statutes.

C-14. County Planning Board.

The governing authority responsible for county planning and organized pursuant to N.J.S.A. 40:27-6.1, and defined therein.

D-1. Day.

For purposes of computing time limits, the word "day" in this ordinance refers to a calendar day.

D-2. Density.

The average number of housing units per unit of land.

D-3. Developer.

The legal or beneficial owner or owners of a lot or of any land proposed to be included in a development including the holder of an option or contract to purchase, or other person having an enforceable proprietary interest in such land.

D-4. Development.

The change of or enlargement of any use or disturbance of any land, the performance of any building or mining operation, the division of land into two or more parcels, and the creation or termination of rights of access or riparian rights including, but not limited to:

1. A change in type of use of a structure or land;
2. A reconstruction, alteration of the size, or material change in the external appearance of a structure or land;
3. A material increase in the intensity of use of land, such as an increase in the number of businesses, manufacturing establishments, offices or dwelling units in a structure or on land;
4. Commencement of resource extraction, drilling, or excavation on a parcel of land;
5. Demolition of a structure or removal of trees;

6. Deposit of refuse, solid or liquid waste or fill on a parcel of land;

7. In connection with the use of land, the making of any material change in noise levels, thermal conditions, or emissions of waste material; and

8. Alteration, either physically or chemically, of a shore, bank, or flood plain, seacoast, river, stream, lake, pond, wetlands or artificial body of water;

D-5. Development Approval.

Any approval granted by the Executive Director or the Commission pursuant to Article 4, Part 2 or Part 4 of this Plan.

D-6. Development, Major.

Any division of land into five or more lots; any construction or expansion of any housing development of five or more dwelling units; any construction or expansion of any commercial or industrial use or structure on a site of more than three acres; or any grading, clearing or disturbance of an area in excess of 5,000 square feet.

D-7. Development, Minor.

All development other than major development.

D-8. Development, Public.

Any development by a public agency.

D-9. District.

A portion of the territory of the Pinelands Area within which certain regulations and requirements or various combinations thereof apply pursuant to the provisions of this Plan.

D-10. Drainage.

The removal of surface water or ground water from land by drains, grading or other means including control of runoff to minimize erosion and sedimentation during and after construction or development and means necessary for water supply preservation or prevention or alleviation of flooding.

D-11. Dwelling.

Any structure or portion thereof which is designed or used for residential purposes.

D-12. Dwelling Unit.

Any room or group of rooms located within

a structure forming a single habitable unit with facilities which are used or intended to be used for living, sleeping, cooking, eating and sanitation by one family.

E-1. Electric Transmission Lines.

Electric lines carrying more than 230 kvs.

E-2. Enlargement.

An addition to the floor area of an existing building, an increase in the size of any other existing structure or an increase in that portion of a tract of land occupied by an existing use.

E-3. Erosion.

The detachment and movement of soil or rock fragments by water, wind, ice or gravity.

E-4. Executive Director.

The chief administrative officer of the Commission or any representative designated by such chief administrative officer to perform any functions delegated to such chief administrative officer pursuant to any provision of this Plan.

F-1. Family

One or more persons related by blood, marriage, adoption or guardianship, or any number of persons not so related occupying a dwelling unit and living as a single house-keeping unit.

F-2. Family, Immediate.

(See I-1).

F-3. Federal Act.

Section 502 of the National Parks and Recreation Act of 1978 (PL95-625).

F-4. First Order Stream.

That portion of a stream, as identifiable on the USGS 7 1/2' quadrangle maps, from the point of upstream origin, downstream to the first point of intersection with another branch, stream or tributary.

F-5. Fish and Wildlife Management.

The changing of the characteristics and interactions of fish and wildlife populations and their habitats in order to promote, protect and enhance the ecological integrity of those populations.

F-6. Flood Plain.

The relatively flat area adjoining the chan-

nel of a natural stream, which has been or may be hereafter covered by flood water.

F-7. Floor Area.

The sum of the gross horizontal areas of the several floors of a building, measured from the exterior faces of the exterior walls, or from the centerline of a wall separating two buildings.

F-8. Forestry.

The growing and harvesting of trees for commercial purposes.

F-9. Forestry Management Plan.

See Section ~~6-404~~ (B) (1) [FORESTRY].

H-1. Habitat.

The natural environment of an individual animal or plant, population, or community.

H-2. Height of Building.

The vertical distance measured from grade to the highest point of the roof for flat roofs, to the deck line for mansard roofs and to the mean height between eaves and ridge for gable, hip and gambrel roofs.

H-3. Historic, Archaeological and Cultural Preservation Board.

See Section 6-1403.

H-4. Historic District.

An area designated by the Commission, pursuant to Section 6-1403, as having such historic, cultural or archaeological significance as to merit special protection.

H-5. Historic Resource.

Any site, building, area, structure or object significant in American history, architecture, archaeology and culture at the national, state, county, local or regional level.

H-6. Hydrophytes.

Any plant growing in water or in substrate that is at least periodically deficient in oxygen as a result of excessive water content.

I-1. Immediate Family.

Those persons related by blood or legal relationship in the following manner: grandparents, grandchildren, parents, sons, daughters, brothers and sisters, aunts and uncles and first cousins.

I-2. Impermeable Surface.

Any surface which does not permit fluids to pass through or penetrate its pores or spaces.

I-3. Institutional Use.

Any land used for the following public or private purposes: educational facilities, including universities, colleges, elementary and secondary and vocational schools, kindergartens and nurseries, cultural facilities such as libraries, galleries, museums, concert halls, theaters and the like; hospitals, including such educational, clinical, research and convalescent facilities as are integral to the operation of the hospital; medical and health service facilities, including nursing homes, supervised residential institutions, rehabilitation therapy centers and public health facilities; law enforcement facilities; military facilities; and other similar facilities.

I-4. Interested Person.

Any persons whose right to use, acquire or enjoy property is or may be affected by any action taken under this Plan, or whose right to use, acquire or enjoy property under this Plan or under any other law of this State or of the United States has been denied, violated or infringed upon by an action or a failure to act under this Plan.

L-1. Land.

Land includes the surface and subsurface of the earth as well as improvements and fixtures on, above, or below the surface and any water found thereon.

L-2. Landfill.

Sites, including open dumps, where solid waste, liquid and dry sewage sludge, and liquid and dry chemical waste are disposed of by land application with or without the use of management practices or soil covering. For the purposes of this Plan solid waste transfer stations shall not be considered landfills.

L-3. Landscaping.

The installation of plant material or seed as a part of development.

L-4. Land Use Ordinance or Land Use Regulation.

Any county or municipal ordinance or regulation which, in any way, regulates or affects the development of land.

L-5. Leachate Collector.

For the purposes of this Plan, "leachate collector" shall have the meaning attributed to the phrase by, and each such "leachate collector" shall conform to the requirements of, the New Jersey Solid Waste Administration.

L-6. Local Permitting Agency.

Any county or municipal official, department, agency or other body authorized to rule on any application for development.

L-7. Lot.

A designated parcel, tract or area of land designated for use or development as a unit.

L-8. Low Income Household.

A household with an annual income of less than 80% of the median income for the county or Standard Metropolitan Statistical Area.

M-1. Median Income.

The median of household income as determined from time to time by the New Jersey Department of Labor and Industry to be the median.

M-2 Middle Income Household.

A household with an annual income between 100% and 120% of the median income for the county or Standard Metropolitan Statistical Area.

M-3. Moderate Income Household.

A household with an annual income which is 80% to 100% of the median income for the county or Standard Metropolitan Statistical Area.

M-4 Municipal Master Plan.

A composite of one or more written or graphic proposals for development of the municipality as set forth and adopted pursuant to N.J.S.A. 40:55-28.

M-5. Municipality.

Any city, borough, town or township.

N-1. Navigable Waters.

Water capable of being transversed by pleasure craft.

O-1. Off-Site Commercial Advertising Sign.

A sign which directs attention to a business, commodity, service or entertainment conducted, sold or offered at a location other than the premises on which the sign is located.

P-1. Parcel.

Any quantity of land capable of being described with such definiteness that its location and boundaries may be established, and which is designed by its owner as land to be used as a unit.

P-2. Person.

An individual, corporation, public agency, business trust, partnership, association, two or more persons having a joint or common interest, or any other legal entity.

P-3. Pinelands.

The Pinelands National Reserve and the Pinelands Area.

P-4. Pinelands Area.

That area designated as such by Section 10(a) of the Pinelands Protection Act.

P-5. Pinelands Development Approval.

See Section 4-203.

P-6. Pinelands National Reserve.

That area designated as such by Section 3(i) of the Pinelands Protection Act.

P-7 Pinelands Protection Act.

N.J.S.A. 13:18A-1 to 29.

P-8. Pinelands Resource Related Use.

Any use which is based on resources which are indigenous to the Pinelands including but not limited to forest products, berry agriculture and sand, gravel or minerals.

P-9. Plants, Threatened or Endangered.

See Section 6-206.

P-10. Plat.

One or more maps of a subdivision or a site plan which shows the location, boundaries and ownerships of individual properties.

P-11. Plan.

The Comprehensive Management Plan for the Pinelands.

P-12. Preapplication Conference.

See Section 4-102.

P-13. Preservation Area.

That area so designated by Section 10(b) of the Pinelands Protection Act.

P-14. Protection Area.

All land within the Pinelands Area which is not included in the Preservation Area.

P-15. Public Agencies.

The government of the United States of America; the State of New Jersey or any other state; their political subdivisions, agencies or instrumentalities; and interstate and regional agencies exercising sovereign powers of government.

P-16. Public Services.

Sewer service, gas, electricity, water, telephone, television and other public utilities, roads and streets and other similar services provided or maintained by any public or private entity.

R-1. Recommended Management Practice.

The management program which employs the most efficient use of available technology, natural, human, and economic resources.

R-2. Recreational Facility, Intensive.

Any recreational facility which does not satisfy the definition of low intensive recreational facility.

R-3. Recreational Facility, Low Intensive.

A facility or area which complies with the standards in Article 5, Part 3, of this Plan and which has an insignificant impact on surrounding uses or on the environmental integrity of the area. It permits such low intensity uses as hiking, hunting, trapping, fishing, canoeing, nature study, and bicycling.

R-4. Resource Conservation Plan.

A plan, prepared for review by the Soil Conservation District, which details the proposed use of agricultural recommended management practices.

R-5. Resource Extraction.

The dredging, digging, extraction, mining and quarrying of sand, gravel or minerals for commercial purposes, not including, however, the private or agricultural extraction

and use of extracted material by a landowner.

S-1. Scenic Corridors.

See Section 6-1003 [SCENIC CORRIDORS].

S-2. Seasonal High Water Table.

The level to which water seasonally rises in the soil in most years.

S-3. Sign.

Any object, device, display or structure, or part thereof, situated outdoors or indoors, which is used to advertise, identify, display, direct or attract attention to an object, person, institution, organization, business, product, service, event or location by any means, including words, letters, figures, designs, symbols, fixtures, colors illumination or projected images. Signs do not include the flag or emblem of any nation, organization of nations, state or city, or any fraternal, religious or civic organizations; merchandise, pictures or models of products or services incorporated in a window display; works of art which in no way identify a product; or scoreboards located on athletic fields.

S-4. Specimen Tree.

Any tree of exceptional size which is listed by the New Jersey Division of Parks and Forestry. A listing of such trees and a map showing their location is maintained at the principal offices of the Commission.

S-5. Structure.

A combination of materials to form a construction for occupancy, use or ornamentation having a fixed location on, above or below the surface of land or attached to something having a fixed location on, above or below the surface of land.

S-6. Subdivision.

The division of a parcel of land into two or more lots, tracts, parcels or other divisions of land. The following shall not be considered subdivisions within the meaning of this Plan, if no development occurs or is proposed in connection therewith:

1. Divisions of property by testamentary or intestate provisions;
2. Divisions of property upon court order; and

3. Conveyances so as to combine existing lots by deed or other instrument.

The term "subdivision" shall also include the term "resubdivision."

S-7. Submerged Lands.

Those lands which are inundated with water throughout the year.

S-8. Structural Alteration.

Any change in either the supporting members of a building, such as bearing walls, columns, beams and girders, or in the dimensions or configurations of the roof or exterior walls.

U-1. Uncertified Municipality or County.

A municipality or county whose master plan and land use ordinance have not been certified by the Commission under Article 3, Part 4 of this Plan.

U-2. Utility Distribution Lines.

Main lines, conduits or pipes located in a street road, alley or easement through which

natural gas, electricity, water, sewage, or storm water discharge is distributed to or from service lines extending from the main line to the distribution system of the building or premises served.

V-1. Vegetation.

Any plant material including grasses, shrubs and trees.

W-1. Wetlands.

See Section 6-103.

W-2. Wetlands, Coastal.

See Section 6-104.

W-3. Wetland Soils.

Those soils designated as very poorly drained or poorly drained by the Soil Conservation Service of the United States Department of Agriculture, including but not limited to Atsion, Bayboro, Berryland, Col-emantown, Elkton, Keansburg, Leon, Muck, Othello, Pocomoke, St. Johns and Freshwater Marsh and Tidal Marsh soil types.

ARTICLE 3

Certification of County, Municipal and Federal Installation Plans

PART 1—PURPOSE

Section 3-101. Purpose

The Pinelands Protection Act is a legislative determination that management and protection of the essential character and ecological values of the Pinelands require a regional perspective in the formulation and implementation of land use policies and regulations. The Act also recognizes, as does this Plan, that local government participation in the management process is fundamental to achieving the goals and objectives of the Act. The Act and this Plan contemplate that local governments will be the principal management entities implementing the Plan, with the Pinelands Commission providing technical assistance to local authorities, monitoring development review and updating the Plan.

The Act also contemplates that the Commission will achieve local participation in the implementation program and oversee implementation of the Plan. The Act provides for certification of local master plans and land use ordinances by the Commission, after which the certified plans and ordinances act as the governing regulations for the municipalities. However, if a local government should choose not to participate in the implementation program, then the Act requires that the Commission adopt and enforce such rules and regulations as are necessary to implement the minimum standards of this Plan.

This Plan is intended, therefore, to serve two functions: as a general guide for local authorities in preparing master plans and

land use ordinances for certification by the Commission, and as a planning and regulatory mechanism that can be adopted and enforced by the Commission if a county or municipality fails to secure certification.

A local authority that incorporates all of the elements of this Plan in its local plan and ordinances will be assured of certification. In contrast, municipal plans and ordinances that deviate from the essential nature of this Plan are unlikely to be certified. However, it is a policy of this Plan to allow municipalities the greatest degree of flexibility and discretion in the preparation of local plans and ordinances, so long as the plans and ordinances do not conflict with the ultimate objectives and minimum requirements of this Plan. There are some elements of this Plan which must be strictly followed. For example, the minimum density provisions in the designated growth areas and the density limitations in the other areas are critical to the overall objectives of the Plan for the distribution and intensity of land uses, as is the requirement that lands in designated growth areas be eligible for density bonuses in the form of transferred Pinelands Development Credits. Conversely, the distribution of densities and many of the uses authorized in the various areas are left to the discretion of the local prerogative. This Article permits the Commission to assess local decisions on an individualized basis and will preserve local discretion to the maximum extent practical, provided that local preferences are in fundamental harmony with the overall objectives of this Plan.

PART 2—CERTIFICATION OF COUNTY PLANS

Section 3-201. Conformance of County Master Plans and Ordinances Required

Within one year after the effective date of this Plan, or any amendment thereof, each county with jurisdiction over land located within the Pinelands Area shall adopt or amend a master plan applicable to such land and shall amend any ordinances applicable to the development of land so that the master plan and ordinances are in conformance with the minimum standards of this Plan.

Section 3-202. Submission of Plan and Ordinances

Within one year after the effective date of this Plan, or any amendment thereof, each county located in whole or in part in the Pinelands Area shall submit, in accordance with the provisions of this Part, its county master plan and any ordinances applicable to the development of land to the Commission for review and determination of whether the county master plan and ordinances are in conformance with the minimum requirements of this Plan. Such county master plan and ordinances shall be in such form and number and shall contain such information as may be required by the Executive Director in order to make the findings required by Section 3-209 [STANDARDS FOR CERTIFICATION OF COUNTY MASTER PLANS AND ORDINANCES].

Section 3-203. Setting of Hearing

After receipt of a county master plan and ordinances, the Executive Director shall give notice of and set the date, time and place for a public hearing for consideration of the application, plan and ordinances. The public hearing shall be held by the Executive Director within thirty days following the receipt of the plan and ordinances in accordance with the provisions of Section 4-103 [COMMISSION HEARING PROCEDURES] of this plan.

Section 3-204. Recommendation of Executive Director

Upon completion of the public hearing, the Executive Director shall review the application and the record of the hearings and shall, within forty-five days following the receipt of the plan and ordinances, submit a report to the Commission setting forth proposed findings and a recommended order as to whether the county master plan and ordinances are in conformance with the minimum standards of this Plan.

Section 3-205. Certification of County Master Plans and Ordinances

Upon receipt of the report of the Executive Director, the Commission shall review the findings, conclusions and recommendations of the Executive Director and shall, within sixty days following the receipt of the plan and ordinances, issue an order certifying, certifying with conditions or disapproving the county master plan and ordinances. If the county master plan or ordinances are disapproved the Commission shall specify the changes necessary in order to secure Commission certification.

Section 3-206. Responsibility of County Upon Conditional Certification or Disapproval

Any county whose master plan or ordinances have been disapproved or certified with conditions shall modify such master plan or ordinances as is necessary to conform to the minimum standards of this Plan, the conditions attached to a conditional certification or specified changes. Within 120 days after entry of the Commission order disapproving or certifying with conditions, each county shall submit its modified master plan and ordinances for review pursuant to the provisions of Sections 3-203 through 3-205 of this Part.

Section 3-207.

Effect of Failure of County to Obtain Commission Approval of Master Plan and Ordinances

No person shall initiate any development which requires county approval or receive any county approval for development of land in the Preservation Area or, subsequent to one year following the adoption of this Plan, of any land in the Pinelands Area located within any county whose master plan or ordinances have not been certified by the Commission pursuant to Section 3-205 [CERTIFICATION OF COUNTY MASTER PLANS AND ORDINANCES] without first obtaining Pinelands Development Approval pursuant to Article 4, Part 2 of this Plan [DEVELOPMENT IN AREAS WITHOUT CERTIFIED LOCAL PLANS].

Section 3-208.

Effect on and Responsibilities of County Upon Certification

Commission certification of a county master plan and ordinances shall authorize such county:

1. To petition the Commission, pursuant to Article 3, Part 3 of this Plan [REVIEW OF LOCAL PERMITS], for authority to conduct preliminary review of municipal master plans and land use ordinances within the county; and

2. To grant, to the extent that it is so authorized by state law or county ordinance, any permits or approvals within its Pinelands Area jurisdiction, subject to Commission review pursuant to Article 4, Part 3 of this Plan [REVIEW OF LOCAL PERMITS]; provided, however, that all such permits or approvals granted, and any other action taken by such county with respect to the development of land within the Pinelands Area, shall be in strict conformance with the certified county master plan and ordinances and the minimum standards of this Plan.

Section 3-209.

Standards for Certification of County Master Plans and Ordinances

County master plans and ordinances, or any parts thereof, shall be certified only if:

A. They are based upon a current and comprehensive inventory and analysis of the nat-

ural resources of the county prepared by the county or any other source. A county may use the inventory provided by the Commission;

B. All standards established by a county for review of applications for subdivision or site plan approval for development proposed within municipalities located within the county, or for any other permit or approval to be granted by any county department, body or agency as a prerequisite to initiating development in the Pinelands Area, are in conformance with the minimum standards of this Plan;

C. They include a capital improvements program that demonstrates that adequate and necessary facilities will be available to serve permitted development;

D. They include provisions relating to solid and liquid waste management which are in conformance with the waste management and water quality programs and standards contained in this Plan;

E. They provide that no application for development within the Pinelands Area shall be determined to be complete by any county department, body or agency unless:

(1) it is accompanied by a Certificate of Filing issued by the Commission pursuant to Section 4-304 of this Plan [CERTIFICATE OF FILING]; and

(2) it contains at least the information required by the Commission pursuant to Section 4-102(B) of this Plan [APPLICATION REQUIREMENTS];

F. They provide that notice of the issuance of any county permit or approval which is a prerequisite to initiating development within the Pinelands Area must be given to the Commission as provided in Section 4-305(D) [NOTICE OF PRELIMINARY APPROVAL] or (E) of this Plan [NOTICE OF FINAL DETERMINATION]; and

G. They otherwise are in conformance with and contain all provisions necessary to implement the objectives of this Plan.

Section 3-210.

Submission and Review of Amendments to Certified County Master Plans and Ordinances

A. Submission.

No amendment to any certified county

master plan or ordinance shall be effective until the county shall have submitted such amendment to the Commission and such amendment has been certified by the Commission, pursuant to Section 3-205 of this Part [CERTIFICATION OF COUNTY MASTER PLANS AND ORDINANCES], or the Executive Director has, pursuant to Subsection (B) hereof, notified the county that such amendment does not affect the prior certification of the master plan or ordinance.

B. Decision Not to Review.

Within fifteen days following receipt of any amendment to a certified master plan or ordinance, the Executive Director shall determine whether or not the amendment raises a substantial issue with respect to the

conformance of the county master plan or ordinance with this Plan. If the Executive Director determines no such substantial issue is raised, he shall certify such fact to the clerk of the county and such amendment shall thereupon take effect in accordance with its terms and applicable law.

C. Decision To Review.

If the Executive Director determines that the amendment raises a substantial issue with respect to the conformance of the amended county master plan or ordinance to this Plan, the amended county master plan or ordinance shall be reviewed pursuant to Sections 3-203 through 3-209 of this Part and the Executive Director shall so inform the county clerk.

**PART 3—DELEGATION TO COUNTY PLANNING BOARDS
OF PRELIMINARY REVIEW OF MUNICIPAL PLANS AND ORDINANCES**

Section 3-301.

Application by County for Delegation

The governing body of any county whose master plan and ordinances have been certified by the Commission pursuant to Part 2 of this Article [CERTIFICATION OF COUNTY PLANS], may petition the Commission for authority to conduct preliminary review of municipal master plans and land use ordinances located within the county by submitting a request for such authority in such form and number and containing such information as may be required by the Executive Director.

Section 3-302.

Delegation by Commission

A. Recommendation of Executive Director.

Within thirty days after receipt of a request filed pursuant to Section 3-301 above, the Executive Director shall submit to the Commission his recommendation as to whether the requested delegation is consistent with the purposes and provisions of the Pinelands Protection Act, the Federal Act and this Plan.

B. Action By The Commission.

Upon receipt of the Executive Director's

recommendation, the Commission shall review the request for authorization and the recommendation of the Executive Director and may, if it determines that the requested delegation is consistent with the purposes and provisions of the Pinelands Protection Act, Federal Act and this Plan, delegate to the petitioning county the preliminary review of municipal master plans and land use ordinances prescribed in Part 4 of this Article. The Commission may, in its discretion, limit such delegation to designated municipalities within a county for a fixed term, with or without provision for automatic or other renewal; and may make such delegation subject to any special terms, conditions or limitations deemed necessary or appropriate by the Commission.

Section 3-303.

***List of Reviewing Counties
and Notice to Municipalities***

The Executive Director shall maintain a list of those counties to which a delegation pursuant to Subsection 3-302(B) above has been made and shall, within ten days following entry of any order by the Commission pursuant to Section 3-302(B) delegating pre-

liminary review authority to any county, notify the clerks of all municipalities within the county of such delegation and of its specific terms.

**Section 3-304.
Revocation of Delegation
and Notice Thereof**

A. Recommendation By Executive Director.

If at any time after a delegation pursuant to Section 3-302(B) above has been made the Executive Director has reason to believe that a county is exercising the delegated preliminary review authority in a manner inconsistent with that represented to the Commission in the request filed pursuant to Section 3-301 or in any manner inconsistent with the purposes and provisions of the Pinelands Protection Act, the Federal Act or this Plan, he shall report all facts giving rise to such determination, together with his recommendation that the delegation be revoked, suspended or modified, to the Commission.

B. Action By the Commission.

Upon receipt of any report and recommendation from the Executive Director pursuant to Subsection (A) hereof, the Commission shall determine whether such county has exercised the delegated preliminary review authority in a manner inconsistent with that represented to the Commission in the request filed pursuant to Section 3-301 or in any manner not consistent with the purposes and provisions of the Pinelands Protection Act, the Federal Act or this Plan and, if it so determines, shall revoke, suspend or modify such delegation.

C. Notice of Revocation.

Within ten days following entry of any order entered by the Commission pursuant to Subsection (B) hereof revoking, suspending or modifying any delegation pursuant to Section 3-302(B), the Executive Director shall give notice of such order and of its terms, by certified mail, to the affected county and to all municipalities within such county.

PART 4—CERTIFICATION OF MUNICIPAL PLANS

**Section 3-401.
Conformance of Municipal Master Plan
and Land Use Ordinances Required**

Within one year after the effective date of this Plan, or any amendment thereof, each municipality with jurisdiction over land located within the Pinelands Area shall conform its master plan and land use ordinances applicable to such land to the minimum standards of this Plan.

**Section 3-402.
Submission of Plan
and Land Use Ordinances**

Within one year after the effective date of this Plan, or any amendment thereof, each municipality located in whole or in part in the Pinelands Area shall submit, in accordance with the provisions of this Part, its master plan and land use ordinances to the Commission for review and determination of whether such plan and ordinances are in conformance with the minimum standards of

this Plan; provided, however, that municipalities in any county which has been delegated preliminary review authority pursuant to Part 3 of this Article shall submit their master plans and land use ordinances to such county in accordance with Section 3-410 of this Part and the provisions of any applicable ordinance or regulation of such county. Such municipal master plan and land use ordinances shall be in such form and number and shall contain such information as may be required by the Executive Director in order to make the findings required by Section 3-409 [STANDARDS FOR CERTIFICATION OF MUNICIPAL MASTER PLANS AND LAND USE ORDINANCES].

**Section 3-403.
Setting of Hearing**

After receipt of the master plan and land use ordinances, the Executive Director shall give notice of and set the date, time, and place for a public hearing for consideration

of the application. The public hearing shall be held by the Executive Director within sixty days following the receipt of the master plan and ordinances in accordance with the provisions of Section 4-103 of this Plan [COMMISSION HEARING PROVISIONS]. At the hearing any person may present any relevant information, including but not limited to nominations of Special Agricultural Production Areas and Agricultural Production Areas that are not designated in the submitted municipal master plan or land use ordinance.

**Section 3-404.
Recommendation of Executive Director**

Upon completion of the public hearing, the Executive Director shall review the application and the record of the hearing and shall, within one hundred days following the receipt of the master plan and land use ordinances, submit a report to the Commission setting forth proposed findings and a recommended order as to whether the master plan and land use ordinances are in conformance with the minimum standards of this Plan.

**Section 3-405.
Certification of Municipal Master Plans and Land Use Ordinances**

Upon receipt of the report of the Executive Director, the Commission shall review the findings, conclusions and recommendation of the Executive Director and shall, within one hundred and twenty days following receipt of the plan and land use ordinances, issue an order certifying, certifying with conditions or disapproving the municipal master plan and land use ordinances. If the municipal master plan and land use ordinances are disapproved the Commission shall specify the changes necessary in order to secure Commission certification of the municipal master plan and land use ordinances.

**Section 3-406.
Responsibility of Municipality Upon Conditional Certification or Disapproval**

Any municipality whose master plan or land use ordinances have been disapproved or certified with conditions shall modify such master plan or land use ordinances as is necessary to conform to the minimum stan-

dards of this Plan and the provisions of any conditions attached to a conditional certification. Within 120 days after the Commission order disapproving or certifying with conditions, each such municipality shall submit its modified master plan and land use ordinances for review pursuant to the provision of Sections 3-403 through 3-405 of this Part [HEARING AND CERTIFICATION].

**Section 3-407.
Effect of Municipality's Failure to Obtain Commission Certification of Master Plan and Land Use Ordinances**

In the Preservation Area, and after one year from the effective date of this Plan, in the Pinelands Area, no person shall carry out any development in an uncertified municipality unless such development has been approved by the Commission pursuant to Article 4, Part 2 of this Plan [DEVELOPMENT IN AREAS WITHOUT CERTIFIED LOCAL PLANS]. A Pinelands Development Approval shall supersede any local decision if a municipality has not received certification of its master plan and land use ordinances.

**Section 3-408.
Effect on and Responsibilities of Municipality Upon Certification**

Commission certification of a municipal master plan and land use ordinances shall authorize such municipality to grant, to the extent that it is so authorized by state law or municipal ordinance, any permits or approvals of development within its Pinelands Area jurisdiction subject to Commission review pursuant to Article 4, Part 3, of this Plan [REVIEW OF LOCAL PERMITS]; provided, however, that all such permits or approvals granted, and any other action taken by such municipality with respect to the development or use of land within the Pinelands Area, shall be in strict conformance with the certified municipal master plan, land use ordinances and this Plan.

**Section 3-409.
Standards for Certification of Municipal Master Plans and Land Use Ordinances**

Municipal master plans and land use or-

dinances, and any parts thereof, shall be certified only if:

A. They are based upon a current and comprehensive inventory and analysis of the natural resources of the municipality prepared by the municipality or any other source. A municipality may use the inventory provided by the Commission;

B. They include provisions which:

(1) regulate the character, location and magnitude of development within the Pinelands Area;

(2) prescribe standards relating to lot layout, road design and construction, and public utility installation which conform to all similar standards contained in this Plan;

(3) implement the overall development intensity standards contained in this Plan through minimum lot area specifications or other appropriate means; and

(4) are adequate to ensure that all development of land in the Pinelands Area is in conformance with the development standards established by Articles 5 and 6 of this Plan;

C. They provide that no application for development within the Pinelands Area shall be determined to be complete by any municipal department, body or agency unless:

(1) it is accompanied by a Certificate of Filing issued by the Commission pursuant to Section 4-304 of this Plan [CERTIFICATE OF FILING]; and

(2) it contains at least the information required by the Commission pursuant to Section 4-102 (B) of this Plan [APPLICATION REQUIREMENTS].

D. They provide that no local permit shall be effective until the review procedures in Article 4, Part 3 of this Plan [REVIEW OF LOCAL PERMITS] have been completed;

E. They include a capital improvements program which demonstrates that adequate and necessary facilities will be available to serve permitted development;

F. They provide for sufficient residentially zoned property to be eligible for an increase in density to accommodate transferred Pinelands Development Credits as provided for in Article 5, Part 4, of this Plan

[PINELANDS DEVELOPMENT CREDIT PROGRAM];

G. If the municipality has established an environmental commission, they provide for referral of applications for development approval to the environmental commission for review and comment;

H. They otherwise are in conformance with and contain all provisions necessary to implement the objectives of this Plan;

I. They demonstrate conformance to the energy conservation requirements of L. 1980, ch. 146;

J. They demonstrate that they are in conformance with the provisions of the Federal Act; and

K. In the event that the distribution and density of land uses at the boundary of a municipality are in conflict with or otherwise inconsistent with the distribution and density of land uses in adjacent municipalities, they include a description of steps which have been taken to resolve such conflicts including consultation with the county or counties in which the municipalities are located.

Section 3-410.

Submission to County Planning Board for Preliminary Review

When a county has, pursuant to the provisions of Part 3 of this Article [DELEGATION TO COUNTY PLANNING BOARDS OF PRELIMINARY REVIEW OF MUNICIPAL PLANS AND ORDINANCES], been delegated preliminary review authority with respect to any municipal plan or land use ordinance, the submission required by Section 3-402 [SUBMISSION OF PLAN AND LAND USE ORDINANCES] in connection with such plan or ordinance shall be made to such county. Within five days following the submission of the plan and land use ordinances, the county shall forward a copy of such application to the Commission.

Section 3-411.

Setting of Hearing and Procedures Therefor

Within fifteen days following the submission of a plan and land use ordinances, the clerk of the county shall set, and give

notice of, the date, time and place for a hearing thereon. Such hearing shall be held within thirty days following the submission of a plan and land use ordinances.

Section 3-412.
Recommendation of County Board

After the hearing held pursuant to Section 3-411 is completed, the county planning board shall review the plan and land use ordinances and the record of the hearing and shall, within sixty days following receipt of the plan and land use ordinances, submit a report to the Commission setting forth its findings and recommendation as to whether the municipal master plan and land use ordinances are in conformance with the minimum standards of this Plan.

Section 3-413.
Recommendation of Executive Director

Upon receipt of the report of the county planning board with respect to the certification of any municipal master plan and land use ordinances, the Executive Director shall review the findings, conclusions and recommendation of the county planning board and the record of the hearing and shall, within one hundred days following receipt of the plan and land use ordinances by the county planning board, submit a report to the Commission setting forth his recommendation as to whether the municipal master plan and land use ordinances should be certified as being in conformance with the minimum standards of this Plan.

Section 3-414.
Action by Commission

Within one hundred and twenty days following the receipt of the plan and land use ordinances by the county planning board, and following the receipt of the reports of the Executive Director and the county planning board with respect to the certification of such municipal master plan and land use ordinances, the Commission shall review the reports and enter an order as provided in

Section 3-405 [CERTIFICATION OF MUNICIPAL MASTER PLANS AND LAND USE ORDINANCES].

Section 3-415.
Submission and Review of Amendments to Certified Municipal Master Plans and Land Use Ordinances

A. Submission.

No amendment to any part of a certified municipal master plan or land use ordinance shall be effective until the municipality shall have submitted such amendment to the Commission and either the Commission has certified such amendment pursuant to Section 3-405 of this Part [CERTIFICATION OF MUNICIPAL MASTER PLANS OR LAND USE ORDINANCES], or the Executive Director has, pursuant to Subsection (B) of this Section, notified the municipality that such amendment does not affect the prior certification of the master plan or land use ordinance.

B. Decision Not to Review.

Within thirty days following receipt of any amendment to a certified master plan or land use ordinance, the Executive Director shall determine whether or not the amendment raises a substantial issue with respect to the conformance of the municipal master plan or land use ordinances with this Plan. If the Executive Director determines that no such substantial issue is raised, he shall certify such fact to the municipal clerk and such amendment shall thereupon take effect in accordance with its terms and applicable law.

C. Decision to Review.

If the Executive Director determines that the amendment raises a substantial issue with respect to the conformance of the amended municipal master plan or land use ordinance to this Plan, the amended municipal master plan or land use ordinance shall be reviewed pursuant to Section 3-403 through 3-414 [CERTIFICATION OF MUNICIPAL MASTER PLANS AND LAND USE ORDINANCES] and the Executive Director shall so inform the municipal clerk.

PART 5—FEDERAL INSTALLATION PLANS

Section 3-501. Conformance of Federal Installation Master Plans

Within one year after approval of this Plan by the Secretary of the Interior, each military installation and federal aviation facility shall prepare and adopt a master plan which is in substantial conformance with this Plan for the installation or facility.

Section 3-502. Elements of Federal Installation Master Plan

A federal installation master plan shall include at least, if applicable to that federal installation, the following:

- A. An environmental impact statement, prepared in accordance with the requirements of the National Environmental Policy Act, of the ongoing mission of the installation;
- B. A delineation of any areas of critical ecological importance;
- C. An existing land use map, depicting the location, character, and intensity of existing land uses;
- D. A future land use map depicting planned or anticipated land uses, including the character and intensity of uses and a schedule of their development; and
- E. A detailed description of ongoing or planned building, construction or other similar activity, including projected dates of commencement and completion.

Section 3-503. Preparation of the Plan for Certification

Each federal installation shall prepare, with the assistance of the Commission staff as may be available from time to time, its federal installation master plan in accordance with the provisions of this Part, and upon its review and approval by the Department of Defense, shall submit it to the Commission for review and determination of whether the master plan is in substantial conformance with this Plan.

Section 3-504. Recommendation of Executive Director

The Executive Director shall review the plan, together with the recommendation of the staff, and shall submit a report to the Commission setting forth proposed findings and recommendations as to whether the federal installation master plan is in substantial conformance with this Plan.

Section 3-505. Certification of Federal Installation Master Plans

Within sixty days after receipt of the Executive Director's report, the Commission shall review the findings and recommendations and shall certify, certify with conditions or disapprove the federal installation master plan. If a federal installation master plan is disapproved, the Commission shall specify the changes necessary in order to secure Commission certification.

Section 3-506. Responsibility of Federal Installation Upon Conditional Certification or Disapproval

Any federal installation whose installation master plan has been disapproved or certified with conditions, shall modify such master plan as is necessary to conform to this Plan, the conditions attached to a conditional certification or specified changes. Within 120 days after entry of the Commission order disapproving or certifying with conditions, each federal installation shall submit its modified master plan for review pursuant to this Part.

Section 3-507. Amendments to Federal Installation Plan

Each federal installation and the Commission may propose amendments to an approved installation plan from time to time. Such amendments shall be approved in the manner provided in this Part for approval of the original plan and such amendments shall not require the revision or approval of the plan as a whole.

PART 6—MODIFICATION OR REVOCATION OF CERTIFICATION OF COUNTY AND MUNICIPAL PLANS AND ORDINANCES

Section 3-601.

Initiation by Executive Director

A. Any person may request the Executive Director to assess whether a certified county or municipal master plan or ordinance is being implemented in accordance with the provisions of this Plan. Such request shall be in writing and shall specify the county or municipal acts which are alleged to be not in conformance with this Plan by date, time and other identifying characteristics.

B. If the Executive Director determines, at any time, that any county or municipality is not implementing and enforcing its certified master plan or ordinances as is necessary to implement this Plan, he shall notify the Commission of such determination and upon its concurrence initiate proceedings pursuant to this Part to revoke, suspend or modify the Commission certification of the municipal or county master plan or ordinances.

Section 3-602.

Notice and Hearing

Upon making a determination to initiate proceedings to revoke, suspend or modify Commission certification of a county or municipal master plan or land use ordinance, the Executive Director shall give notice and conduct a public hearing in accordance with the provisions of Section 4-103 [COMMISSION HEARING PROCEDURES] of this Plan.

Section 3-603.

Recommendation of Executive Director

After the completion of the hearing required by Section 3-602, the Executive Director shall review the record of the hearing and shall, within forty-five days of the conclusion of the hearing, submit a report to the Commission setting forth his findings, conclusions and recommendations as to the action which should be taken by the Commission pursuant to this Part. He may recommend any action which the Commission is authorized to take pursuant to Section 3-604.

Section 3-604.

Action by Commission

Upon receipt of the report of the Executive Director pursuant to Section 3-603, the Commission shall review the findings, conclusions and recommendations of the Executive Director and shall issue a final order with respect to the revocation, suspension or modification of the Commission certification of the county or municipal master plan or ordinances. Upon determining that the county or municipality is not implementing its master plan, ordinances or this Plan, the Commission shall issue an order:

1. Revoking or suspending Commission certification of the county or municipal master plan or land use ordinances;

2. Modifying such certification to impose any conditions necessary to ensure adequate county or municipal review of development within its jurisdiction; or

3. Taking any other action it deems necessary to ensure county or municipal cooperation in the implementation of the objectives of this Plan.

Section 3-605.

Effect of Modification or Revocation of Commission Certification

Revocation, suspension or modification of Commission certification of any county or municipal master plan or land use ordinance shall have the same effect as if the county or municipal master plan or land use ordinance had been disapproved or certified with conditions in the first instance as provided in Section 3-207 [EFFECT OF FAILURE OF COUNTY TO OBTAIN COMMISSION CERTIFICATION OF MASTER PLAN AND LAND USE ORDINANCES] or 3-407 [EFFECT OF FAILURE OF MUNICIPALITY TO OBTAIN COMMISSION CERTIFICATION OF MASTER PLAN AND LAND USE ORDINANCES]. Any revocation, suspension or modification of Commission certification pursuant to this Part shall remain in effect until otherwise ordered by the Commission.

PART 7—ADOPTION OF RULES AND REGULATIONS FOR UNCERTIFIED AREAS

Section 3-701. Commission Adoption of Rules and Regulations for Uncertified Areas

In the event that any county or municipality fails to obtain certification of its land use plan and ordinance, the Commission shall adopt and enforce such rules and regulations as may be necessary to implement the minimum standards contained in this Plan and as may be applicable to any such county or municipality.

Section 3-702. Preparation and Review of Rules and Regulations

The Commission shall prepare or cause to be prepared such rules and regulations which are consistent with and implement this Plan for any municipality or county which fails to obtain certification under this Plan. Said rules and regulations shall include those provisions necessary to implement the goals and objectives of this Plan including:

A. A procedure for nominating and designat-

ing Special Agricultural Production Areas; and

B. A procedure for implementing all the mandatory and optional elements of Article 6 [MANAGEMENT PROGRAMS AND MINIMUM STANDARDS]. Said rules and regulations shall not include the optional programs in Article 5 [MINIMUM STANDARDS FOR LAND USES AND INTENSITIES].

Section 3-703. Public Hearing

The Commission shall conduct a public hearing in accordance with the provisions of Article 4 [DEVELOPMENT REVIEW] to consider the proposed rules and regulations for uncertified areas.

Section 3-704. Adoption of Rules and Regulations

Upon completion of the public hearing provided in Section 3-703 above, the Commission shall revise and adopt said rules and regulations.



ARTICLE 4

Development Review

INTRODUCTION

The Pinelands Protection Act charges the Pinelands Commission with ensuring that the minimum standards, goals and objectives of this Plan are implemented and enforced. The procedures by which the Commission will discharge its development review responsibilities are set out in this Article, according to whether the applicant is a public or private entity and whether the proposed activity is located in a certified or uncertified municipality. Part 1 establishes a set of uniform application requirements which include a pre-application conference which is designed to afford an applicant the opportunity to informally resolve preliminary application problems and to determine the extent and form of the information and documentation which must be submitted in the application. Part 1 also establishes a uniform procedure for determining when an application for development approval is complete. Section 4-103 prescribes notice and public hearing requirements for development review as well as for the certification of municipal or county plans and ordinances (Article 3), or amendments to the Plan itself (Article 7).

Part 2 of this Article establishes the procedures for development review in uncertified jurisdictions. Part 3 of this Article

sets forth the procedures for development review in certified areas, including the Commission's authority to review development approvals at the local level. Part 4 contains those procedures applicable to review of public development in the Pinelands Area.

In addition, Part 5 of this Article contains provisions for the procedures to be employed in consideration of applications to waive strict compliance with the standards of the Plan. If a waiver is granted by the Commission, the applicant may proceed with the development review procedures in Part 3, if in a certified area, or Part 4, if in an uncertified area.

Part 6 sets forth a procedure whereby any person may secure a clarification or interpretation of the meaning or applicability of any provision of this Plan. The effect of a letter of interpretation is to permit the applicant to proceed with the development review procedure in Part 2, if in an uncertified area, or Part 3, if in a certified area. Part 7 provides for coordinated permitting with other state agencies.

Part 8 sets forth the procedures to follow if any applicant or other aggrieved person wishes to appeal a decision by the Executive Director of the Commission.

PART 1—UNIFORM PROCEDURES

Section 4-101.

Applicability

For the purposes of this Article, the following shall not be considered development:

1. The improvement, expansion, or reconstruction of any single family dwelling unit or appurtenance thereto;
2. The improvement, expansion, construction, or reconstruction of any structure accessory to a single family dwelling;
3. The improvement, expansion, construction, or reconstruction of any structure used exclusively for agricultural or horticultural purposes;
4. The construction, repair or removal of any sign;
5. The repair of existing utilities and the installation of utilities to serve existing or approved development; or
6. The clearing of less than 1500 square feet of land that is not located in a wetland or within 200 feet of a scenic corridor.

Section 4-102.

Pre-Application Conference; Application Requirements

A. Pre-Application Conference.

1. Request.

Any applicant for any approval or waiver provided for in this Plan may request an informal conference with the Executive Director prior to filing an application. All requests for a pre-application conference shall include the name and address of the applicant, the legal description and street address, if any, of the property proposed for development, a brief description of the nature of any proposed development and the nature of the approval or waiver sought by the applicant.

2. Scheduling of Conference.

Within fifteen days following receipt of any request for a pre-application conference, the Executive Director shall schedule a pre-application conference and notify the applicant of the time, date and location of the conference and specify any additional information which the Executive Director determines is necessary.

3. Conduct and Purpose of Conference.

The Executive Director shall conduct the pre-application conference. The conference shall be informal and its purpose shall be to openly consider the proposals, views and concerns of the applicant and the Commission and to determine whether any of the application requirements of Section 4-102(B) [APPLICATION REQUIREMENTS] should be waived or any additional information should be required.

4. Pre-Application Conference Orders.

At the conclusion of the pre-application conference, the Executive Director shall forward a letter to the applicant indicating whether any of the application requirements contained in Section 4-102(B) [APPLICATION REQUIREMENTS] are to be waived or any additional information is to be submitted.

5. Representations of the Executive Director.

No representation made by the Executive Director during the course of any pre-application conference shall be binding on the Commission or the Executive Director with respect to any application subsequently submitted.

B. Application Requirements.

1. General Requirements.

All applications shall be submitted to the Executive Director at the principal office of the Commission in such form and number as he shall from time to time establish. The filing of an application shall be deemed to be authorization for the Executive Director or his staff to inspect the property which is the subject of the application. The application shall be accompanied by a sworn statement that the requirements of Subsection 4-102(B)(2) [NOTICE] of this Article have been satisfied.

2. Notice.

The applicant shall provide notice of filing, or a copy of all applications for development approval filed with the Commission, applications for waivers and applications for letters of interpretation to the township and county clerk, and the environmental commission, if any, of the municipality.

3. Waiver of Application Requirements Following Pre-Application Conference.

The Executive Director may waive or modify any of the application requirements contained in this Subsection if, after a pre-application conference held pursuant to Section 4-102(A) [PRE-APPLICATION CONFERENCE], he determines that any required information is either not relevant or not necessary to assure proper consideration of any application. Such waiver or modification shall be made in a pre-application order issued pursuant to Section 4-102(A)(4) [PRE-APPLICATION CONFERENCE ORDERS].

4. Application for Approval of Minor Development.

Unless the submission requirements are modified or waived pursuant to Subsection (B)(3) hereof, an application filed pursuant to Section 4-203 [PINELANDS DEVELOPMENT APPROVAL REQUIRED FOR DEVELOPMENT IN UNCERTIFIED AREAS] or Section 4-303 [APPLICANT TO SUBMIT COPIES OF LOCAL APPLICATIONS TO COMMISSION] for approval of minor development shall include at least the following information:

(a) the applicant's name and address and his interest in the subject property;

(b) the owner's name and address, if different from the applicant's, and the owner's signed consent to the filing of the application;

(c) the legal description and street address, if any, of the subject property;

(d) the present use of the subject property;

(e) a brief written statement generally describing the proposed development;

(f) a USGS Quadrangle map, or copy thereof, on which the boundaries of the subject property and all proposed development are shown;

(g) a plat or plan showing the location of all boundaries of the subject property, the location of all proposed development, and existing or proposed facilities to provide water for the use and consumption of occupants of all buildings and sanitary facilities which will serve the proposed development. The following information shall be included with respect to existing or proposed sanitary facilities;

(i) On-Site Treatment and Holding Facilities—Location, size, type and capacity of any proposed on-site wastewater treatment or holding facilities; and

(ii) Soil Borings and Percolation Tests—If on-site sewage disposal is proposed, results of soil borings and percolation tests in accordance with N.J.S.A. 58:11-23 *et seq.* and the regulations adopted pursuant thereto shall be submitted at suitable locations with a tract map showing location, logs, elevations of all test holes, indicating where ground water was encountered, estimating the seasonal high water table and demonstrating that such facility is adequate to meet the water quality standards contained in Article 6 of this Plan.

(h) a location map, including the area extending at least one-thousand feet beyond each boundary of the subject property, showing ownership boundary lines, the boundary of the proposed development, owners of holdings adjoining and adjacent to the subject property, existing facilities, buildings and structures on the site, all proposed development, wetlands, streams (including intermittent streams), rivers, lakes and other waterbodies and existing roads;

(i) a soils map including a county soils survey which conforms to the guidelines of the United States Department of Agriculture Soil Conservation Service, showing the location of all proposed development; and

(j) a map showing existing vegetation, identifying predominant vegetation types in the area, identifying all trees with trunk diameters in excess of twelve inches which are to be removed as a result of the proposed development, and showing proposed landscaping of the subject property including the location of the tree line before and after development.

5. Application for Approval of Major Development.

Unless the submission requirements are modified or waived pursuant to Subsection (B)(3) hereof, an application filed pursuant to Section 4-203 [PINELANDS DEVELOPMENT APPROVAL REQUIRED FOR DEVELOPMENT IN UNCERTIFIED AREAS] or Section 4-303 [APPLICANT TO SUBMIT COPIES OF LOCAL APPLICATIONS TO

COMMISSION] for approval of major development shall include at least the following information:

(a) all information required by Sections 4-102(B)(4)(a-d) of this Part;

(b) a brief written statement generally describing the proposed development and the market it is intended to serve; the number of total units; the floor area of all units and the anticipated market value of all units to be included in the proposed development;

(c) a written statement addressing each of the standards or guidelines set forth in Articles 5 and 6 of this Plan; and stating specifically how the proposed development meets each such standard or guideline;

(d) a plat or plan showing the location of all boundaries of the subject property, the location of all proposed development, and existing or proposed facilities to provide water for the use and consumption of occupants of all buildings and sanitary facilities which will serve the proposed development. The following information shall be included with respect to existing or proposed wastewater treatment facilities:

(i) Sanitary Sewer Distribution—Location, size, and direction of flow of all existing and proposed sanitary sewer lines and pumping stations serving the proposed development and all existing and proposed connections to existing facilities;

(ii) On-Site Treatment and Holding Facilities—Location, size, type and capacity of any proposed on-site wastewater treatment or holding facilities; and

(iii) Soil Borings and Percolation Tests—If on-site sewage disposal is proposed, results of soil borings and percolation tests in accordance with the requirements of N.J.S.A. 58:11-23 *et seq.* and the regulations adopted pursuant thereto shall be submitted with tract map showing location, logs, and elevations of all test holes, indicating where ground water was encountered, and estimating the seasonal high water table.

(e) a project site base map, at a scale of no less than 1 inch to 200 feet and including the areas extending at least one-thousand feet beyond each boundary of the subject proper-

ty, showing ownership boundary lines, the boundary of the proposed development, owners of holdings, if any, adjoining and adjacent to the subject property, existing facilities, buildings and structures on the site, all proposed development, wetlands, streams (including intermittent streams), rivers, lakes and other waterbodies, and existing roads;

(f) a soils map including a county soils survey in conformance with the guidelines of the United States Department of Agriculture Soil Conservation Service, at the same size and scale as the project site base map, delineating all soil series at an appropriate level of detail and, in sewered projects, sufficient soil borings to confirm the accuracy of the soils map;

(g) a slope map, at the same size and scale as the project site base map, indicating contour elevations at two foot intervals and shaded to show slope categories of 0-3%, 3-8%, 8-15%, 15-25% and 25% plus;

(h) a resource capability map, at the same size and scale as the project site base map, indicating the cumulative limitations to development due to the standards and guidelines contained in this Plan. This map should be prepared prior to any engineering, site layout or design work;

(i) a proposed development map, at the same size and scale as the project site base map, showing areas of proposed development; the location of surveyor's tape placed on the site delineating the boundaries of the property; the number of residential lots and other type of development in each general area; all proposed lot lines; areas proposed to be retained as open space; the applicable land use areas boundaries; the location of proposed facilities such as dams and impoundments, community water systems, storm drainage systems, community sewerage systems, industrial waste water discharges and waste disposal areas; the proposed primary road network; and all areas to be disturbed by construction activities;

(j) a map, at the same size scale as the project site base map, showing existing vegetation, identifying the predominant vegetation types in the area and identifying all trees with diameters in excess of twelve inches and all other vegetation which is to be

removed or disturbed as a result of the proposed development, and the tree line before and after development;

(k) a map, at the same size and scale as the project site base map, showing storm water drainage patterns and calculations and the applicant's proposed storm water run-off management plan, including results of percolation tests and soil borings performed in the recharge area together with letters of review and comment from the local Soil Conservation District and county engineer;

(l) a narrative description of the following:

(i) soil, slope and critical resource data not presented on the base maps;

(ii) existing on-site land uses;

(iii) public water and sewer systems, other public utilities, storm drainage plans, erosion and sedimentation control measures, solid waste disposal methods, and alterations to shorelines, wetlands and water bodies;

(iv) proposed uses of pesticides and herbicides;

(v) sources of air and noise pollution;

(vi) outdoor recreation and open space resources;

(vii) legal instruments, such as homeowners' association charters and agreements, proposed declaration of covenants, deeds, and other documents and instruments of conveyance;

(viii) any proposed on-site waste discharges including, except with respect to discharges into an individual septic system, quantities, composition, proposed pretreatment and proposed disposal site;

(m) legal instruments evidencing the applicant's right, title or interest in any Pinelands Development Credits;

(n) a landscaping plan on a map, of the same size and scale as the project site base map, identifying the species of plants to be installed and the quantity and location of all plants proposed to be planted, demonstrating that the landscaping will be carried on within six months of the completion of construction, and demonstrating that the landscaping will stabilize soils;

(o) if the proposed development includes

industrial or commercial facilities, the following additional information must be included:

(i) the proposed hours of operation of any such facility;

(ii) an energy conservation plan including special energy conservation design considerations, detailed energy conservation practices and an assessment of provisions for public transportation, van and car pooling; and

(iii) the number of employees to be employed at the proposed facility;

(p) if the proposed development includes any commercial resource extraction activities, all information required by Article 6, Part 6 [RESOURCE EXTRACTION];

(q) if the proposed development includes any commercial forestry activities, all information required by Article 6, Part 4 [FORESTRY];

(r) if the proposed development includes one hundred or more dwelling units, a fiscal impact analysis comparing the cost of the proposed development and the revenues to be generated by the proposed development during the ten-year period immediately subsequent to completion of the development;

(s) all public utility agreements, or other documentation, evidencing the availability of electric, gas, water, sewer and other necessary public utility services;

(t) if the proposed development includes one hundred or more dwelling units or more than three hundred parking spaces, the information required by Article 6, Part 9 [AIR QUALITY];

(u) the cultural resources survey described in Article 6, Part 14 [HISTORIC ARCHAEOLOGICAL AND CULTURAL PRESERVATION];

(v) a list of all permits required for the proposed development from county, municipal, state and federal agencies.

6. Application for Waiver.

An application for a waiver of strict compliance filed pursuant to Article 4, Part 5 [WAIVER OF STRICT COMPLIANCE] shall include at least the following information:

(a) all information required in an applica-

tion for development approval as set out in Paragraph (4)(a)-(f) hereof;

(b) the waiver sought, the provisions or standards of this Plan from which a waiver is requested and a statement of the reasons for the waiver;

(c) at the option of the applicant, all other information required in Paragraphs (4) and (5) hereof;

(d) a statement of the extraordinary hardship imposed on the applicant and why the same hardship is not imposed on other property in the area similarly situated or an explanation of any compelling public need for the proposed development; and

(e) the present use of the subject property.

7. Application for Letter of Interpretation.

An application for a letter of interpretation pursuant to Article 4, Part 6 [LETTERS OF INTERPRETATION] shall include all information which, after a pre-application conference held pursuant to Section 4-102(A) [PRE-APPLICATIONS CONFERENCE], the Executive Director determines is necessary for evaluation of the applicant's request.

8. Imposition of Additional Application Requirements.

At any time during the review of any application filed pursuant to this Plan, the Executive Director may require an applicant to submit any additional information which he determines is reasonably necessary to facilitate adequate review of the application. If the applicant does not submit the additional material within 30 days, or request an extension of time to do so, the application shall be deemed to be withdrawn.

C. Determination of Whether Application is Complete.

1. Determination by Executive Director.

Within thirty days following receipt of any application filed pursuant to this Plan, the Executive Director shall determine whether such application is complete. If he determines that the application is not complete, he shall mail a written statement to the applicant specifying the deficiencies of the application. The Executive Director shall take no further action on the application until the deficiencies are remedied.

2. Remedy of Deficiencies.

Within thirty days following receipt of a statement of deficiencies from the Executive Director, or such extension as the Executive Director may grant, the applicant shall submit all additional information requested in such statement. The failure of the applicant to submit such additional information shall be deemed a withdrawal of the application.

3. Effect of Determination.

Any determination of completeness made by the Executive Director pursuant to Subsection (C)(1) hereof shall not preclude any local permitting agency or other public agency from requiring additional information as a prerequisite to consideration of any application which must be filed with such agency.

Section 4-103.

Commission Hearing Procedures

A. Applicability.

The procedures set out in this Section shall be applicable, except to the extent that they are specifically modified by other provisions of this Plan with respect to particular subject matters, to all public hearings held pursuant to Articles 3 [CERTIFICATION OF PLANS], 4 [DEVELOPMENT REVIEW], and 7 [AMENDMENTS TO PLAN] of this Plan.

B. Notice of Public Hearing.

1. Content.

All notices of public hearings shall include:

(a) the time and place of hearing;

(b) the authority pursuant to which the hearing is held;

(c) the name and address of the applicant;

(d) a brief description of the subject matter to be considered at the hearing;

(e) if the public hearing relates to an application for development approval, a statement that the application and supporting materials are available for public inspection and copying at the principal offices of the Commission; and

(f) a statement that any person may at such public hearing speak or submit a written statement.

2. *Persons Entitled to Notice.*

(a) Notice of public hearings shall be given by the Commission:

(i) by sending a copy of the notice to the applicant, or the owner of the subject property, if different, by certified mail;

(ii) by sending a copy of the notice, by mail, to any person, organization or agency which has previously filed with the Commission a written request, together with an annual fee in an amount to be determined from time to time by the Commission to cover the actual cost of such notice.

(b) Notice of public hearings shall be given by the applicant:

(i) if the public hearing relates to an application for development approval, by sending a copy of the notice by certified mail to each owner of record, if different from the applicant, of any land on which development is proposed;

(ii) if the public hearing relates to an application for development approval, by sending a copy of the notice, by mail, to:

(aa) the clerk of the county or municipal planning board and environmental commission, if any, with jurisdiction over any property on which development has been proposed or which would be directly affected by a map amendment proposed pursuant to Article 7 [AMENDMENTS TO PLAN] hereof;

(bb) any landowners within 200 feet of any border of property proposed for development.

(iii) by publication of a copy of the notice, at least once, in a newspaper having general circulation in the area;

(iv) by conspicuous posting on each parcel proposed for development.

3. *Time of Notice.*

All notices required by this Subsection shall be published, posted or mailed at least ten days in advance of the hearing.

4. *Notice To Be Given By Applicant.*

The applicant shall file with the Executive Director, no less than seven days prior to the hearing for which notice was given, an affidavit that the requirements of Subsection 2(b) have been satisfied.

C. *Duty of Commission Staff.*

1. *Presentation of Information.*

At the hearing the Commission staff shall present information concerning pertinent application considerations and the standards set out in this Plan. The Commission staff shall have the right to participate fully in the hearing process and shall act as an advocate for a full and complete record upon which an informed decision can be made.

2. *Statement of Pertinent Considerations.*

The Commission staff shall state at the outset of the hearing which considerations and required findings it considers pertinent to the application and shall briefly outline the information it intends to present.

3. *Production of Additional Information.*

Upon a sufficient showing by any person made at any time during the hearing, or on his own motion, the Executive Director may order the Commission staff to produce any additional information with respect to any of the required findings.

D. *Conduct of the Hearing.*

1. *Submission of Information.*

Any person may appear at a public hearing and submit information or written materials, either individually or as a representative of an organization. Each person who appears at a public hearing or who submits written materials shall identify himself and his address and state the name and mailing address of any organization he represents. The Executive Director may exclude information that he finds to be irrelevant, immaterial or unduly repetitious.

2. *Continuance By Executive Director.*

The Executive Director may continue the hearing to a fixed date, time and place. Unless such continuance is publicly announced at a properly noticed and convened hearing, the Executive Director shall cause notice to be given to all persons originally entitled to notice of the date, time and place of such continued hearing in the same manner as specified in Subsection (B) hereof.

3. *Record of Hearing.*

(a) The Executive Director shall assure that the proceedings are recorded by any appropriate means and such record of pro-

ceedings shall be transcribed at the request of any person upon application to the Executive Director and payment of a fee to cover the cost of transcription, or on order of the Executive Director. If a sound recording is made, any person shall be entitled to listen to the recording at any reasonable time or to make copies at his own expense.

(b) The record of proceedings shall consist of the transcript of testimony; all applications, exhibits and papers submitted in any proceeding with respect to the matter being considered; and the summary and report or reports of the Executive Director.

(c) All summaries and reports of the Executive Director shall be public records, open to inspection at a reasonable time and upon reasonable notice.

E. Content and Service of Decision of Executive Director or Commission.

1. All decisions and orders of the Executive Director or the Commission, and all recommendations of the Executive Director to the Commission, shall be in writing and shall include findings of fact, shall refer to the information in the record upon which such decision or order is based, shall specify the reason or reasons for such decision, and shall contain a conclusion or statement separate from the findings of fact which shall set forth any recommendation or final approval, conditional approval, or denial of the application being considered.

2. Except as provided in Section 4-604 for letters of interpretation, notice of all decisions and orders of the Executive Director or the Commission shall be mailed to:

(a) the applicant;

(b) any person, organization or agency which has previously filed with the Commission a written request, together with an annual fee in an amount to be determined from time to time by the Commission to cover the actual cost of said notice;

(c) the clerk of the county or municipal planning board and environmental commission, if any, with jurisdiction over the property which was the subject of the decision or order;

(d) any other person who has demonstrated an interest in the proceeding.

3. All decisions and orders of the Executive Director or the Commission shall be considered rendered three days after notice of such decisions and orders has been deposited in the United States Mail addressed to those persons identified in Subsection E(2) hereof.

Section 4-104.

Waiver of Time Limits

A. By Agreement.

Any time limit imposed by statute or this Plan on the processing of any application may be waived or extended by agreement of the Executive Director and the applicant.

B. Automatic Waiver.

Any applicant who requests a continuance of any hearing at which his application is being considered, or who requests any extension of any time limit imposed by statute or this Plan, shall be deemed to have waived the applicability of that time limit.

PART 2—DEVELOPMENT IN AREAS WITHOUT CERTIFIED LOCAL PLANS

Section 4-201.

Purpose

This Part establishes the procedures and standards for development review in a jurisdiction which has not received certification of its master plan and land use ordinances. No development in such jurisdictions shall be carried out unless the Commission determines that the proposed development is in conformance with the minimum standards of

this Plan, including adequate consideration of on-site and off-site engineering, planning and design elements, so as to preserve and maximize the benefits to the wide diversity of rare, threatened and endangered plant and animal species and the many significant and unique natural, ecological, agricultural, scenic, and recreational resources found in the Pinelands Area. In particular, it is the purpose of this Part to ensure that all de-

velopment which is not regulated by certified local master plans and land use ordinances is located, planned, designed, laid out, constructed and serviced in conformance with the minimum standards of this Plan.

Section 4-202.

Applicability

A. The provisions of this Part shall be applicable to all development in the Preservation Area upon adoption of this Plan and shall remain applicable to such land until the master plan and land use ordinances of the municipality with jurisdiction over such land are certified by the Commission pursuant to Article 3, Part 4, of this Plan [CERTIFICATION OF LOCAL PLANS], except for those activities specifically excepted in Section 4-101 of this Article.

B. After one year following the effective date of this Plan, the provisions of this Part shall be applicable to all development in any portion of the Pinelands Area located in any jurisdiction where the master plan or land use ordinances have not been certified by the Commission, except for those activities specifically excepted in Section 4-101 in this Article.

Section 4-203.

Pinelands Development Approval Required for Development in Uncertified Areas

Subject to the provisions of Section 4-202, no person shall carry out any development in any portion of the Pinelands Area located within the jurisdiction of a municipality with an uncertified master plan or land use ordinance without first obtaining Pinelands Development Approval from the Commission pursuant to the procedures set out in this Part.

Section 4-204.

Application for Pinelands Development Approval in Uncertified Areas

An application for Pinelands Development Approval in uncertified municipalities shall be submitted to the Commission in accordance with the requirements of Section 4-102(B) [APPLICATION REQUIREMENTS].

Section 4-205.

Action by Executive Director on Application

Within ninety days following the receipt of a complete application for Pinelands Development Approval, the Executive Director shall review the application and all information submitted by the applicant or any other person relating to the application and upon completion of such review, approve, approve with conditions or disapprove the application. The application may be approved or approved with conditions only if the Executive Director finds that the development as proposed, or subject to any conditions which may be imposed, conforms to each of the minimum standards for development approval established by Section 4-206 below. The Executive Director may attach to an approval any reasonable condition which he finds is necessary to achieve the objectives of this Plan. A Pinelands Development Approval required pursuant to this Part shall supersede any local decision.

Section 4-206.

Standards for Uncertified Areas

Pinelands Development Approval may be granted pursuant to this Part only if the Executive Director finds that the proposed development:

A. Satisfies all of the criteria and standards established in Articles 5 [MINIMUM STANDARDS FOR LAND USES AND INTENSITIES] and 6 [MANAGEMENT PROGRAMS AND STANDARDS] of this Plan, provided, however, that all optional elements of Article 6 shall be mandatory for any jurisdiction which is uncertified; and

B. Is otherwise consistent with the objectives of the Federal Act, the Pinelands Protection Act and this Plan.

Section 4-207.

Reconsideration Rights

Any interested person who is aggrieved by any determination made by the Executive Director pursuant to this Part may seek reconsideration of such determination as provided by Section 4-801 [RECONSIDERATION AND JUDICIAL REVIEW] of this Plan.

PART 3—REVIEW OF LOCAL PERMITS

Section 4-301.

Purpose

It is the purpose of this Part to establish procedures and standards to govern Commission review of municipal or county approval of applications for development in the Pinelands Area, to ensure that development will occur only to the extent that it is consistent with the objectives of this Plan, and to ensure that adequate consideration will be given to critical on-site and off-site engineering, planning and design elements so as to preserve and maximize the benefits to the wide diversity of rare, threatened and endangered plant and animal species and the many significant and unique natural, ecological, agricultural, scenic, archaeological, historic, cultural and recreational resources found in the Pinelands Area. In particular, it is the purpose of this Part to ensure that all development approved by local permitting agencies is located, planned, designed, laid out, constructed and serviced in accordance with the standards set forth in Articles 5 [MINIMUM STANDARDS FOR LAND USES AND INTENSITIES] and 6 [MANAGEMENT PROGRAMS AND MINIMUM STANDARDS] and the objectives of this Plan.

The procedures established in this Part provide for Commission review of all permits issued by local permitting agencies except for activities specifically exempted by the Pinelands Protection Act or this Plan. The standards of this Part are minimum standards to be met by all development in the Pinelands and are designed to assure that all such development will be adequately planned, designed and served to protect the unique environment of the Pinelands Area.

In order to alert landowners at an early stage to any issues raised by a proposed development in regard to the conformance of the development with the minimum standards of this Plan, this Part also provides for Commission staff participation during the local permitting agency proceedings, as well as providing for Commission review of preliminary local approvals of applications for development.

Section 4-302.

Applicability

A. The provisions of this Part shall be applicable to development of land located within a certified county or municipality, except for those activities specifically excepted in Section 4-101 of this Article.

B. The provisions of this Part shall also, for one year following the effective date of this Plan, be applicable to development of land located in the Protection Area, except for those activities specifically excepted in Section 4-101 of this Article.

Section 4-303.

Applicant to Submit Copies of Local Applications to Commission

Prior to filing any application for development of land in the Pinelands Area with any local permitting agency, the applicant shall file a copy of the application with the Commission in accordance with the requirements of Section 4-102(B) [APPLICATION REQUIREMENTS].

Section 4-304.

Certificate of Filing; Required for Determination of Completeness

Within five days following receipt of a complete application, the Executive Director shall issue a Certificate of Filing. No local permitting agency shall determine that any application for development is complete unless it is accompanied by a Certificate of Filing issued pursuant to this Section.

Section 4-305.

Report Requirements of Local Permitting Agency with Respect to Applications for Development

A. General Requirement.

Every local permitting agency shall give notice to the Commission, as hereinafter specified, of the filing of, and changes to, any application for development and of hearings and meetings concerning the filing and disposition of every application for development filed with it.

B. Notice of Filing.

Within seven days following a determination of completeness of an application for development, or any change to any application for development which was previously filed, notice of such application shall be given by the local agency, by certified mail, to the Commission. The notice shall be in such form as the Executive Director shall from time to time specify; but each such notice shall contain at least the following information:

1. The name and address of the applicant;
2. The legal description and street address, if any, of the property which the applicant proposes to develop;
3. A brief description of the proposed development, including uses and intensity of uses proposed;
4. The docket number of the Certificate of Filing issued by the Executive Director and the date on which it was issued;
5. The date on which the application, or change thereto, was filed and any docket or other identifying number assigned to such application by the local permitting agency;
6. The local permitting agency with which the application or change thereto was filed;
7. The content of any change made to any such application since it was filed with the Commission; and
8. The nature of the local approval or approvals being sought.

C. Notice of Hearings and Meetings.

Notice of any hearing, public meeting or other formal proceeding at which an application for development is to be considered shall be given to the Commission by certified mail or delivery of the same to the principal office of the Commission not less than five days prior to such meeting, hearing or proceeding and shall be in such form as the Executive Director shall from time to time specify. Each notice shall contain at least the following information:

1. The name and address of the applicant;
2. The docket number of the Certificate of Filing issued by the Executive Director and the date on which it was issued;

3. The date, time and location of the meeting, hearing, or other formal proceeding;

4. The name of the local permitting agency or representative thereof which will be conducting the meeting, hearing, or other formal proceeding;

5. Any written reports or comments received by the local permitting agency on the application for development which have not been previously submitted to the Commission; and

6. The purpose for which the meeting, hearing or other formal proceeding is to be held.

D. Notice of Preliminary Approval

Notice of any grant of preliminary site plan or subdivision approval or any other preliminary approval of any application for development provided for by the Municipal Land Use Law or any county or municipal ordinance shall be given to the Commission, by certified mail, within five days following such grant or approval. Such notice shall be in such form as the Executive Director shall from time to time specify, but shall contain at least the following information:

1. The name and address of the applicant;
2. The legal description and street address, if any, of the property which the applicant proposes to develop;

3. The docket number of the Certificate of Filing issued by the Executive Director and the date on which it was issued;

4. The date on which the preliminary approval was granted;

5. Any written reports or comments received by the local permitting agency on the application for development which have not been previously submitted to the Commission;

6. A copy of the preliminary approval which was granted; and

7. The names and addresses of all persons who actively participated in the local proceedings.

E. Notice of Final Determination

Notice of any final determination with respect to any application for development shall be given to the Commission by certified

mail within five days following such determination and shall be in such form as the Executive Director shall from time to time specify; but such notice shall contain at least the following information:

1. The name and address of the applicant;
2. The legal description and street address, if any, of the property which the applicant proposes to develop;
3. The docket number of the Certificate of Filing issued by the Executive Director and the date on which it was issued; and
4. A copy of the resolution or other documentation of the local permitting agency approving or denying the application and, if the application was approved, a copy of any final site plan, plot or similar document which was submitted by the applicant.

**Section 4-306.
Commission Staff Participation
in Local Review Process**

A. Determination of Degree of Participation.

Upon receipt of an application filed pursuant to Section 4-303 [APPLICANT TO SUBMIT COPIES OF LOCAL APPLICATIONS TO COMMISSION] or any notice given pursuant to Section 4-305 (B) or (C), the Executive Director may at his discretion, after reviewing the application for development, determine that, by reason of the nature of the development proposal, the site involved or any other factor, the Commission staff should participate in the local permitting process. The participation of the Commission staff may include, but is not limited to:

1. Submitting, in writing, an analysis of any concerns and opinions the Commission staff has with respect to the conformance of the proposed development with the minimum standards of this Plan, including a list of any conditions which it determines should be imposed in the event that a permit is granted; or
2. Submitting written evidence with respect to the satisfaction, by the proposed development, of any applicable standards for development contained in this Plan.

B. Local Permitting Agency to Allow Commission Staff Participation.

Each local permitting agency granted permitting authority by Section 3-208 [EFFECT ON AND RESPONSIBILITIES OF COUNTY UPON CERTIFICATION] or 3-408 [EFFECT ON AND RESPONSIBILITIES OF MUNICIPALITY UPON CERTIFICATION], after certification of the jurisdiction's plan, shall permit the Commission staff to appear at any meeting or hearing described in Section 4-305 (C) [NOTICE OF HEARINGS AND MEETINGS] and present opinions and evidence in regard to the application being considered. At the option of the Executive Director, the opinions and evidence of the Commission staff may be submitted to the local permitting agency in written form in addition to actual appearance at such hearing or meeting.

C. Conference with Commission Staff.

Subsequent to any submission by the Commission staff pursuant to Subsection (A) hereof, either the applicant or local permitting agency may request an informal conference with the Executive Director for the purpose of discussing any application for development. The Executive Director shall schedule such conference within twenty-one days following any such request.

**Section 4-307.
Commission Review Following
Preliminary Approval**

A. Decision to Review Local Approval.

Upon receipt of any notice of local approval given pursuant to Section 4-305(D) [NOTICE OF PRELIMINARY APPROVAL], the Executive Director shall review the application for development submitted and any Commission staff recommendation made pursuant to Section 4-306 [COMMISSION STAFF PARTICIPATION IN LOCAL REVIEW PROCESS] and determine whether the grant of preliminary approval raises substantial issues with respect to the conformance of the proposed development with the minimum standards of this Plan. If substantial issues are raised, the preliminary approval shall be reviewed pursuant to this Section. If substantial issues are not raised, the preliminary

approval shall not be reviewed. A decision not to review a preliminary approval constitutes assurance that absent changes in the application or new information, the Executive Director will not review final approval under Section 4-310 [COMMISSION REVIEW FOLLOWING FINAL LOCAL APPROVAL].

B. Notice of Decision and Hearing.

Within thirty days following receipt of any notice of preliminary approval issued pursuant to Subsection 4-305(D) [NOTICE OF PRELIMINARY APPROVAL], the Executive Director shall give notice of his determination by certified mail to the applicant and the clerk of the local permitting agency which granted such preliminary approval. If the Executive Director determines that the preliminary approval should be reviewed by the Commission, the notice shall indicate that either the applicant or the local permitting agency may, within twenty-one days of mailing of such notice, request that a hearing be held before an Administrative Law Judge pursuant to the procedures established by Section 4-801 [RECONSIDERATION AND JUDICIAL REVIEW] for the purpose of reviewing such preliminary approval.

C. Notices to Persons Participating in Local Permitting Process; Opportunity to Comment.

If the Executive Director decides to review a preliminary approval, he shall notify all persons who actively participated in the proceedings before the local permitting agency of such determination and inform them that they may participate in any proceedings held pursuant to this Part.

D. No Action by Applicant Prior to Receipt of Notice.

No person shall carry out any development pursuant to a preliminary approval granted by any local permitting agency until he has received the notice provided for in Subsection 4-307(B) [NOTICE OF DECISION AND HEARING] of this Part. If such notice indicates that the Commission intends to conduct a review of such preliminary approval pursuant to this Section, no development shall be carried out until such review has been completed.

Section 4-308.

Decision on Review

A. Determination by Executive Director.

If no hearing is requested by the applicant or the local permitting agency pursuant to Section 4-307(B) [NOTICE OF DECISION AND HEARING], the Executive Director shall review the application and the file and determine whether the preliminary approval is in conformance with the minimum standards of this Plan. The Executive Director may approve the preliminary approval, approve the preliminary approval with conditions or disapprove the preliminary approval. To the extent it is possible to determine from the information which has been supplied with the application for preliminary approval whether the entire proposed development complies with the minimum standards of this Plan, the Executive Director shall inform the applicant and local reviewing agency of his determination of compliance. In making his determination the Executive Director shall consider the changes which it may be necessary to make in the development proposal to achieve compliance or whether the Executive Director is likely to review the application again after final approval is obtained.

B. Review by the Commission.

If a hearing is requested pursuant to Section 4-307(B) [NOTICE OF DECISION AND HEARING], the Commission shall, upon receipt of the findings of fact and recommendations of the Administrative Law Judge, review such findings and recommendation, the application, the file and the record of the hearing, and approve, approve with conditions or disapprove the preliminary approval.

C. Standards

Preliminary approvals may be approved or approved with conditions only if the Executive Director of the Commission determines that the development as proposed, or with any conditions which are imposed, conforms to the minimum standards established by Section 4-206 [STANDARDS FOR UNCERTIFIED AREAS].

D. Effect of Determination.

1. If the Executive Director or Commission

disapproves any preliminary approval of an application for development, the local permitting agency shall revoke such preliminary approval and, thereafter, deny approval of such application.

2. If the Executive Director or Commission approves a preliminary approval subject to conditions, the local permitting agency shall, within thirty days, modify its preliminary approval to include all conditions imposed by the Executive Director or Commission, and shall grant final approval only if the application for final approval demonstrates that such conditions have been or will be met by the applicant.

Section 4-309.
Notice of Changes Made Subsequent to Local Preliminary Approval

Each local permitting agency shall give notice to the Commission of any design, engineering or other changes made to any application for development by an applicant subsequent to any local preliminary approval reported to the Commission pursuant to Section 4-305(D) [NOTICE OF PRELIMINARY APPROVAL], including changes made in response to conditions imposed by the Executive Director or Commission pursuant to Section 4-308 [DECISION ON REVIEW], to the Executive Director, by certified mail, within five days of receipt of such changes. Such notice shall be in such form as the Executive Director shall from time to time specify but shall contain at least the following information:

1. The name and address of applicant;
2. The legal description and street address, if any, of the property which the applicant proposes to develop;
3. The docket number of the Certificate of Filing issued by the Executive Director and the date on which it was issued;
4. Copies of any amended application, site plans, plats or other documents reflecting such changes; and
5. A brief description of the nature of such changes.

Any such change shall be subject to review by the Commission pursuant to Sections 4-307 [COMMISSION REVIEW FOLLOWING

PRELIMINARY APPROVAL] and 4-308 [DECISION ON REVIEW] in the same manner as the original preliminary approval.

Section 4-310.
Commission Review Following Final Local Approval

A. Decision to Review Local Approval.

Upon receipt of any notice given pursuant to Subsection 4-305(E) [NOTICE OF FINAL DETERMINATION], the Executive Director shall review the application for development submitted, any Commission staff recommendation made pursuant to Section 4-306 [COMMISSION STAFF PARTICIPATION IN LOCAL REVIEW PROCESS] and any decision on preliminary review pursuant to Section 4-308 [DECISION ON REVIEW] and determine whether the approval of the application for development raises substantial issues with respect to the conformance of the proposed development with the minimum standards of this Plan. If substantial issues are raised, the approval shall be reviewed pursuant to Sections 4-311 [PUBLIC HEARING] and 4-312 [DECISION ON REVIEW].

B. Notice of Decision and Hearing.

Within fifteen days following receipt of any notice of final determination given pursuant to Subsection 4-305(E) [NOTICE OF FINAL DETERMINATION], the Executive Director shall give notice of his determination by certified mail to the applicant and the clerk of the local permitting authority which granted such approval. Such notice shall set a date, time and place for public hearing as required by Section 4-311 [PUBLIC HEARING].

C. No Action by Applicant Prior to Receipt of Notice.

No person shall carry out any development pursuant to an approval of an application for development which has been granted by any local permitting agency until he has received the notice provided for in Subsection (B) hereof. If such notice provides that the Commission intends to review such approval pursuant to Section 4-311 [PUBLIC HEARING] and 4-312 [DECISION ON REVIEW] of this Part, no development shall be carried out until such review has been completed.

**Section 4-311.
Public Hearing**

If the Executive Director determines that the approval should be reviewed by the Commission, he shall, within thirty days following the date on which notice of that determination is mailed, conduct a public hearing to be held pursuant to the procedures set out in Section 4-103 of this Plan. However, an applicant may, at his option, waive all time limits for review imposed by the Pinelands Protection Act or this Plan and request that the hearing be held by an Administrative Law Judge pursuant to the procedures established in Section 4-801 [RECONSIDERATION AND JUDICIAL REVIEW]. Within forty-five days following receipt of the findings of fact, conclusions and recommendations of the Administrative Law Judge, the Commission shall issue a final order.

**Section 4-312.
Decision on Review**

A. Determination by Commission.

If a hearing is held pursuant to Section 4-103 [COMMISSION HEARING PROVISIONS], the Commission shall, within forty-five days following the notice given pursuant to Section 4-310(B) [NOTICE OF DECISION AND HEARING], review the application, the file and the record of the hearing and make a determination as to whether the permit should be approved, approved with conditions or disapproved. If a hearing is held before an Administrative Law Judge pursuant to Section 4-801 [RECONSIDERATION AND JUDICIAL REVIEW], the Commission shall, upon receipt of the proposed

findings of fact and recommendation of the Administrative Law Judge, review such findings and recommendations, the record of the hearing, the application and the file and approve, approve with conditions or disapprove the final permit.

B. Standards.

The permit shall be approved or approved with conditions only if the Commission determines that the development as proposed, or with any conditions which are imposed, conforms with the minimum standards established in Section 4-206 [STANDARDS FOR UNCERTIFIED AREAS].

C. Effect on Commission's Decision.

1. If the Commission disapproves the final local approval of any such application, the local permitting agency shall revoke such approval and, thereafter, deny final approval of such application.

2. If the Commission approves the local permitting agency's approval of any such application subject to conditions, the local permitting agency shall, within thirty days, modify its approval to include all conditions imposed.

**Section 4-313.
Reconsideration**

Any interested person who is aggrieved by any determination made by the Executive Director or Commission pursuant to this Part may seek reconsideration of or judicial review, as the case may be, of such determination as provided in Part 8 of this Article [RECONSIDERATION AND JUDICIAL REVIEW].

PART 4—PUBLIC DEVELOPMENT

**Section 4-401.
Purpose**

This Part establishes procedures and standards designed to assure that public development in the Pinelands Area is in conformance with the goals and provisions of this Plan.

**Section 4-402.
General Requirements**

A. Conformance with Minimum Standards.

All development within the Pinelands Area by any state or local public agency shall be in conformance with the minimum standards set out in Section 4-206 [STANDARDS

FOR UNCERTIFIED AREAS] and all other standards and guidelines contained in this Plan, except as otherwise provided by memorandum of agreement between the Commission and such agency. All development within a military and federal installation area shall be in substantial conformance with the minimum standards and guidelines contained in this Plan.

B. Commission Approval Required.

Except as provided in an intergovernmental agreement, no development shall be initiated by any state or local public agency prior to conferring with and obtaining the approval of the Commission pursuant to the procedures established by this Part. Except as provided in an intergovernmental memorandum of agreement, the Commission shall review development within a federal military installation or development by other federal agency to the extent that any other state or local permit is required. Such review shall be in accordance with the provisions of Part 7 of this Article [COORDINATED PERMITTING WITH STATE AGENCIES].

C. Intergovernmental Agreements.

The Commission may enter into intergovernmental memoranda of agreements with any agency of the federal, state or local government which authorize such agency to carry out specified development activities without securing individual development approval from the Commission under this Part.

D. Exception for National Defense.

1. Notwithstanding any provision of this Plan, if the commander of a military installation determines that strict compliance with the provisions of this Plan, approved plan or memorandum of agreement would prevent achievement of the installation's national defense mission or other national security requirements, the installation commander shall certify such fact to the Commission in writing setting forth the basis of his determination.

2. Upon receipt by the Commission of such certification, strict compliance with any provision of this Plan shall be waived.

3. In time of war or when war is imminent or a national emergency is declared by Con-

gress or the President, nothing in this Plan shall modify or limit any other provisions of law granting emergency powers to the President, the Secretary of Defense, or persons possessing such authority by delegation from the President or Secretary of Defense, to include but not be limited to acts of using property, mobilizing and training personnel, or acquiring property.

Section 4-403.

Pre-Application Conference and Submission Requirements

A. Request for Pre-Application Conference.

Prior to initiating any development within the Pinelands, a public agency shall submit a request for a pre-application conference to the Executive Director pursuant to Section 4-102(A) [PRE-APPLICATION CONFERENCE].

B. Submission Requirement.

Following the completion of the pre-application conference, the interested public agency shall submit such information which the Executive Director determines is necessary to enable the Commission to review the proposed development for conformity with the standards of this Plan.

Section 4-404.

Review of Submission by Executive Director

Within thirty days following receipt of all information required to be submitted pursuant to Subsection 4-403(B), the Executive Director shall review the information and make a determination as to whether the proposed development raises a substantial issue with respect to the conformance of the proposed development with the minimum standards of this Plan. If the Executive Director determines that no substantial issue is raised, he shall issue a Certificate of Conformity. If the Executive Director determines that a substantial issue is raised, he shall submit a report to the Commission setting forth his findings, conclusions and recommendations with respect to the proposed development.

Section 4-405.

Action by Commission

Within thirty days following receipt of the report of the Executive Director pursuant to Section 4-404, the Commission shall consider the reports of the Executive Director and any additional information which may be submitted by the public agency proposing the development and shall determine whether the proposed development is in conformance with the standards set out in Section 4-406. The Commission shall issue an order approving, approving with conditions or disapproving the proposed development.

Section 4-406.

Standards for Public Development

The Commission shall approve or conditionally approve an application filed pursuant to this Part only if the development as proposed, or with any conditions which are imposed:

A. Satisfies all of the standards established by Articles 5 [MINIMUM STANDARDS FOR LAND USES AND INTENSITIES] and 6 [MANAGEMENT PROGRAMS AND MINIMUM STANDARDS] of this Plan or a certified local plan; and

B. If the proposed development includes any public roads, the applicant demonstrates that: alternative transportation modes including mass transit and non-motorized methods cannot be employed to satisfy transportation needs; and public fishing and/or crabbing access facilities in association with bridge crossings will be provided as appropriate.

Section 4-407.

Effect of Commission Order

No public agency shall carry out any development which has been disapproved by the Commission pursuant to Section 4-405 [ACTION BY COMMISSION], nor shall any public agency initiate any proposed development which has been approved with conditions by the Commission pursuant to Section 4-405 unless the conditions imposed are incorporated into the proposed development.

PART 5—WAIVER OF STRICT COMPLIANCE WITH PROVISIONS OF THE COMPREHENSIVE MANAGEMENT PLAN

Section 4-501.

Purpose

This Part establishes procedures and standards pursuant to which the Commission may waive strict compliance with this Plan. Waivers granted pursuant to this Part are intended to provide relief where strict compliance with this Plan will create an extraordinary hardship or where the waiver is necessary to serve a compelling public need.

Section 4-502.

Application

An application for waiver shall be submitted to the Commission in accordance with the requirements of Section 4-102(B) [APPLICATION REQUIREMENTS]. An application for waiver may be filed prior to filing an application for development. If dur-

ing review of an application for development it appears necessary to obtain a waiver, the applicant may apply for a waiver; such application shall stay the time period for review set forth in Parts 2 [UNCERTIFIED AREAS] or 3 [REVIEW OF LOCAL PERMITS] of this Article as the case may be.

Section 4-503.

Action by Executive Director

Within ninety days following receipt of a complete application for waiver, the Executive Director shall review the application and the file and either approve or disapprove the application for waiver. The Executive Director shall give written notification of his decision to the applicant, the Commission, interested persons and any person, organization or agency which has registered under Section 4-103(B)(2)(a) (ii) [PERSONS EN-

TITLED TO NOTICE]. The Executive Director's decision shall not become final until:

A. The time for Commission action under Section 4-504 [ACTION BY COMMISSION] has expired; and

B. The time for reconsideration under Section 4-801 [RECONSIDERATION] has expired.

Section 4-504.

Action by Commission

Within thirty days after notification of the Executive Director's decision, the Commission may refer the decision of the Executive Director to the Office of Administrative Law. If the Executive Director's decision is referred to the Office of Administrative Law, the referral shall be treated as a petition for reconsideration in accordance with the provisions of Part 8 of this Article [RECONSIDERATION AND JUDICIAL REVIEW].

Section 4-505.

Standards

An application for a waiver shall be approved only if the Executive Director finds an extraordinary hardship or compelling public need under the following standards:

A. The particular physical surroundings, shape or topographical conditions of the specific property involved would result in an extraordinary hardship, as distinguished from a mere inconvenience, if the provisions of this Plan are literally enforced. The necessity of acquiring additional land to meet the minimum lot size requirements of this Plan shall not be considered an extraordinary hardship, unless the applicant can demonstrate that there is no adjacent land which is reasonably available. An applicant shall be deemed to have established the existence of extraordinary hardship only if he demonstrates, based on specific facts, one of the following:

1. The subject property is not capable of yielding a reasonable return if used for its present use or developed as authorized by the provisions of this Plan, and that this inability to yield a reasonable return results from unique circumstances peculiar to the

subject property which (a) do not apply to or affect other property in the immediate vicinity, (b) relate to or arise out of the characteristics of the subject property rather than the personal situation of the applicant; and (c) are not the result of any action or inaction by the applicant or the owner or his predecessors in title; or

2. The applicant can demonstrate that in good faith reliance on a valid municipal development approval, he has made expenditures of such a nature and amount that he is unable to secure a minimum reasonable rate of return on those expenditures under a strict application of the minimum standards of this Plan. In determining whether an applicant can secure a minimum reasonable rate of return, the Commission shall employ the following criteria:

(a) the rate of return shall be related to the applicant's debt to equity ratio in the project;

(b) expenditures for legal or other professional services that are unrelated to the design or construction of improvements shall not be considered as development expenditures;

(c) taxes paid shall not be considered as development expenditures except for any increase in taxes which result from the governmental approval or improvements actually constructed on the property.

3. For applications filed within two years of the effective date of this Plan, a valid final subdivision approval under the Municipal Land Use Law for the property proposed for development in the Protection Area was in effect on February 7, 1979, provided that all lots proposed for development have an area of at least one acre, unless sewer is available, and the proposed development is in conformance with the minimum standards and guidelines of Article 6 [MANAGEMENT PROGRAMS AND MINIMUM STANDARDS] of this Plan.

B. An applicant shall be deemed to have established compelling public need if he demonstrates, based on specific facts, that the proposed development will serve an essential health or safety need of the municipality in which the proposed development is

located, that the public health and safety require the requested waiver, that the public benefits from the proposed use are of a character that override the importance of the protection of the Pinelands as established in the Protection Act or the Federal Act, that the proposed use is required to serve existing needs of the residents of the Pinelands, and that there is no alternative available to meet the established public need; and

C. The granting of the waiver will not be materially detrimental or injurious to other property or improvements in the area in which the subject property is located, increase the danger of fire, endanger public safety or result in substantial impairment of the resources of the Pinelands Area; and

D. The waiver will not be inconsistent with the purposes, objectives or the general spirit and intent of the Pinelands Protection Act, the Federal Act or this Plan; and

E. The waiver granted is the minimum relief necessary to relieve the extraordinary hardship, including the granting of a residential development right to lands in Forest Areas and Rural Development Areas that may be transferred or clustered to land which is suitable for clustering under the provisions of Section 5-310 of Article 5 [MINIMUM STANDARDS FOR CLUSTERING RESIDENTIAL RIGHTS] or other developable land in

the Rural Development Area, or to satisfy the compelling public need; and

F. Any waiver approved under the final subdivision standard of Subsection A(3) of this Section shall be subject to the condition that the waiver shall expire after two years if substantial construction of improvements is not commenced, or if fewer than 10% of the total number of lots in the subdivision are sold or built upon within any succeeding twelve-month period.

Section 4-506.

Effect of Grant of Waiver

Any waiver granted under the provisions of this Part shall only be considered a waiver of the particular standard which the Commission or the Executive Director waived. It shall not constitute an approval of the entire development proposal.

Section 4-507.

Reconsideration

Any person who is aggrieved by any determination made by the Executive Director pursuant to this Part may seek reconsideration by the full Commission of such determination as provided by Section 4-801 [RECONSIDERATION AND JUDICIAL REVIEW] of this Plan.

PART 6—LETTERS OF INTERPRETATION

Section 4-601.

Purpose

This Part is intended to provide an expeditious method by which any person may secure a clarification or interpretation of the meaning of any provision of this Plan, or any rule or regulation adopted pursuant to it.

Section 4-602.

Authority

The Executive Director may, subject to the procedures, standards, and limitations set forth in this Part, issue letters of clarification or interpretation of any provision of this

Plan, or any rule or regulation issued pursuant to it. No letter of clarification or interpretation shall have the effect of modifying, amending, abrogating or waiving any substantive requirement of this Plan. These interpretations may include:

A. A determination of whether a particular use, which is not expressly authorized in an area, is substantially similar to the uses authorized in the area and should be authorized;

B. A determination of the presence of significant archaeological data in accordance with the provisions of Section 6-1407

[UNDESIGNATED HISTORIC AND ARCHAEOLOGICAL SITES] of this Plan; or C. A determination of the definition or application of any provision of this Plan.

Section 4-603.
Request for Interpretation

A request for a letter of clarification or interpretation shall be initiated by requesting a pre-application conference pursuant to Section 4-102(A) [PRE-APPLICATION CONFERENCE]. This request shall set forth the clarification or interpretation requested and the facts or the circumstances which are the basis for the request for an interpretation, together with any proposed clarification or interpretation desired by the applicant. Within fifteen days after receipt of a request for a letter of clarification or interpretation, the Executive Director shall inform the applicant of any additional information which is required in order to make a determination of the requested clarification or interpretation.

Section 4-604.
Interpretation by Executive Director

Except as provided in Section 4-605 [LIMITATIONS ON ISSUANCE OF USE INTERPRETATIONS], the Executive Director shall, within forty-five days following the receipt of a request for clarification or interpretation, issue a letter of clarification or interpretation. An analysis of all pending requests for letters of interpretation will be submitted to the Commission at its regular monthly meeting. A copy of the letter shall be provided to the appropriate township or county clerk, planning board and the environmental commission, if any. The letter issued by the Executive Director shall specify the grounds, reasons and analysis upon which the clarification or interpretation is based. In the event the Executive Director fails to render a letter of clarification or interpretation within forty-five days or such longer period of time as may be agreed to by the applicant, the request for clarification or interpretation shall be deemed to have been denied. Nothing in this Section shall be construed to prevent any person from resubmitting a request for clarification or interpretation.

Section 4-605.
Limitations on Issuance of Use Interpretations

- A. No use interpretation shall permit a use listed as an authorized use in any area to be established in any area in which such use is not listed;
- B. No use interpretation shall permit any use in any area unless the Executive Director determines that the use will be in conformity with the minimum standards and requirements of this Plan; and
- C. No use interpretations shall authorize any use in a particular area unless the use is substantially similar to other uses authorized in the area.

Section 4-606.
Effect of and Limitation on Favorable Interpretation

- A. No letter of clarification or interpretation shall authorize the establishment of a use or the carrying out of any development, but shall merely authorize the preparation, filing and processing of applications for any permits and approvals which may be required by the codes and ordinances of any local permitting agency with jurisdiction over the subject property or this Plan.
- B. No letter of clarification or interpretation shall be valid for a period longer than one year from the date of issuance, unless a final approval pursuant to this Plan has been granted within that period, and development is thereafter diligently pursued to completion, or the use is commenced within that period.

Section 4-607.
Binding Effect of Interpretations

Any letter of clarification or interpretation issued by the Executive Director pursuant to this Part shall be binding so long as the applicant complies with all applicable conditions imposed by the provisions of this Part or other provisions of this Plan.

Section 4-608.
Monthly Report

The Executive Director shall keep a record

of each classification or interpretation rendered pursuant to this Part and shall file a monthly report of such clarifications or interpretations with the Commission. The report may include a recommendation of the Executive Director that this plan be amended to add new uses to the various use lists established by this Plan to reflect any use interpretations given pursuant to this Part.

Section 4-609.

Reconsideration

Any interested person who is aggrieved by any clarification or interpretation given by the Executive Director pursuant to this Part may within 15 days seek reconsideration by the full Commission of such clarification or interpretation as provided in Section 4-801 [RECONSIDERATION] of this Plan.

PART 7—COORDINATED PERMITTING WITH STATE AGENCIES

Section 4-701.

Applicant to Submit Application to Executive Director

Prior to filing any application for development in the Pinelands Area with any department, board, bureau, official or other agency of the State of New Jersey, the applicant shall file with the Commission a duplicate copy of the application and shall obtain a Certificate of Filing pursuant to Section 4-702(B) [ISSUANCE OF CERTIFICATION OF FILING] of this Plan. The Executive Director may within fifteen days require the applicant to submit any additional information which he determines is necessary in order to evaluate the interest of the Commission in such application.

Section 4-702.

Determination of Commission Interests; Commission Staff Participation in State Review Process

A. Review of Application.

Within fifteen days following receipt of any application or additional information submitted pursuant to Section 4-701 [APPLICANT TO SUBMIT APPLICATION TO EXECUTIVE DIRECTOR], the Executive Director shall review the application and additional information and determine what, if any, special interests the Commission has with respect to the application, the extent to which the Commission staff should participate in any proceedings held by the state agency with which the application is to be filed, and whether any Commission review provided for in this Plan should be conducted

before, after, or simultaneously with any proceedings to be conducted by the state agency.

B. Issuance of Certificate of Filing.

1. If the Executive Director determines that any proceedings to be conducted by the state agency in question should be conducted prior to or simultaneously with any Commission review provided for in this Plan, the Executive Director shall within thirty (30) days issue to the applicant a Certificate of Filing evidencing the fact that the applicant has complied with the provisions of Section 4-701 [APPLICANT TO SUBMIT APPLICATION TO EXECUTIVE DIRECTOR] and authorizing the filing of the application with the state agency. Such Certificate of Filing shall indicate that any permit, approval or authorization granted by the state agency shall be conditioned upon the issuance of any Commission approval provided for by this Plan.

2. If the Executive Director determines that any proceedings to be conducted by any state agency should be conducted after any Commission review provided for by this Plan, he shall issue a Certificate of Filing authorizing the filing of the application with the state agency only after all required Commission approvals provided for by this Plan have been granted.

C. Determination of Degree of Participation.

If the Executive Director determines pursuant to Subsection (A) hereof that any state agency proceeding, with respect to an application filed pursuant to Section 4-701

[APPLICANT TO SUBMIT APPLICATION TO EXECUTIVE DIRECTOR], should be conducted before or simultaneously with any Commission review, he shall determine the appropriate nature and extent of Commission staff participation in such proceeding. Its participation may include, but is not limited to:

1. Submitting a written analysis of any concerns and opinions the Commission staff has with respect to the conformance of the proposed development with the minimum standards of the Plan, including a list of any conditions which it determines should be imposed in the event that the permit is granted;

2. Submitting written evidence with respect to the conformance by the proposed development with the minimum standards of this Plan.

D. State Agency To Allow Commission Staff Participation.

Each state agency with jurisdiction over any application for development in the Pinelands Area shall permit the Commission staff to participate at any meeting, hearing or other proceeding at which an application for development in the Pinelands Area is to be considered and to present the opinions of the Commission staff with respect to the application. At the option of the Executive Director, the Commission staff submissions to the state agency may be in written form in addition to actual appearance at such hearing or meeting.

Section 4-703.

Notice from State Agencies with Respect to Applications for Development

A. General.

Every department, board, bureau, official and other agency of the state shall give notice to the Commission of the filing of any applications for development and of hearings, meetings and other formal proceedings concerning the filing and disposition of every application for development in the Pinelands Area filed with it.

B. Notice of Filing.

Notice of filing of any application for development shall be given by certified mail

within seven days following such filing and shall contain the following information:

1. The name and address of the applicant;
2. The legal description and street address, if any, of the property which the applicant proposes to develop;
3. A brief description of the proposed development, including uses and intensity of uses proposed;
4. The docket number of the Certificate of Filing issued by the Executive Director and the date on which it was issued;
5. The date on which the application was filed and any docket or other identifying number assigned to such application by the state agency;
6. The state agency with which the application was filed; and
7. The nature of the approval or approvals being sought.

C. Notice of Hearings and Meetings.

Notice of any hearing, public meeting or other formal proceeding at which the filing or disposition of any application for development in the Pinelands Area is to be considered shall be given by certified mail no less than five days prior to such meeting or hearing and shall contain the following information:

1. The name and address of the applicant;
2. The docket number of the Certificate of Filing issued by the Executive Director and the date on which it was issued;
3. The date, time and location of the meeting or hearing;
4. The name of the state agency which will conduct the meeting or hearing;
5. Any written reports or comments received by the state agency on the application which have not previously been submitted to the Commission; and
6. The purpose for which the meeting or hearing is to be held.

D. Notice of Grant of Final Determination.

Notice of any final determination by any department board, bureau, official or other agency of the state with respect to any application for development in the Pinelands

Area shall be given by certified mail within five days of the grant or denial of such approval and shall contain the following information:

1. The name and address of the applicant;
2. The legal description and street address, if any, of the property which the applicant proposes to develop;
3. The docket number of the Certificate of Filing issued by the Executive Director and the date on which it was issued;
4. A copy of the permit, approval or authorization which was issued; and
5. A copy of any approved site plan or plat.

Section 4-704.

Referral of Matters to State Agency

At any stage of any Commission review of development provided for in this Plan, the Executive Director may refer any issue raised in such review to any state department, board, bureau, official or other agency of the state with a request for such information or assistance as may be necessary or convenient to permit the Commission to fulfill its duties and responsibilities. Upon receipt of such referral, the state agency shall provide any requested information, as-

sistance or recommendation relating to any issues within the areas of its expertise. Any such information, assistance or recommendations shall not be binding on such agency with respect to the granting of any permit, approval or other authorization required by the laws and regulations applicable to such agency but shall be deemed to be purely advisory to the Commission.

Section 4-705.

Referral of Matters to Commission by State Agency

At any stage of any proceedings conducted by any state department, board, bureau, official or other agency of the state with respect to development in the Pinelands Area, such agency may refer any issue raised in such proceedings to the Commission. Upon receipt of such referral, the Commission shall provide any requested information or recommendation relating to any issues relating to this Plan, any other Commission rules or regulations, or any other matters of special concern to the Commission. Such recommendations shall not be binding on the Commission with respect to the grant of any approval required by this Plan but shall be deemed purely advisory.

PART 8—RECONSIDERATION AND JUDICIAL REVIEW

Section 4-801.

Reconsideration

A. Notice.

Any person who is granted, by any provision of this Plan, a right to seek reconsideration by the full Commission of any determination made by the Executive Director shall, within fifteen days after the decision is rendered, perfect such right by giving notice by mail of his intent to seek reconsideration by the Commission. Such notice shall include:

1. The name and address of the person requesting the reconsideration;
2. The docket number of the application which is the subject of the reconsideration request;

3. The date on which the determination which is to be reconsidered was made;

4. A brief statement of the basis for the reconsideration request;

5. A certificate of service indicating that service of the notice has been made, by certified mail, on the clerk of the county or municipal planning board and environmental commission, if any, with jurisdiction over the property which was the subject of the decision or order.

B. Hearing.

Within fifteen days following receipt of a notice filed pursuant to Subsection (A) hereof, or of any demand for a hearing at which an Administrative Law Judge is to preside which is provided for in this Plan, the Ex-

Executive Director shall initiate the procedures for assignment of an Administrative Law Judge to preside at the hearing pursuant to the Administrative Procedures Act, N.J.S.A. 52:14B-1 et seq., and the procedures established by the Office of Administrative Law. The time, date and location of such hearing shall be designated by the Office of Administrative Law.

C. Burden.

The person seeking reconsideration shall have the burden of going forward and the burden of proof on all issues.

D. Commission Review of Record.

Within forty-five days following receipt of the findings of fact, conclusions and recommendations of the Administrative Law Judge, the Commission shall consider the hearing record and such findings of fact, conclusions

and recommendations and issue a final order with respect to the matter in controversy.

Section 4-802.

Judicial Review

Judicial review may be had of any determination or order of the Commission as provided by Section 19 of the Pinelands Protection Act or any other provision of state law. If reconsideration of a determination of the Executive Director is sought by any person pursuant to Section 4-801 [RECONSIDERATION], all limitation periods provided by state law for seeking judicial review of any decision of the Commission shall be deemed to commence upon entry of the Commission's order on reconsideration pursuant to Section 4-801(D) [COMMISSION REVIEW OF RECORD].

ARTICLE 5

Minimum Standards for Land Uses and Intensities

INTRODUCTION

The Pinelands Protection Act provides in part that the Comprehensive Management Plan is to "encourage appropriate patterns of compatible residential, commercial and industrial development in or adjacent to areas already utilized for such purposes, in order to accommodate regional growth influences in an orderly way while protecting the Pinelands environment from the individual and cumulative adverse impacts thereof" and to "discourage piecemeal and scattered development" while protecting the Pinelands environment. Article 5 contains minimum standards for the development and use of land which the Pinelands Commission has determined are necessary to protect and maintain the essential character of the Pinelands environment and to accomplish the purposes of the Pinelands Protection Act and the Federal Act.

The provisions of this Article are intended to serve as minimum standards for the preparation and adoption of county and municipal master plans and land use ordinances. However, it is recognized that the specific provisions of this Article, including the management area delineations, can be refined at the local level provided that the objectives and goals the minimum standards represent will be achieved. In determining whether to certify a municipal master plan or land use ordinance under the provisions of Part 4 of Article 3 [CERTIFICATION OF MUNICIPAL PLANS] of this Plan, the Pinelands Commission will consider the extent to which the municipal master plan or land use ordinance ensures that all development of land will be in conformance with the minimum standards of this Article.

PART 1—STANDARDS OF GENERAL APPLICABILITY

Section 5-101.

Development in Accordance with this Plan

No development shall be carried out by any person unless that development conforms to the minimum requirements and standards of this Plan.

Section 5-102.

Expansion of Existing Uses

Notwithstanding the use restrictions contained in Part 3 of this Article, any lawful use other than those uses which are expressly limited in Article 6 [MANAGEMENT PRO-

GRAMS AND MINIMUM STANDARDS] of this Plan, and which existed on the effective date of this Plan, may be expanded provided that:

A. The expansion of the use meets all of the minimum standards of Article 6 [MANAGEMENT PROGRAMS AND MINIMUM STANDARDS];

B. The area of expansion does not exceed 50% of the floor area, the area of the use or the capacity of the use, whichever is applicable, on the effective date of this Plan; or

C. The developer demonstrates that the ex-

pansion of the existing use in excess of 50% is necessary in order to maintain the economic viability of the existing use.

Section 5-103.

Map Status

The following maps, the originals of which are maintained at the offices of the Commission, are hereby designated and established as a part of this Plan and shall be as much a part of this Plan as if they were set out in full in this Plan:

- A. Pinelands Area Jurisdiction Boundaries, Plate 1.
- B. Surficial Geology, Plate 2.
- C. NW-SE Geologic Cross-Section, Plate 3.
- D. Hydrogeologic Features, Plate 4.
- E. Surface Water Hydrology, Plate 5.
- F. Agricultural Soils, Plate 6.
- G. Depth to Seasonal High Water Table, Plate 7.
- H. Hydrologic Soil Group, Plate 8.
- I. Soil Factors Limiting Use for Septic Tank Absorption Fields, Plate 9.
- J. Vegetation, Plate 10.
- K. Wildland Fire Hazard Classification, Plate 11.
- L. Watersheds Supporting Characteristic Pinelands Aquatic Communities, Plate 12.
- M. Prehistoric Archaeologic Resources, Plate 13.
- N. Historic, Archaeologic and Architectural Resources, Plate 14.

- O. Cultural Subregions, Plate 15.
- P. Land Use, Plate 16.
- Q. Sewer Service Areas, Plate 17.
- R. Water Service Areas, Plate 18.
- S. Solid Waste Disposal Sites, Plate 19.
- T. Transportation Systems, Plate 20.
- U. Major Public Land Holdings, Plate 21.
- V. Resource Extraction Areas, Plate 22.
- W. Ecological Critical Area Importance Values, Plate 27.
- X. Land Capability, Plate 28.

Section 5-104.

Height Limitations

A. In all Pinelands Management Areas other than Regional Growth Areas and Pinelands Towns no structure shall exceed a height of 35 feet, except as provided in Subsection B hereof.

B. The height limitation in Subsection A shall not apply to any of the following structures, provided that such structures are compatible with uses in the immediate vicinity and conform to the objectives of Part 10 of Article 6: silos, barns and other agricultural structures, church spires, cupolas, domes, monuments, water towers, fire observation towers, transmission towers, windmills, chimneys, smoke stacks, derricks, conveyors, flag poles, masts, aerials, solar energy facilities, and similar structures required to be placed above the roof level and not intended for human occupancy.

PART 2—PINELANDS MANAGEMENT AREAS

Section 5-201.

Purpose

In order to ensure that the development and use of land in the Pinelands meet the minimum standards of this Plan, the Pinelands Commission hereby finds that it is necessary to establish eight management areas governing the general distribution of land uses and intensities in the Pinelands. Except for Special Agricultural Production

Areas and the Pinelands Villages, the boundaries of the management areas are set forth on the Land Capability Map identified in Section 5-103. Special Agricultural Production Areas and additional Agricultural Production Areas may be created as an element of a municipal master plan or land use ordinance under the provisions of Sections 5-204 and 5-205 of this Part. The boundaries of Pinelands Villages shall be delineated in accordance with the criteria in Section 5-206.

The boundaries of the management areas may be refined and/or adjusted in municipal master plans and land use ordinances provided that the Commission determines that the goals and objectives of this Plan will be implemented by the proposed municipal master plan or land use ordinance under the municipal plan certification procedures of Article 3.

Section 5-202.

Pinelands Management Areas Established

The following Pinelands Management Areas are hereby established:

- A. Preservation Area District.
- B. Forest Areas.
- C. Agricultural Production Areas.
- D. Special Agricultural Production Areas.
- E. Rural Development Areas.
- F. Pinelands Villages and Pinelands Towns.
- G. Regional Growth Areas.
- H. Military and Federal Installation Areas.

Section 5-203.

Goals and Objectives of Pinelands Management Areas

A. Preservation Area District.

The Preservation Area District is the heart of the Pinelands environment and is an area of significant environmental and economic values that are especially vulnerable to degradation. It is a large, contiguous area of forest, transected by a network of pristine wetlands, streams and rivers, all of which support diverse plant and animal communities. The area must be protected from development and land use that would adversely affect its long-term ecological integrity.

B. Forest Areas.

Forest Areas are undisturbed, forested portions of the Protection Area which support characteristic Pinelands plant and animal species. These areas are an essential element of the Pinelands environment and are very sensitive to random and uncontrolled development. Some parts of the Forest Areas are more suitable for development

than others provided that such development is subject to strict environmental performance standards.

C. Agricultural Production Areas.

Agricultural Production Areas are areas of active agricultural use, together with adjacent areas of prime and unique agricultural soils or soils of statewide significance, which are suitable for expansion of agricultural operations.

D. Special Agricultural Production Areas.

Special Agricultural Production Areas are discrete areas within the Preservation Area District which are primarily used for berry agriculture or horticulture of native Pinelands plants. They represent a unique and essential element of the Pinelands economy and are a part of the essential character of the Pinelands.

E. Rural Development Areas.

Rural Development Areas are areas which are slightly modified and may be suitable for limited future development subject to strict adherence to the environmental performance standards of Article 6. They represent a balance of environmental and development values that is intermediate between the pristine Forest Areas and existing growth areas.

F. Pinelands Villages and Pinelands Towns.

Pinelands Villages and Towns are existing communities in the Pinelands which are appropriate for infill residential, commercial and industrial development that is compatible with their existing character.

1. Pinelands Villages are: (i) Bamber Lake, (ii) Belcoville, (iii) Belleplain, (iv) Blue Anchor, (v) Bricksboro, (vi) Brookville, (vii) Cassville, (viii) Chatsworth, (ix) Cologne-Germania, (x) Clermont, (xi) Corbin City, (xii) Cumberland, (xiii) Delmont, (xiv) Dennisville, (xv) Dorchester, (xvi) Dorothy, (xvii) Eldora, (xviii) Elm, (xix) Elwood, (xx) Estell Manor, (xxi) Folsom, (xxii) Goshen, (xxiii) Green Bank, (xxiv) Heislerville, (xxv) Indian Mills, (xxvi) Lake Pine, (xxvii) Landisville, (xxviii) Leesburg, (xxix) Legler, (xxx) Lower Bank, (xxxi) Milmay, (xxxii) Mizpah, (xxxiii) Nesco, (xxxiv) New Gretna, (xxxv) New Lisbon, (xxxvi) Newtonville, (xxxvii) North

Dennis, (xxxviii) Oceanville, (xxxix) Petersburg, (xl) Pomona, (xli) Port Elizabeth, (xlii) Port Republic, (xliii) Richland, (xliv) Smithville, (xlv) South Dennis, (xlvi) Swanton, (xlvii) Sweetwater, (xlviii) Tabernacle, (xlix) Tansboro, (l) Taunton Lake, (li) Tuckahoe, (lii) Vanhiseville, (liii) Warren Grove, (liv) Waterford Works, (lv) Weekstown, (lvi) Westcoatville, (lvii) West Creek, (lviii) Whiting, and (lix) Winslow.

2. Pinelands Towns are: (i) Buena, (ii) Egg Harbor City, (iii) Hammonton, (iv) Lakehurst, (v) Tuckerton, and (vi) Woodbine.

G. Regional Growth Areas.

Regional Growth Areas are areas of existing growth or lands immediately adjacent thereto which are capable of accommodating regional growth influences while protecting the essential character and environment of the Pinelands, provided that the environmental objectives of Article 6 are implemented through municipal master plans and land use ordinances.

H. Military and Federal Installation Areas.

Military and Federal Installation Areas are federal enclaves within the Pinelands. They represent a unique element of the Pinelands landscape and are a substantial resource to the region and the state, provided that their activities preserve and protect the unique natural, ecological, agricultural, archaeological, historic, scenic, cultural and recreational resources of the Pinelands.

Section 5-204.

Minimum Standards for Municipal Designation of Special Agricultural Production Areas

Special Agricultural Production Areas may be designated at the option of a municipality, or upon nomination to the Commission by an individual prior to certification, in the Preservation Area District in accordance with the following criteria:

1. The area to be designated is primarily agricultural in use and is of a size capable of sustained active agricultural operation taking into account adjacent and surrounding uses and the availability of agricultural support uses; and

2. The area may include land in an adjacent municipality also designated under this Section; and

3. The area is primarily comprised of lands used for active berry agricultural or active native horticultural use and lands which are essential to and held for the protection of active berry agricultural or active native horticultural uses.

Section 5-205.

Minimum Standards for Municipal Designation of Agricultural Production Areas

Agricultural Production Areas may be designated in the Protection Area at the option of a municipality or upon nomination to the Commission by an individual prior to certification, in accordance with the following criteria:

1. The area to be designated is primarily agricultural in use and is of a size capable of sustained active agricultural operation taking into account adjacent and surrounding uses and the availability of agricultural support uses; and

2. The area may include land in an adjacent municipality also designated under this Section; and

3. The area is primarily comprised of lands used for active agricultural use including lands which are held as buffers, water conservation areas or for other protection of active agricultural uses.

Section 5-206.

Minimum Criteria for Delineation of Boundaries of Pinelands Villages

In the preparation of municipal master plans and land use ordinances, municipalities should designate the boundaries of Pinelands Villages in accordance with the following criteria:

A. The village area should include the center of the village, typically located at or near the intersection of two roads, the developed lands contiguous to the village center, and other cleared lands not in active agricultural use.

B. In the Preservation Area District and For-

est Areas the village area should not contain more than 50% forested land.

C. In Agricultural Production Areas and Forest Areas the village area should not include active agricultural lands except for isolated areas of less than 10 acres.

D. Village boundaries along roads leading to and from the village center should not be extended more than 1/2 mile from the village center.

E. Village delineations should not intrude into wetlands vegetation associations.

F. Villages should include areas of high septic suitability (Hydrologic Soil Group B) contiguous to developed lands.

G. The designated village area should not contain more vacant land than built land, nor provide for an additional increment of development which is greater than the number of non-accessory structures that currently exist in the village. For the purposes of this Section built land for residential structures should be calculated as the existing lot size or 3.2 acres, whichever is less, and built land for

non-residential structures should be calculated as the lot size required by existing zoning at the time of adoption of this Plan.

Section 5-207.
Incorporation of Pinelands Management Areas into Municipal Master Plans and Land Use Ordinances

In order to be certified under the provisions of Part 4 of Article 3 of this Plan (CERTIFICATION OF MUNICIPAL PLANS), a municipal master plan or land use ordinance must incorporate and implement the minimum standards of this Article governing the distribution and intensity of land uses.

Section 5-208.
Minimum Residential Allocation of Density in Wetlands

Each municipality shall allocate a minimum residential density to all wetlands that is at least one-fifth of the average gross residential density of uplands located in the same management area as the wetlands.

PART 3—MINIMUM STANDARDS FOR LAND USE DISTRIBUTION AND INTENSITIES

Section 5-301.
Purpose

In order to ensure the long-term integrity of the Pinelands environment while accommodating regional growth influences, the Pinelands Commission finds that it is appropriate and necessary to establish minimum standards governing the character, location and magnitude of development and the use of land in the Pinelands.

Section 5-302.
Minimum Standards Governing the Distribution and Intensity of Development and Land Use in the Preservation Area District

Use of land in the Preservation Area District shall be limited to the following:

A. Residential dwellings on lots of 3.2 acres, provided that:

(1) the dwelling unit will be the applicant's principal place of residence;

(2) the applicant has not developed a dwelling unit under this Section within the previous 5 years; and

(3) the applicant can demonstrate a cultural, social or economic link to the essential character of the Pinelands under the following tests:

(a) the parcel of land on which the dwelling is to be located was owned by the applicant or a member of his immediate family on February 7, 1979; and either

(b) the applicant is a member of a two-generation extended family that has resided in the Pinelands for at least twenty years; or

(c) the primary source of the applicant's household income is employment or participation in a Pinelands resource-related activity.

B. Agricultural employee housing as an element of, and accessory to, an active agricultural operation.

C. Berry agriculture and horticulture of native plants and other agricultural activities compatible with the existing soil and water conditions that support traditional Pinelands berry agriculture.

D. Forestry.

E. Beekeeping.

F. Fish and wildlife management.

G. Low intensity recreational uses, provided that:

(1) the parcel proposed for low intensity recreational use has an area of at least fifty acres;

(2) the recreational use does not involve the use of motorized vehicles except for necessary transportation;

(3) access to bodies of water is limited to no more than 15 linear feet of frontage per 1000 feet of water body frontage;

(4) the parcel will contain no more than 1 campsite per 2 acres, provided that the campsites shall not be clustered at a net density exceeding 6 campsites per acre;

(5) clearing of vegetation, including ground cover and soil disturbance, does not exceed 5 percent of the parcel; and

(6) no more than 1 percent of the parcel will be covered with impermeable surfaces.

H. Intensive recreational uses, provided that:

(1) the use was in existence on February 7, 1979 and the capacity of the use will not exceed two times the capacity of the use on February 7, 1979;

(2) the use is necessary to achieve recreational use of a particular element of the Pinelands environment, and

(3) the use is environmentally and aesthetically compatible with the essential character of the Pinelands and will not unduly burden available public services.

I. Public service infrastructure which is necessary to serve only the needs of the Preservation Area District uses.

J. Resource extraction operations.

K. Signs.

L. Accessory uses.

Section 5-303.

Minimum Standards Governing the Distribution and Intensity of Development and Land Use in Forest Areas

A. The following uses shall be permitted in a Forest Area:

1. Residential dwelling units on lots of 3.2 acres, provided that:

(a) the dwelling unit will be the applicant's principal place of residence;

(b) the applicant has not developed a dwelling unit under this Section within the previous 5 years; and

(c) the applicant can demonstrate a cultural, social or economic link to the essential character of the Pinelands under the following tests:

(i) the parcel of land on which the dwelling is to be located was owned by the applicant or a member of his immediate family on February 7, 1979; and either

(ii) the applicant is a member of a two-generation extended family that has resided in the Pinelands for at least twenty years; or

(iii) the primary source of the applicant's household income is employment or participation in a Pinelands resource-related activity.

2. Residential dwelling units at municipally designated densities provided that the total number of dwelling units authorized by a municipality for those portions of the municipality in Forest Areas does not exceed the following total number of dwelling units:

(a) In Barnegat Township—
459 dwelling units.

(b) In Bass River Township—
87 dwelling units.

- (c) In Berkeley Township—
139 dwelling units.
 - (d) In Buena Vista Township—
163 dwelling units.
 - (e) In Corbin City—
64 dwelling units.
 - (f) In Dennis Township—
599 dwelling units.
 - (g) In Eagleswood Township—
80 dwelling units.
 - (h) In Egg Harbor City—
69 dwelling units.
 - (i) In Egg Harbor Township—
95 dwelling units.
 - (j) In Estell Manor City—
1065 dwelling units.
 - (k) In Evesham Township—
60 dwelling units.
 - (l) In Folsom Borough—
114 dwelling units.
 - (m) In Galloway Township—
110 dwelling units.
 - (n) In Hamilton Township—
1325 dwelling units.
 - (o) In Hammonton Town—
93 dwelling units.
 - (p) In Jackson Township—
264 dwelling units.
 - (q) In Lacey Township—
541 dwelling units.
 - (r) In Little Egg Harbor Township—
19 dwelling units.
 - (s) In Manchester Township—
638 dwelling units.
 - (t) In Maurice River Township—
1198 dwelling units.
 - (u) In Medford Township—
17 dwelling units.
 - (v) In Middle Township—
154 dwelling units.
 - (w) In Monroe Township—
111 dwelling units.
 - (x) In Mullica Township—
1027 dwelling units.
 - (y) In Ocean Township—
238 dwelling units.
 - (z) In Pemberton Township—
211 dwelling units.
 - (aa) In Plumsted Township—57 dwell-
ing units.
 - (bb) In Port Republic City—
10 dwelling units.
 - (cc) In Shamong Township—
51 dwelling units.
 - (dd) In Southampton Township—
224 dwelling units.
 - (ee) In Stafford Township—
560 dwelling units.
 - (ff) In Tabernacle Township—
33 dwelling units.
 - (gg) In Upper Township—
674 dwelling units.
 - (hh) In Vineland City—
110 dwelling units.
 - (ii) In Waterford Township—
27 dwelling units.
 - (jj) In Weymouth Township—
376 dwelling units.
 - (kk) In Winslow Township—
187 dwelling units.
 - (ll) In Woodbine Borough—
31 dwelling units.
3. Agriculture.
4. Agricultural employee housing as an element of, and necessary to, an active agricultural operation.
5. Forestry.
6. Low intensity recreational uses, provided that:
- (a) the parcel proposed for low intensity recreational use has an area of at least fifty acres;
 - (b) the recreational use does not involve the use of motorized vehicles except for necessary transportation;
 - (c) access to bodies of water is limited to no more than 15 linear feet of frontage per 1000 feet of water body frontage;
 - (d) clearing of vegetation, including ground cover and soil disturbance, does not exceed 5 percent of the parcel; and
 - (e) no more than 1 percent of the parcel will be covered with impermeable surfaces.
7. Intensive recreational uses, provided that:

(a) the use was in existence on February 7, 1979 and the capacity of the use will not exceed two times the capacity of the use on February 7, 1979;

(b) the use is necessary to achieve recreational use of a particular element of the Pinelands environment; and

(c) the use is environmentally and aesthetically compatible with the essential character of the Pinelands and will not unduly burden available public services.

8. Public service infrastructure which is necessary to serve the needs of the Pinelands.

9. Signs.

10. Accessory uses.

B. In addition to uses permitted under Subsection A of this Section, a municipality may, at its option, permit the following uses in a Forest Area:

1. Institutional uses, provided that:

(a) the use does not require or will not generate subsidiary or satellite development in the Forest Area;

(b) the applicant has demonstrated that adequate public service infrastructure will be available to serve the use; and

(c) the use is primarily designed to serve the needs of the Forest Area in which the use is to be located.

2. Pinelands resource-related industrial or manufacturing uses, provided that:

(a) the parcel proposed for development has an area of at least five acres;

(b) the principal raw material for the proposed use is found or produced in the Pinelands; and

(c) the use does not require or will not generate subsidiary or satellite development in a Forest Area.

3. Airport facilities and compatible light industrial uses, provided that the airport is publicly owned or serves a Pinelands Town.

4. Campgrounds, not to exceed 6 campsites per gross acre, provided that the campsites may be clustered at a net density not to exceed 10 campsites per acre.

5. Agricultural commercial establishments, provided that:

(a) the principal goods or products available for sale were produced in the Pinelands; and

(b) the sales area of the establishment does not exceed 5000 square feet.

6. Roadside retail sales and service establishments, provided that:

(a) the parcel proposed for development has roadway frontage of at least fifty feet;

(b) no portion of any structure proposed for development will be more than three hundred feet, measured along a line parallel to the roadway, from the closest part of a roadside retail sales and service establishment structure that was in existence on February 7, 1979; and

(c) the proposed use will not unduly burden public services, including but not limited to water, sewer and roads.

7. Resource extraction operations.

8. Landfills.

C. No residential dwelling unit shall be located on a lot of less than 3.2 acres.

**Section 5-304.
Minimum Standards Governing
the Distribution and Intensity
of Development and Land Use
in Agricultural Production Areas**

A. The following uses shall be permitted in an Agricultural Production Area:

1. Residential dwelling units on lots of 3.2 acres, provided that:

(a) the dwelling unit will be the applicant's principal place of residence;

(b) the applicant has not developed a dwelling unit under this Section within the previous 5 years; and

(c) the applicant can demonstrate a cultural, social or economic link to the essential character of the Pinelands under the following tests:

(i) the parcel of land on which the dwelling is to be located was owned by the applicant or a member of his immediate family on February 7, 1979; and either

(ii) the applicant is a member of a two-generation extended family that has resided in the Pinelands for at least twenty years; or

(iii) the primary source of the applicant's household income is employment or participation in a Pinelands resource-related activity.

2. Residential dwelling units at a density of 1 unit per 10 acres, provided that the dwelling unit is accessory to an active agricultural operation, and is intended for the use of the owners or employees of the agricultural operation.

3. Agriculture.

4. Agricultural employee housing as an element of, and accessory to, an active agricultural operation.

5. Forestry.

6. Low intensity recreational uses, provided that:

(a) the parcel proposed for low intensity recreational use has an area of at least fifty acres;

(b) the recreational use does not involve the use of motorized vehicles except for necessary transportation;

(c) access to bodies of water is limited to no more than 15 linear feet of frontage per 1000 feet of water body frontage;

(d) clearing of vegetation, including ground cover and soil disturbance, does not exceed 5 percent of the parcel; and

(e) no more than 1 percent of the parcel will be covered with impermeable surfaces.

7. Intensive recreational uses, provided that:

(a) the use was in existence on February 7, 1979 and the capacity of the use will not exceed two times the capacity of the use on February 7, 1979;

(b) the use is necessary to achieve recreational use of a particular element of the Pinelands environment; and

(c) the use is environmentally and aesthetically compatible with the essential character of the Pinelands and will not unduly burden available public services.

8. Agricultural commercial establishments, provided that:

(a) the principal goods or products available for sale were produced in the Pinelands; and

(b) the sales area of the establishment does not exceed 5000 square feet.

9. Agricultural products processing facilities.

10. Public service infrastructure.

11. Signs.

12. Accessory Uses.

B. In addition to the uses permitted under Subsection A of this Section, a municipality may, at its option, permit the following uses in an Agricultural Production Area:

1. Institutional uses, provided that:

(a) the use does not require or will not generate subsidiary or satellite development in the Agricultural Production Area;

(b) the applicant has demonstrated that adequate public service infrastructure will be available to serve the use; and

(c) the use is primarily designed to serve the needs of the Agricultural Production Area in which the use is to be located.

2. Pinelands resource-related industries, provided that:

(a) the parcel proposed for development has an area of at least five acres;

(b) the principal raw material for the proposed use is found or produced in the Pinelands; and

(c) the use does not require or will not generate subsidiary or satellite development in an Agricultural Production Area.

3. Airports and heliports which are accessory to agricultural uses and are used exclusively for the storage, fueling, loading and operation of aircraft as a part of an ongoing agricultural operation.

4. Airport facilities and compatible light industrial uses, provided that the airport is publicly owned or serves a Pinelands Town.

5. Fish and wildlife management.

6. Campgrounds, provided that the parcel shall contain no more than 1 campsite per

gross acre and that the campsites are clustered at a net density of 10 campsites per acre.

7. Resource extraction operations.

8. Landfills.

C. No residential dwelling unit shall be located on a lot of less than 3.2 acres.

Section 5-305.

Minimum Standards Governing the Distribution and Intensity of Development and Land Use in Special Agricultural Production Areas

A. Use of land in a Special Agricultural Production Area shall be limited to the following:

1. Residential dwellings on lots of 3.2 acres, provided that:

(a) the dwelling unit will be the applicant's principal place of residence;

(b) the applicant has not developed a dwelling unit under this Section within the previous 5 years; and

(c) the applicant can demonstrate a cultural, social or economic link to the essential character of the Pinelands under the following tests:

(i) the parcel of land on which the dwelling is to be located was owned by the applicant or a member of his immediate family on February 7, 1979; and either

(ii) the applicant is a member of a two-generation extended family that has resided in the Pinelands for at least twenty years; or

(iii) the primary source of the applicant's income is employment or participation in a Pinelands resource related activity.

2. Berry agriculture and horticulture of native plants and other agricultural activities compatible with the existing soil and water conditions that support traditional Pinelands berry agriculture.

3. Agricultural employee housing as an element of, and accessory to, an active agricultural operation.

4. Beekeeping.

B. No residential dwelling unit shall be located on a lot of less than 3.2 acres.

Section 5-306.

Minimum Standards Governing the Distribution and Intensity of Development and Land Use in Rural Development Areas

A. Residential dwelling units at municipally designated densities, including provisions for the clustering of allocated dwelling units, shall be permitted in a Rural Development Area provided that the total number of dwelling units authorized by a municipality for a Rural Development Area does not exceed 200 dwelling units per square mile of private, non-wetland, undeveloped land.

B. In addition to the residential uses permitted under Subsection A, a municipality may permit any use which is compatible with the essential character of the Pinelands environment and is similar in character, intensity and impact to the following uses:

1. Agriculture;

2. Agricultural employee housing as an element of, and accessory to, an active agricultural operation;

3. Forestry;

4. Recreational facilities, other than amusement parks;

5. Agricultural products sales establishments;

6. Agricultural processing facilities and other light industrial uses;

7. Roadside retail sales and service establishments;

8. Resource extraction operations;

9. Landfills;

10. Public service infrastructure;

11. Institutional uses;

12. Signs; and

13. Accessory uses.

C. No residential dwelling unit shall be located on a lot of less than 3.2 acres.

Section 5-307.

Minimum Standards Governing the Distribution and Intensity of Development and Land Use in Pinelands Villages and Towns

A. Any use may be authorized in a Pinelands Village or Town, provided that:

1. Public service infrastructure necessary to support the use is available, or can be provided without any development in the Preservation Area District or a Forest Area; and

2. The character and magnitude of the use is compatible with existing structures and uses in the Village or Town.

B. No residential dwelling unit shall be located on a parcel of less than 3.2 acres if served by a conventional on-site septic waste water system, or a parcel of less than 1 acre if served by an alternative or innovative on-site waste water system.

Section 5-308.

Minimum Standards Governing the Distribution and Intensity of Development and Land Use in Regional Growth Areas

A. Any use may be permitted in a Regional Growth Area, provided that:

1. Except as provided in Subsections 2 and 3 of this Section and Part 4 of this Article, the total number of dwelling units authorized by a municipality for a Regional Growth Area shall be equal to and not exceed the following density per acre of developable land:

- (a) In Barnegat Township—
2.0 dwelling units per acre.
- (b) In Beachwood Borough—
3.5 dwelling units per acre.
- (c) In Berkeley Township—
2.0 dwelling units per acre.
- (d) In Berlin Borough—
2.0 dwelling units per acre.
- (e) In Berlin Township—
2.0 dwelling units per acre.
- (f) In Chesilhurst Borough—
1.5 dwelling units per acre.
- (g) In Dennis Township—
1.0 dwelling unit per acre.

- (h) In Dover Township—
3.5 dwelling units per acre.
- (i) In Eagleswood Township—
2.0 dwelling units per acre.
- (j) In Egg Harbor Township—
3.5 dwelling units per acre.
- (k) In Evesham Township—
2.0 dwelling units per acre.
- (l) In Galloway Township—
2.5 dwelling units per acre.
- (m) In Hamilton Township—
3.5 dwelling units per acre.
- (n) In Jackson Township—
3.0 dwelling units per acre.
- (o) In Lacey Township—
3.5 dwelling units per acre.
- (p) In Little Egg Harbor Township—
3.5 dwelling units per acre.
- (q) In Manchester Township—
3.5 dwelling units per acre.
- (r) In Medford Township—
1.0 dwelling unit per acre.
- (s) In Medford Lakes Borough—
3.0 dwelling units per acre.
- (t) In Monroe Township—
2.0 dwelling units per acre.
- (u) In Ocean Township—
3.5 dwelling units per acre.
- (v) In Pemberton Township—
2.0 dwelling units per acre.
- (w) In Shamong Township—
1.0 dwelling unit per acre.
- (x) In Southampton Township—
1.0 dwelling unit per acre.
- (y) In South Toms River Borough—
3.5 dwelling units per acre.
- (z) In Stafford Township—
3.5 dwelling units per acre.
- (aa) In Tabernacle Township—
1.0 dwelling unit per acre.
- (bb) In Upper Township—
1.0 dwelling unit per acre.
- (cc) In Waterford Township—
—3.0 dwelling units per acre.
- (dd) In Winslow Township—
1.5 dwelling units per acre.

For purposes of this Section, developable lands are those privately held, non-wetland

lands with a depth to seasonal high water table of greater than 5 feet. Where sewer systems are available, soils with a depth to seasonal high water table exceeding 1.5 feet may also be considered developable.

2. The land use element of a municipal master plan and land use ordinance shall include residential zoning districts which permit development within the following range of densities:

- (a) less than .5 to .5 dwelling units per acre;
- (b) .5 to 1 dwelling units per acre;
- (c) 1 to 2 dwelling units per acre;
- (d) 2 to 3 dwelling units per acre;
- (e) 3 to 4 dwelling units per acre;
- (f) 4 to 6 dwelling units per acre;
- (g) 6 to 9 dwelling units per acre;
- (h) 9 to 12 dwelling units per acre; and
- (i) 12 and greater dwelling units per acre.

Municipal master plans or land use ordinances shall provide that development at a density which is greater than the lowest density in each range can be carried out if the increase in density is achieved through a density bonus for use of Pinelands Development Credits.

3. Nothing in this Subsection is intended to prevent a municipality, as a part of a certified master plan or land use ordinance, from employing additional density bonus or incentive programs, provided that such programs do not interfere with the required municipal program for use of Pinelands Development Credits.

B. No residential dwelling unit shall be located on a parcel of less than 3.2 acres if served by a conventional on-site septic waste water system or a parcel of less than 1 acre if served by an alternative or innovative on-site waste water system.

Section 5-309.

Minimum Standards Governing the Distribution and Intensity of Development and Land Use in Military and Federal Installation Areas

Any use associated with the function of the federal installation may be permitted in a

Military and Federal Installation Area, provided that:

A. The use shall not require any development, including public service infrastructure, in the Preservation Area District or in a Forest Area; and

B. All development substantially meets the standards of Article 6 of this Plan or an intergovernmental agreement entered into pursuant to Article 4, Part 4 of this Plan (PUBLIC DEVELOPMENT).

Section 5-310.

Minimum Standards for Clustering Residential Development Rights in Forest Area Municipalities

As part of its master plan or land use ordinances a municipality with jurisdiction over land in Forest Areas must include a provision allowing the clustering of residential development rights from any parcel of land located in a Forest Area in the municipality to areas within the municipality that contain at least 500 acres of contiguous land which is accessible to areas of existing growth and development and which does not exhibit any of the following characteristics:

1. Wetlands as defined in Part 1 of Article 6;
2. Somewhat excessively and excessively drained soils as delineated on Plate 9;
3. Lands which recharge to ground water aquifers as identified by a depth of the unsaturated zone of 20-30 and 30-40 feet on Plate 4, except as underlain by a clay aquiclude;
4. Extreme fire hazard as depicted on Plate 11;
5. Active agricultural use with a preferential tax assessment under the provisions of the Farmland Assessment Act of 1964;
6. Depth to seasonal high water table of less than 5 feet as delineated on Plate 7;
7. Drainage basins of first order streams as identified on USGS 7-1/2' maps;
8. Basins of streams entering public lands which are managed for resource protection or recreation;
9. Active cranberry bogs and areas which drain to active cranberry bogs;
10. Unique plant communities or the min-

imum forest corridor area as delineated on the Special Areas Map (Figure 7.1); and

11. Flood-prone areas designated under the federal flood insurance programs.

Section 5-311.

Minimum Standards for Substandard Lots

A. Notwithstanding any other provision of this Plan, the owner of a parcel of land of an acre or more in any Forest Area, Rural Development Area or Agricultural Production Area in the Protection Area, excluding those lands governed by the New Jersey Coastal Wetlands Act, N.J.S.A. 13:9A-1 et seq., shall be exempt from the density limitations of this Part for a period of one year from the effective date of this Plan, provided that:

1. The parcel was owned by the applicant or a member of his immediate family on February 7, 1979;

2. The dwelling unit will be the primary residence of the applicant;

3. The parcel was not in common ownership with a contiguous parcel on February 7, 1979; and

4. The development of the dwelling unit otherwise complies with the minimum standards of this Plan.

B. A municipality may, as a part of its master plan and land use ordinance prepared and certified under the provisions of Article 3 of this Plan, exempt the owners of parcels of land from the density limitations of this Part, provided that:

1. The municipality has identified each lot that will be exempt under the municipal exemption plan or has established a program of registration for the owners of such lots;

2. No lot of less than one acre will be exempt from the density provisions of this Part;

3. The dwelling unit will be the primary residence of the applicant;

4. No lot that was in common ownership with any contiguous land on February 7, 1979 is exempt from the density provisions of this Part; and

5. The development of the lots exempted from the density limitations of this Part will comply with all other minimum standards of this Plan.

PART 4—PINELANDS DEVELOPMENT CREDIT PROGRAM

Section 5-401.

Purpose

If land use and development of the Pinelands is concentrated in Regional Growth Areas, the Pinelands as a region can tolerate additional development without damaging the Pinelands environment. It is the purpose of this Part to facilitate such patterns of growth and development by providing landowners in the Preservation Area District, Special Agricultural Production Areas, and Agricultural Production Areas with an opportunity to secure an additional beneficial use of their land without the risk of damaging the essential ecological character of the Pinelands.

Section 5-402.

Pinelands Development Credit Program Required

In order to be certified under the provisions of Part 4 of Article 3 of this Plan, the master plan and land use ordinances of a municipality which has land in a Regional Growth Area shall include provisions implementing the Pinelands Development Credit Program.

Section 5-403.

Pinelands Development Credits Established

A. Except for land which is owned by a public agency on the effective date of this

Plan or land which is subject to an easement limiting the use of land to non-residential uses, every parcel of land in the Preservation Area District, an Agricultural Production Area or a Special Agricultural Production Area shall have a use right known as "Pinelands Development Credits" that can be used to secure a density bonus for lands located in Regional Growth Areas.

B. Pinelands Development Credits are hereby established at the following ratios:

1. In the Preservation Area—

(a) Uplands—1 Pinelands Development Credit per 39 acres;

(b) Wetlands—.2 Pinelands Development Credits per 39 acres; and

2. In the Agricultural Production Area and Special Agricultural Production Area—

(a) Uplands and areas of active agriculture, including berry agricultural bogs and fields—.2 Pinelands Development Credits per 39 acres;

(b) Wetlands, other than berry agricultural bogs and fields—.2 Pinelands Development Credits per 39 acres.

C. The owners of parcels of land which are smaller than 39 acres shall have fractional Pinelands Development Credits at the same ratio established in Subsection B of this Section for the area in which the parcel is located.

D. Notwithstanding the provisions of subsections B and C hereof, the owner of record of .1-9.75 acres of land in the Preservation Area District, Agricultural Production Areas and Special Agricultural Production Areas, as of February 7, 1979, shall be entitled to at least .25 Pinelands Development Credits provided that the parcel of land is vacant and was not in common ownership with any contiguous land on February 7, 1979.

Section 5-404.

Limitations on Use of Pinelands Development Credits

A. No Pinelands Development Credit may be used to secure a density bonus unless the owner of the land from which the credit has

been obtained has deed restricted the use of the land in perpetuity to those non-residential uses authorized by this Plan as of the date of the sale or conveyance of the credit by recorded deed restriction which is specifically and expressly enforceable by the Commission. The uses authorized by this Plan at the time of transfer shall be enumerated in the deed of conveyance.

B. The bonus density of a parcel of land on which Pinelands Development Credits are used shall not exceed the upper limits of the density range of the municipal zone or district in which the property is located.

Section 5-405.

Pinelands Development Credit Bonus Multipliers

Pinelands Development Credits which are used for securing a density bonus for parcels of land located in a Regional Growth Area shall yield a bonus of four dwelling units per credit.

Section 5-406.

Aggregation of Development Credits

Pinelands Development Credits may be aggregated from different parcels for use in securing a bonus for a single parcel of land in a Regional Growth Area provided that the density does not exceed the limits of the density range specified in the municipal district in which the property is located.

Section 5-407.

Recordation of Deed Restriction

No development involving the use of Pinelands Development Credits shall be carried out until the developer has provided the municipality with jurisdiction over the parcel of land from which the Pinelands Development Credits were obtained, the municipality in which the parcel of land to be developed is located, and the Commission with evidence of recordation of a restriction on the deed to the land from which the development credits were obtained.

*residentially developed property zone
no pinelands credits*

PART 5—MINIMUM STANDARDS FOR MUNICIPAL RESERVE AREAS

Section 5-501.

Purpose

In order to enable counties and municipalities with jurisdiction over land in Rural Development Areas and Regional Growth Areas to plan for an orderly rate and pattern of growth within both areas, the Pinelands Commission hereby establishes a municipal option that may be incorporated in a municipal master plan or land use ordinance which allows a municipality to designate areas in a Rural Development Area as Municipal Reserve Areas. These areas would be eligible for development under the minimum standards established for development and land use in Regional Growth Areas, including use of Pinelands Development Credits.

Section 5-502.

Designation of Municipal Reserve Areas

A municipality may, in its master plan and land use ordinance, designate lands in Rural Development Areas that are adjacent to or contiguous with a Regional Growth Area or areas of existing growth and development located outside of the Pinelands as Municipal Reserve Areas, provided that the area designated:

1. Does not contain significant amounts of:
 - (a) Wetlands as defined in Part 1 of Article 6 of this Plan;
 - (b) Somewhat excessively and excessively drained soils as delineated in Plate 9;
 - (c) Active agricultural lands;
 - (d) Aquifer recharge areas as indicated by a depth of the unsaturated zone of 20-30 and 30-40 feet on Plate 4 and not underlain by a clay aquiclude;
 - (e) Extreme fire hazard areas as delineated in Plate 11; and
 - (f) Flood-prone areas designated under the Federal Flood Insurance Program.

2. Has a relatively uniform boundary which conforms to physical or environmental features;

3. Is geographically balanced around existing or planned community centers;

4. Is accessible to employment centers, and areas of commercial activity and recreation opportunities;

5. Is not contiguous with a Preservation Area District, Forest Area or Agricultural Production Area and preserves an adequate buffer of low intensity use between the Municipal Reserve Area and such districts;

6. Has available or is planned for full public services including sewer, water, roads, police and fire protection, and schools and libraries.

Section 5-503.

Development in Municipal Reserve Areas

A municipal master plan or land use ordinance that designates a Municipal Reserve Area shall include provisions ensuring that development of the reserve area at Regional Growth Area densities will occur only when all of the following conditions are met:

1. Adjacent developable land in the Regional Growth Area has been substantially developed in accordance with the land use and management programs provided in this Plan;

2. All essential public services are available; and

3. The amount of vacant developable land in all Regional Growth Areas in the municipality is insufficient to meet the growth needs of the county and the municipality projected for the next five years as determined or approved by the county in which the reserve area is located, as well as by the Pinelands Commission.

ARTICLE 6

Management Programs and Minimum Standards

INTRODUCTION

This article establishes management programs and minimum standards governing development and land use in the Pinelands. In addition, guidelines for county and municipal preparation of management programs for scenic, energy conservation and recreation are provided. All the programs are intended to be implemented by the administration of municipal and county master plans and land use ordinances through the development review procedures established in Article 4 of

this Plan [DEVELOPMENT REVIEW]. Prior to certification of county or municipal master plans and land use ordinances, the standards and guidelines of these programs will be implemented and enforced by the Pinelands Commission. The standards set forth in this Article are minimum requirements and a municipality or county may adopt more restrictive regulations, provided that such regulations are compatible with the goals and objectives of this Plan.

PART 1—WETLANDS

Section 6-101.

Purpose

Coastal and inland wetlands constitute a vital element of the ecological character of the Pinelands. They are critical habitats for many threatened and endangered plant and animal species and play many other important roles including the maintenance of surface and ground water quality. This program is deemed to be the minimum standards necessary to protect the long-term integrity of wetlands.

Section 6-102.

Wetlands Management Program

In order to be certified under the provisions of Article 3 [CERTIFICATION OF COUNTY, MUNICIPAL AND FEDERAL INSTALLATION PLANS] of this Plan, a municipal master plan or land use ordinance must provide for the protection of the integrity of

wetlands. It is not necessary that the municipal program incorporate the literal terms of the program set out in this Part; rather, a municipality may adopt alternative and additional techniques which will achieve equivalent protection of the wetlands defined in this Part, as would be achieved under the provisions of this Part.

Section 6-103.

Wetlands

Wetlands are those lands which are inundated or saturated by water at a magnitude, duration and frequency sufficient to support the growth of hydrophytes. Wetlands include lands with poorly drained or very poorly drained soils as designated by the National Cooperative Soils Survey of the Soil Conservation Service of the United States Department of Agriculture. Wetlands include coastal wetlands and inland wetlands, including submerged lands.

Section 6-104.

Coastal Wetlands

Coastal wetlands are banks, low-lying marshes, swamps, meadows, flats, and other lowlands subject to tidal inundation which support or are capable of supporting one or more of the following plants:

salt meadow grass (*Spartina patens*),
spike grass (*Distichlis spicata*),
black grass (*Juncus gerardi*),
saltmarsh grass (*Spartina alterniflora*),
saltworts (*Salicornia europaea* and
Salicornia bigelovii),
sea lavender (*Limonium carolinianum*),
saltmarsh bulrushes (*Scirpus robustus* and
Scirpus paludosus var. *atlanticus*),
sand spurrey (*Spergularia marina*),
switch grass (*Panicum virgatum*),
tall cordgrass (*Spartina pectinata*),
hightide bush (*Iva frutescens* var. *oraria*),
cattails (*Typha angustifolia* and *Typha*
latifolia),
spike rush (*Eleocharis rostellata*),
chairmaker's rush (*Scirpus americanus*),
bent grass (*Argostis palustris*),
sweet grass (*Hierochloa odorata*),
wild rice (*Zizania aquatica*),
Olney's threesquare (*Scirpus olneyi*),
marsh mallow (*Hibiscus palustris*),
salt reed grass (*Spartina cynosuroides*),
common reed grass (*Phragmites communis*),
pickerel grass (*Pontederia cordata*),
arrowheads (*Sagittaria* spp.),
spatterdock (*Nuphar variegatum*),
red maple (*Acer rubrum*), and
Atlantic white cedar (*Chamaecyparis*
thyoides).

Coastal wetlands include those lands which are delineated by the New Jersey Department of Environmental Protection on official maps at a scale of 1:2,400 listed in N.J.A.C. 7:7A-1.13.

Section 6-105.

Inland Wetlands

Inland wetlands include, but are not limited to:

A. Atlantic White Cedar Swamps.

Atlantic white cedar swamps are areas dominated by Atlantic white cedars (*Chamaecyparis thyoides*) and supporting one or more of the following hydrophytic plants:

red maple (*Acer rubrum*),
sweetbay (*Magnolia virginiana*),
blackgum (*Nyssa sylvatica*),
dangleberry (*Gaylussacia frondosa*),
highbush blueberry (*Vaccinium*
corymbosum),
swamp azalea (*Rhododendron viscosum*),
fetterbush (*Leucothoe racemosa*),
sweet pepperbush (*Clethra alnifolia*),
inkberry (*Ilex glabra*),
pitcher plant (*Sarracenia purpurea*),
sundew (*Drosera* spp.),
cinnamon fern (*Osmunda cinnamomea*),
royal fern (*Osmunda regalis*),
and sphagnum moss (*Sphagnum* spp.).

B. Hardwood Swamps.

Hardwood swamps are areas dominated by red maple (*Acer rubrum*), blackgum (*Nyssa sylvatica*) and/or sweetbay (*Magnolia virginiana*) and supporting one or more of the following hydrophytic plants:

gray birch (*Betula populifolia*),
pitch pine (*Pinus rigida*),
Atlantic white cedar (*Chamaecyparis*
thyoides),
sweet gum (*Liquidambar styraciflua*),
sweet pepperbush (*Clethra alnifolia*),
highbush blueberry (*Vaccinium*
corymbosum),
swamp azalea (*Rhododendron viscosum*),
fetterbush (*Leucothoe racemosa*),
leatherleaf (*Chamaedaphne calyculata*),
dangleberry (*Gaylussacia frondosa*),
cinnamon fern (*Osmunda cinnamomea*),
chain fern (*Woodwardia* spp.),
and rushes (*Juncus* spp.);

or other lowland forests dominated by one or more of the following plants:

sweetgum (*Liquidambar styraciflua*),
pin oak (*Quercus palustris*),
and willow oak (*Quercus phellos*).

C. Pitch Pine Lowlands.

Pitch pine lowlands are areas dominated by pitch pine (*Pinus rigida*) and supporting one or more of the following hydrophytic plants:

red maple (*Acer rubrum*),
blackgum (*Nyssa sylvatica*),
gray birch (*Betula populifolia*),
leatherleaf (*Chamaedaphne calyculata*),
dangleberry (*Gaylussacia frondosa*),
sheep laurel (*Kalmia angustifolia*),

highbush blueberry (*Vaccinium corymbosum*), sweet pepperbush (*Clethra alnifolia*), and wintergreen (*Gaultheria procumbens*).

D. Bogs.

Bogs are areas dominated by hydrophytic, shrubby vegetation including:

cranberry (*Vaccinium macrocarpon*), leatherleaf (*Chamaedaphne calyculata*), sheep laurel (*Kalmia angustifolia*), highbush blueberry (*Vaccinium corymbosum*), swamp azalea (*Rhododendron viscosum*), sweet pepperbush (*Clethra alnifolia*), dangleberry (*Gaylussacia frondosa*), or staggerbush (*Lyonia mariana*).

Sphagnum moss (*Sphagnum* spp.), pitcher plant (*Sarracenia purpurea*), sundew (*Drosera* spp.), and sedges (*Carex* spp.) are among the herbaceous plants which are found in bogs. Active cranberry bogs and shrub thickets dominated by leatherleaf (*Chamaedaphne calyculata*) are included in this category.

E. Inland Marshes.

Inland marshes are areas which are dominated by hydrophytic grasses (*Gramineae*) and sedges (*Carex* spp.) and which include one or more of the following plants: pickerelweed (*Pontederia cordata*), arrow arum (*Peltandra virginica*), cattail (*Typhus* spp.), and rushes (*Juncus* spp.).

F. Lakes and Ponds.

Lakes and ponds are seasonal or permanent standing bodies of water.

G. Rivers and Streams.

Rivers and streams are bodies of water which periodically or continuously contain moving water or which form a link between two bodies of standing water.

Section 6-106.

Development Prohibited

Development shall be prohibited in all wetlands in the Pinelands except as specifically authorized in this Part.

Section 6-107.

Significant Adverse Impact

A significant adverse impact shall be de-

emed to exist where it is determined that one or more of the following modifications of a wetland will have an irreversible effect on the ecological integrity of the wetland and its biotic components:

1. An increase in surface water runoff discharging into a wetland;
2. A change in the normal seasonal flow patterns in the wetland;
3. An alteration of the water table in the wetland;
4. An increase in erosion resulting in increased sedimentation in the wetland;
5. A change in the natural chemistry of the ground or surface water in the wetland;
6. A loss of wetland habitat;
7. A reduction in wetland habitat diversity;
8. A change in wetlands species composition; or
9. A significant disturbance of areas used by indigenous and migratory wildlife for breeding, nesting, or feeding.

Section 6-108

Agriculture and Horticulture

Horticulture of native Pinelands species and berry agriculture shall be permitted in all wetlands subject to the requirements of Part 5 [AGRICULTURE] of this Article. Beekeeping shall be permitted in all wetlands.

Section 6-109.

Forestry

Forestry shall be permitted in all wetlands subject to the requirements of Part 4 [FORESTRY] of this Article.

Section 6-110.

Fish and Wildlife Management

Fish and wildlife management activities shall be permitted in all wetlands subject to the minimum standards of all other parts of this Article; provided that the management activity does not have a significant adverse impact, as set forth in Section 6-107, on the wetland in which the activity is carried out; and provided that the activity conforms to all

state and federal regulations. On a case by case basis, fish and wildlife management proposals shall be evaluated relative to the scientific research value of the proposal.

Section 6-111.
Low Intensity Uses

Hunting, fishing, trapping, hiking, boating, swimming and other similar low intensity recreational uses shall be permitted in all wetlands provided that such uses do not involve any structure other than those authorized in Section 6-112.

Section 6-112.
Water-Dependent Recreational Facilities

A. Docks, piers, moorings, and boat launches for the use of a landowner shall be permitted in all wetlands, provided that the use will not result in a significant adverse impact, as set forth in Section 6-107, and conforms to all state and federal regulations.

B. Commercial or public docks, piers, moorings, and boat launches shall be permitted provided that:

1. There is a demonstrated need for the facility that cannot be met by existing facilities;

2. The development conforms with all state and federal regulations; and

3. The development will not result in a significant adverse impact, as set forth in Section 6-107.

Section 6-113.
Public Improvements

Bridges, roads, trails and utility transmission and distribution facilities shall be permitted in wetlands provided that:

A. There is no feasible alternative route or site for the facility that does not involve development in a wetland;

B. The public need cannot be met by existing facilities or modification thereof; and

C. The facility will not result in a significant adverse impact, as set forth in Section 6-107.

Section 6-114.
Wetland Transition Areas

No development, except for those uses which are specifically authorized in this Part, shall be carried out within 300 feet of any wetland, unless the applicant has demonstrated that the proposed development will not result in a significant adverse impact on the wetland, as set forth in Section 6-107.

PART 2—VEGETATION

Section 6-201.
Purpose

Vegetation represents the most visible element of the essential character of the Pinelands and constitutes the fundamental structure of wildlife habitats, including the habitats of several species which are designated as threatened or endangered. The Pinelands landscape is comprised of a mosaic of plant associations which reflects the interaction of water, soil, topography, fire and human influence. The continued integrity of the Pinelands vegetation is essential to the preservation and maintenance of the essential character of the Pinelands. Therefore, vegetation clearing should be limited to authorized forestry activities, fire hazard

mitigation, preparation of agricultural fields, and the minimum clearing necessary to permit construction of development or land use authorized by this Plan. In addition, landscaping materials employed in the Pinelands must be compatible with native vegetation in order to preserve the visual and ecological character of the Pinelands.

Section 6-202.
Vegetation Management Program

In order to be certified under the provisions of Article 3 [CERTIFICATION OF COUNTY, MUNICIPAL AND FEDERAL INSTALLATION PLANS] of this Plan, a municipal master plan or land use ordinance must provide for the protection of the integrity of

Pinelands vegetation. It is not necessary that a municipal program incorporate the literal terms of the program set out in this Part; rather, a municipality may adopt alternative and additional techniques which will achieve equivalent protection of Pinelands vegetation as would be achieved under the provisions of this Part.

Section 6-203. Vegetation Removal Standards

The clearing of more than 1500 square feet of vegetation from any parcel of land, other than clearing for agricultural activities, shall be authorized only if the applicant can demonstrate:

- A. That the removal is necessary to accommodate the development or maintenance of a permitted structure or to carry out a permitted use of the property; or
- B. That removal is necessary in order to implement the fire management objectives of this Plan; or
- C. That removal is necessary to eliminate a pedestrian or vehicular safety hazard; or
- D. That removal is necessary to eliminate a hazard to a building; and
- E. That specimen trees will not be cleared or removed; and
- F. That the area to be cleared will be landscaped in accordance with the following requirements:

1. All landscaping as shown on the site plan shall be completed within six months of completion of construction;

2. All landscaping shall ensure the stabilization of soils;

3. All development in the Pinelands, other than turfed areas dedicated for public recreational purposes, shall utilize native vegetation for landscaping, including but not limited to:

- (a) Pitch pine;
- (b) Short-leaf pine;
- (c) Black oak;
- (d) Southern red oak;
- (e) White oak;
- (f) Blackjack oak;
- (g) Scrub oak;

- (h) Post oak;
- (i) Chestnut oak;
- (j) Scarlet oak;
- (k) Black huckleberry;
- (l) Dangleberry;
- (m) Sheep laurel;
- (n) American holly;
- (o) Low bush blueberry;
- (p) Mountain laurel; and
- (q) Grasses, such as the little blue-stem, deertongue, redtop, and switchgrass, to the extent practicable; however, in no case shall areas planted with non-native grasses exceed 12 feet in width.

Section 6-204. Development Prohibited in the Vicinity of Threatened or Endangered Plants

No development shall be carried out by any person unless it is designed to avoid irreversible adverse impacts on the survival of populations of the following plants, which are hereby found and declared to be threatened or endangered plants of the Pinelands:

1. Sensitive-joint vetch,
Aeschynomene virginica.
2. Red milkweed,
Asclepias rubra.
3. Silvery aster,
Aster concolor.
4. Pickering's morning glory,
Breweria pickeringii.
5. Pine Barrens reedgrass,
Calamovilfa brevipilis.
6. Barratt's sedge,
Carex barrattii.
7. Sickle-leaved golden aster,
Chrysopsis falcata.
8. Spreading pogonia,
Cleistes divaricata.
9. Broom crowberry,
Corema conradii.
10. Rose-colored tickseed,
Coreopsis rosea.
11. Rushfoil,
Crotonopsis elliptica.

12. Stiff tick trefoil,
Desmodium strictum.
13. Knotted spike rush,
Eleocharis equisetoides.
14. Resinous boneset,
Eupatorium resinosum.
15. Pine Barrens gentian,
Gentiana autumnalis.
16. Yellow-fringed orchid,
Habenaria ciliaris.
17. Crested yellow orchid,
Habenaria cristata.
18. Southern yellow orchid,
Habenaria integra.
19. Swamp pink,
Helonias bullata.
20. New Jersey rush,
Juncus caesariensis.
21. Lily-leaved twayblade,
Liparis lilifolia.
22. Loesel's twayblade,
Liparis loeselii.
23. Southern twayblade,
Listera australis.
24. Boykin's lobelia,
Lobelia boykinii.
25. Canby's lobelia,
Lobelia canbyi.
26. Hairy ludwigia,
Ludwigia hirtella.
27. Linear-leaved ludwigia,
Ludwigia linearis.
28. Climbing fern,
Lygodium palmatum.
29. Torrey's muhly,
Muhlenbergia torreyana.
30. Yellow asphodel,
Narthecium americanum.
31. Floating heart,
Nymphoides cordata.
32. Narrow panic grass,
Panicum hemitomon.
33. Hirst's panic grass,
Panicum hirstii.
34. American mistletoe,
Phoradendron flavescens.
35. Maryland milkwort,
Polygala mariana.
36. Slender rattlesnake root,
Prenanthes autumnalis.
37. Awned meadow beauty,
Rhexia aristosa.
38. Capitulate beakrush,
Rhynchospora cephalantha.
39. Slender beaked rush,
Rhynchospora inundata.
40. Knieskern's beaked rush,
Rhynchospora knieskernii.
41. Curly grass fern,
Schizaea pusilla.
42. Chaffseed,
Schwalbea americana.
43. Long's bulrush,
Scirpus longii.
44. Slender nut rush,
Scleria minor.
45. Reticulated nut rush,
Scleria reticularis.
46. Sclerolepis,
Sclerolepis uniflora.
47. Wand-like goldenrod,
Solidago stricta.
48. Little ladies tresses,
Spiranthes tuberosa.
49. False asphodel,
Tofieldia racemosa.
50. Humped bladderwort,
Utricularia gibba.
51. White-flowered bladderwort,
Utricularia olivacea.
52. Purple bladderwort,
Utricularia purpurea.
53. Reclined bladderwort,
Utricularia resupinata.
54. Yellow-eyed grass,
Xyris flexuosa.

PART 3—FISH AND WILDLIFE

Section 6-301.

Purpose

The Pinelands environment supports a rich diversity of fish and wildlife species. Many threatened and endangered species are found in the Pinelands and they, together with the other fauna of the area, constitute an important part of the essential ecological character of the Pinelands that requires careful management and protection.

Section 6-302.

Protection of Threatened or Endangered Wildlife Required

No development shall be carried out unless it is designed to avoid irreversible adverse impacts on habitats that are critical to the survival of populations of the following Pinelands threatened or endangered animals:

A. Amphibians.

1. Eastern tiger salamander,
Ambystoma tigrinum.
2. Pine Barrens treefrog,
Hyla andersoni.
3. Southern grey treefrog,
Hyla chrysoscelis.
4. Eastern mud salamander,
Pseudotriton montanus.

B. Reptiles.

1. Bog turtle,
Clemmys muhlenbergi.
2. Timber rattlesnake,
Crotalus horridus horridus.
3. Wood turtle,
Clemmys insculpta.
4. Corn snake,
Elaphe guttata.
5. Northern pine snake,
Pituophis melanoleucus melanoleucus.

C. Birds.

1. Bald eagle,
Haliaeetus leucocephalus.
2. Peregrine falcon,
Falco peregrinus.
3. Osprey,
Pandion haliaetus.

4. Cooper's hawk,
Accipter cooperii.
5. Least tern,
Sterna albifrons.
6. Black skimmer,
Rynchops nigra.
7. Great blue heron,
Ardea herodias.
8. Red-shouldered hawk,
Buteo lineatus.
9. Northern harrier,
Circus cyaneus.
10. Merlin,
Falco columbarius.
11. Upland sandpiper (plover),
Bartramia americana.
12. Roseate tern,
Sterna dougallii.
13. Barred owl,
Strix varia.
14. Short-eared owl,
Asio flammeus.
15. Red-headed woodpecker,
Melanerpes erythrocephalus.
16. Cliff swallow,
Petrochelidon pyrrhonota.
17. Bobolink,
Dolichonyx oryzivorus.
18. Ipswich sparrow,
Passerculus sandwichensis princeps.
19. Pied-billed grebe,
Podilymbus podiceps.
20. Short-billed marsh wren,
Cistothorus platensis.
21. Savannah sparrow,
Passerculus sandwichensis.
22. Henslow's sparrow,
Ammodramus henslowii.
23. Vesper sparrow,
Pooecetes gramineus.

24.

D. Fishes

1. American shad,
Alosa sapidissima.
2. Native brook trout,
Salvelinus fontinalis.

Section 6-303.
Protection of Wildlife Habitat

All development or other authorized activity shall be carried out in a manner which

avoids disturbance of fish and wildlife habitats that are essential to the continued nesting, resting, breeding and feeding of significant populations of fish and wildlife in the Pinelands.

PART 4—FORESTRY

Section 6-401.
Purpose

Forest vegetation represents a unique and financially valuable part of the essential character of the Pinelands. If they are properly managed, Pinelands forests represent significant economic opportunities to their owners while perpetuating the overall ecological value of the Pinelands. This Part encourages commercial forestry that will maximize forest land values and provide for the long-term economic and environmental integrity of the Pinelands.

Section 6-402.
Forestry Management Program

In order to be certified under the provisions of Article 3 [CERTIFICATION OF COUNTY, MUNICIPAL AND FEDERAL INSTALLATION PLANS] of this Plan, a municipal master plan and land use ordinance must provide for the protection of the integrity of Pinelands forests. It is not necessary that the municipal program incorporate the literal terms of the program set out in this Part; rather, a municipality may adopt alternative and additional techniques which will achieve equivalent protection of forestry resources as would be achieved under the provisions of this Part.

Section 6-403.
Forestry Application Requirements

In addition to the information required by Section 4-102(B) [APPLICATION REQUIREMENTS] of this Plan, an application for any permit involving the harvesting of trees for commercial purposes or fish and wildlife management shall include the following:

1. A Forestry Management Plan, which details the management practices proposed to

be employed, including but not limited to harvesting practices, reforestation, and the following:

(a) location and size of tracts;

(b) type of ownership;

(c) map of the property showing wetlands, types of vegetation cover, receiving waters, location of stream crossings and alternatives, location of skid trails, location of access roads and landings, cutting boundaries and size of filter or buffer strips.

(d) property description including land use; acreage of open, crop, and woodland; general soil types and erodibility; range of percent of slope; timber quality and age (forest type, species, age, DBH, height, volume, and reproduction); and understory;

(e) description of timber to be harvested;

(f) description of regeneration plans; and

(g) description of intermediate management practices to be applied.

2. A letter of comment or no comment from the New Jersey Bureau of Forest Management on the Forestry Management Plan; and

3. A financial surety, guaranteeing performance of the requirements of Subsections 6-404(d) and (e) in the form of guaranty, letter of credit or other recognized form of financial surety.

Section 6-404.
Forestry Standards

Forestry shall be authorized throughout the Pinelands provided:

(a) That access to land proposed for harvesting:

(i) is direct;

(ii) follows previously established roads and trails to the maximum extent practical;

(iii) avoids wetland areas except as are absolutely necessary to harvest wetland species or to gain access to the harvesting site; and

(iv) avoids crossing streams with high and unstable banks and those with approaching slopes exceeding 10% where alternative crossings exist.

(b) That all activities during and after harvesting are carried out in a manner to avoid damage to stream banks and bottoms, erosion, and degradation of water quality, including the following:

(i) stream banks at crossings shall be stabilized during and after harvesting;

(ii) culverts and bridges shall be temporary in nature;

(iii) trees which serve to stabilize stream banks shall be retained; other trees shall be felled to avoid stream banks where practical and winched off such banks where felling occurs;

(iv) a 25-foot vegetated buffer along streams, ponds, lakes, and marshes shall be maintained;

(v) the use of active and intermittent stream channels for skidding of logs shall be prohibited;

(vi) skidding shall not occur within 25 feet of streams, ponds, lakes, and marshes except for necessary crossings;

(vii) accessways for forestry activities shall be located at least 100 feet from streams, ponds, lakes, and marshes where practical;

(viii) landings shall be located in well drained areas where practical, at least 200 feet from public roads where practical, and at least 200 feet from ponds, lakes, marshes;

(ix) filter strips shall be located between: harvested areas, landings, and skid trails; and streams, ponds, lakes, and marshes;

(x) water diversion devices shall be installed as necessary to control erosion.

(c) That only those trees which have been selected for harvesting are cut; that all trees are cut to the base; and all practical steps are taken to minimize damage to undesignated trees.

(d) That at the conclusion of any harvesting operation:

(i) all areas disturbed for access, processing, moving or loading trees shall be regraded to approximate natural slopes and that water diversion devices are installed as necessary in order to avoid erosion;

(ii) all accessways shall be closed and devices installed, such as poles, pilings or berms that will preclude use of the accessway;

(iii) bare ground areas shall be stabilized with vegetation where necessary;

(iv) all debris shall be removed from streams;

(v) all non-vegetative refuse shall be collected; and

(vi) all hanging trees shall be removed.

(e) That harvesting and reforestation activities shall ensure the regeneration of the harvested forest and;

(f) That harvesting and reforestation in Atlantic White Cedar and hardwood swamps is conducted in the following manner:

(i) Atlantic White Cedar will be clear-cut and slash will be managed to create site conditions favorable to regeneration of Atlantic White Cedar;

(ii) reforestation to ensure Atlantic White Cedar regeneration will involve control of competitive hardwood species;

(iii) existing streams shall be cutting boundaries where practical;

(iv) harvesting methods employed shall be those which minimize environmental damage including the use of winches, corduroy roads and helicopters; and

(v) harvesting will occur to the greatest extent practical during dry periods or when the ground is frozen.

(g) That proposed activity does not involve the draining or filling of wetlands.

PART 5—AGRICULTURE

Section 6-501.

Purpose

Agricultural activity is an important element of the Pinelands economy and plays a significant role in the conservation of the essential ecological character of the Pinelands. In particular, the dependency of berry agriculture on pristine water has contributed greatly to the ecological stability of the Pinelands. However, the long-term vitality of agricultural activities depends upon protection from competing land uses and continued use of agricultural practices that conserve the soil and water resources of the Pinelands.

Section 6-502.

Agricultural Management Program

In order to be certified under the provisions of Article 3 [CERTIFICATION OF COUNTY, MUNICIPAL AND FEDERAL INSTALLATION PLANS] of this Plan, a municipal master plan and land use ordinance must contain a program to protect the integrity of agriculture in the Pinelands. It is not necessary that the municipal program incorporate the literal terms of this Part; rather, a municipality may adopt alternative and additional techniques which will achieve equivalent protection of agriculture as would be achieved under the provisions of this Part.

Section 6-503.

General Agricultural Standards

A. All agricultural activities and fish and wildlife management activities, including the preparation of land and the planting, nurturing and harvesting of crops, shall be carried out in accordance with recommended management practices established for the particular agricultural activity by the New Jersey Department of Agriculture, the Soil Con-

servation Service, and the New Jersey Agricultural Experimental Station at Rutgers University.

B. In Agricultural Production Areas and Special Agricultural Production Areas a Resource Conservation Plan shall be prepared by the operator of every agricultural use, or the appropriate Soil Conservation District, located in an area which has been designated by any agency of federal, state, or local government as having substandard surface or ground water. If prepared by the operator, such plan shall be submitted to the Soil Conservation District for review. The Resource Conservation Plan shall be reviewed, updated and revised as necessary and shall provide for the use of recommended management practices as found in, but not limited to, the following publications:

1. Erosion and runoff—Soil Conservation Service Technical Guide;
2. Animal waste—Soil Conservation Service Animal Waste Management Field Manual; and
3. Fertilizers and Pesticides—Rutgers University, Cook College, Cooperative Extension Service Annual Recommendations.

Section 6-504.

Exemption from Nuisance Ordinances ("Right-to-Farm")

As an element of its agricultural program each municipality shall exempt agricultural operations in any Agricultural Production or Special Agricultural Production Area from all municipal ordinances and regulations which inhibit efficient crop production, including but not limited to ordinances and regulations imposing time limits on operations, dust limits and odor restrictions, except those ordinances and regulations which are strictly necessary for the maintenance of public health.

PART 6—RESOURCE EXTRACTION

Section 6-601.

Purpose

Sand, gravel and other mineral resources are important Pinelands values that have been commercially utilized in the past. Such activity can provide a substantial economic benefit to landowners; however, it is critical that such activities do not conflict with other values of the Pinelands. This Part is intended to ensure that extraction activities do not adversely affect long-term ecological values in the Pinelands, and that abandoned extraction sites will be restored so that they will be a functional part of the Pinelands ecosystem.

Section 6-602.

Resource Extraction Management Program

In order to be certified under the provisions of Article 3 [CERTIFICATION OF COUNTY, MUNICIPAL AND FEDERAL INSTALLATION PLANS] of this Plan, a municipal master plan and land use ordinance must contain a program to manage resource extraction operations. It is not necessary that the municipal program incorporate the literal terms of the program set out in this Part; rather, a municipality may adopt alternative and additional techniques which will achieve equivalent protection of the Pinelands as would be achieved under the provisions of this Part.

Section 6-603.

Existing Resource Extraction Operations

A. No new resource extraction operations shall be permitted in the Preservation Area District or Special Agricultural Production Areas. Resource extraction operations that were in operation on August 8, 1980 may be continued in any portion of the Preservation Area District or Special Agricultural Areas provided that:

1. The operation was authorized by a valid registration certificate issued by the New Jersey Department of Labor and Industry under N.J.S.A. 34:6-98 4(h) prior to February 8, 1979; or

2. The operation was exempt from registration requirements of the New Jersey De-

partment of Labor and Industry and was authorized by and operating under a valid municipal permit prior to February 8, 1979; and

3. The area of extraction is limited to the value given under the category "acreage to be mined" on the mine registration application submitted to the Department of Labor and Industry, or the municipal permit in the case of an operation permitted under subsection 2 of this Section; and

4. The extraction activity meets the standards and requirements of Sections 6-606 and 6-607.

B. The owner or operator of existing resource extraction operations in the Preservation Area shall register with the Pinelands Commission on or before January 21, 1981. The owner or operator of existing resource extraction operations in the Protection Area shall register with the Pinelands Commission within 120 days of the effective date of this Plan. Such registration shall describe the area and extent of the operation's existing permit and shall include a copy of all outstanding permits. Existing operations in the Preservation Area shall obtain a development permit on or before February 20, 1981. All existing operations in the Protection Area shall file an application for development approval within 60 days of the applicable effective date of this Plan.

Section 6-604.

Time Limit on Resource Extraction Permits

No permit authorizing resource extraction shall be issued for any period exceeding two years. Nothing in this Section shall be construed to prohibit any person from securing additional permits provided that the requirements of Section 6-603 [EXISTING RESOURCE EXTRACTION OPERATIONS] are met.

Section 6-605.

Application Requirements for Resource Extraction

All applications for development involving resource extraction shall include, in addition

to the information required by Section 4-102(B) [APPLICATION REQUIREMENTS], the following information:

1. A topographic map at a scale of 1 inch equals 400 feet, showing the proposed dimensions, location and operations on the subject property;

2. A U.S.G.S. quadrangle map showing the dimensions of the property and an area of at least 1000 feet beyond such boundary in all directions;

3. The location, size and intended use of all buildings;

4. The location of all points of ingress and egress;

5. The location of all streams, wetlands and significant vegetation, forest associations and wildlife habitats;

6. The location of all existing and proposed streets and rights-of-way, including railroad rights-of-way, excluding those included within the area to be mined;

7. A soils map;

8. A reclamation plan which includes:

(a) method of stockpiling topsoil and overburden;

(b) proposed grading and final elevations;

(c) topsoil material application and preparation;

(d) type, quantity and age of vegetation to be used;

(e) fertilizer application including method and rates;

(f) planting method and schedules; and

(g) maintenance requirements schedule.

Section 6-606.

Resource Extraction Standards

Resource extraction operations shall be approved only if the applicant can demonstrate that the proposed resource extraction operation:

1. Is designed so that no area of excavation, sedimentation pond, storage area equipment or machinery or other structure or facility is closer than:

(a) 200 feet to any property line;

(b) 500 feet to any residential or non-resource extraction related commercial use which is in existence on the date the permit is issued;

2. Is to be located on a parcel of land of at least 20 acres;

3. Provides that all topsoil that is necessary for restoration will be stored on the site and will be protected from wind or water erosion;

4. Is fenced or blocked so as to prevent unauthorized entry into the resource extraction operation through access roads;

5. Provides ingress and egress to the resource extraction operation from public roads by way of gravel or porous paved roadways;

6. Is designed so that surface runoff will be maintained on the parcel in a manner that will provide for on-site recharge to ground water;

7. Will not involve excavation below the seasonal high water table, unless the excavation will serve as a recreational or wildlife resource or a water reservoir for public, agricultural or industrial uses or for any other use authorized in the area in which the site is located; provided that in no case shall excavation have a depth exceeding 65 feet below the natural surface of the ground existing prior to excavation unless it can be demonstrated that a depth greater than 65 feet will result in no significant adverse impact relative to the proposed final use or on off-site areas;

8. Will be carried out in accordance with an extraction schedule which depicts the anticipated sequence, as well as anticipated length of time that each portion of the parcel proposed for extraction will be worked;

9. Will involve restoration of disturbed areas at the completion of the resource extraction operation in accordance with the requirements of Section 6-607 [RESTORATION STANDARDS] of this Part, and the implementation of the restoration plan is secured by a letter of credit, surety bond or other guarantee of performance; and

10. Will not involve clearing adjacent to

ponds in excess of 20 acres or an area necessary to complete scheduled operations; or will not involve unreclaimed clearing exceeding 150 acres for surface excavation at any time.

Section 6-607. Restoration Standards

All parcels of land which are used for resource extraction operations shall be restored as follows:

1. Restoration shall be a continuous process, and each portion of the parcel shall be restored within two years after resource extraction is completed for that portion;
2. Restoration shall proceed in the same sequence and time frame set out in the extraction schedule required in Section 6-606(8);
3. All restored areas shall be graded so as to conform to the natural contours of the parcel; the slope of surface of restored surfaces shall not exceed one foot vertical to three feet horizontal except as provided in Subsection 6 of this Section;
4. Topsoil shall be restored in approximately the same quality and quantity as existed at the time the resource extraction operation was initiated;
5. Drainage flows, including direction and

volume, shall be restored to the maximum extent practical to those flows existing at the time the resource extraction operation was initiated;

6. Any body of water created by the resource extraction operation shall have a graded shoreline with a slope not to exceed one foot vertical to five feet horizontal;

7. All equipment, machinery and structures, except for structures that are useable for recreational purposes or any other use authorized in the area, shall be removed within six (6) months after the resource extraction operation is terminated and restoration is completed; and

8. Reclamation shall to the maximum extent practical result in the reestablishment of the vegetation association which existed prior to the extraction activity and shall include:

- (a) the planting of a minimum of 1000 one-year-old pitch pine seedlings per acre;
- (b) stabilization of exposed areas by establishing ground cover vegetation;
- (c) cluster planting of characteristic Pinelands oak species, such as blackjack oak, bear oak, chestnut oak and black oak, and shrubs such as black huckleberry, sheep laurel and mountain laurel, at a spacing sufficient to ensure establishment of these species.

PART 7—WASTE MANAGEMENT

Section 6-701.

Purpose

The disposal of solid and liquid waste by application to land in the Pinelands represents a substantial threat to surface and ground water quality. It is the purpose of this Part to provide standards to protect the Pinelands from degradation resulting from waste disposal activities.

Section 6-702.

Waste Management Program

In order to be certified under the pro-

visions of Article 3 [CERTIFICATION OF COUNTY, MUNICIPAL AND FEDERAL INSTALLATION PLANS] of this Plan, a municipal or county master plan and land use ordinances must contain a program for waste management. It is not necessary that the municipal or county program incorporate the literal terms of the program set out in this Part; rather, a municipality or county may adopt alternative or additional management techniques which will achieve the protection of the Pinelands equivalent to that which would be achieved under the provisions of this Part.

**Section 6-703.
Landfills Prohibited**

Except as otherwise provided in this Part, no person shall operate any landfill within the Pinelands.

**Section 6-704.
Existing Landfills**

Landfill operations that were in lawful use on August 8, 1980 may be continued provided that:

1. No landfill shall be operated within the Preservation Area;
2. Landfills in Regional Growth Areas, Pinelands Towns and Villages, or Rural Development Areas are terminated on August 8, 1990;
3. Landfills in Agricultural Production Areas or Forest Areas are terminated on August 8, 1990, or when the new waste disposed of equals twenty-five percent of the authorized disposal capacity on August 8, 1980, whichever occurs first;
4. There are no practical, alternative disposal sites available outside of the Pinelands;
5. All waste accepted from outside the Pinelands is from counties with at least fifty percent of their land area within the Pinelands;
6. The operation of the landfill will meet the requirements of the Solid Waste Management Act, N.J.S.A. 13:1E-1 et seq. and all adopted and certified district waste management plans;
7. All areas filled to final design elevations shall be capped with an impervious material within one year. Prior to the establishment and filling of new areas, all existing areas shall be filled to final elevation and capped with an impervious material. The type and nature of capping shall be in accordance with the standards of the New Jersey Solid Waste Administration; and
8. Expansion of any existing landfill operation shall only occur if:
 - (a) no feasible alternative disposal techniques are available;
 - (b) the expansion does not involve the disposal of waste within 2500 feet of an existing residential use;

(c) the expansion area is lined and includes a leachate collection and treatment system and a methane collection and disposal system; and either

(d) the expansion will occur only on lands containing adequate clay aquicludes as determined by the Commission in consultation with the New Jersey Solid Waste Administration; or

(e) when there are no lands containing adequate clay aquicludes, all measures necessary to prevent the degradation of ground water shall be reviewed and analyzed. Those measures determined to be most effective to prevent the degradation of ground water shall be implemented.

**Section 6-705.
New Landfills**

Landfills not existing on August 8, 1980 shall be permitted in the Protection Area only if a solid waste management district demonstrates to the Commission that a new landfill is significantly preferable from an environmental perspective to continuation of an existing landfill, that there are no practical alternative disposal techniques available, as demonstrated in a certified solid waste management plan, that there are no feasible alternative land sites available, that all waste to be accepted is from counties with at least 50% of their land area within the Pinelands, and that the new landfill shall be operated in accordance with Sections 6-704(6)-(8). New landfills established under this Section may be continued only until August 8, 1990.

**Section 6-706.
Categories of Wastes Prohibited**

No hazardous, toxic, chemical, petroleum (including oil spill pollutants), or nuclear waste shall be accepted for disposal or disposed of at any site within the Pinelands. No septic waste or liquid sludge shall be accepted for disposal or disposed of at any landfill site within the Pinelands except in accordance with state and federal regulations; provided, however, that nothing in this Part shall be construed to prohibit the surface application of liquid sludge and septage as a part of an agricultural program.

Section 6-707.
Compliance with County, State and Federal Requirements

No provision of this Plan shall be construed as authorizing any landfill operation

in violation of any local, state or federal regulation or plan governing the disposal of waste material, including the Resource Conservation and Recovery Act, 42 U.S.C. §6901 et seq., and associated implementing rules and regulations.

PART 8—WATER QUALITY

Section 6-801.
Purpose

An essential element of the overall ecological value of the Pinelands environment is its extensive surface and ground water resources of exceptional quality. The Pinelands Protection Act provides that the Plan protect and maintain the quality of surface and ground water through the control of development and land use, and close cooperation and coordination with local, state and federal agencies of government. This management program is intended to protect and preserve surface and ground waters of the Pinelands and to ensure that random and uncontrolled growth and development will not degrade the Pinelands environment.

Section 6-802.
Water Quality Management Program Required

In order to be certified under the provisions of Article 3 [CERTIFICATION OF COUNTY, MUNICIPAL AND FEDERAL INSTALLATION PLANS] of this Plan, a municipal master plan and land use ordinance must provide for the protection of surface and ground water quality in the Pinelands. It is not necessary that the municipal program incorporate the literal terms of the program set out in this Part; rather, a municipality may adopt alternative and additional techniques which will achieve the equivalent protection of surface and ground water quality as would be achieved under the provisions of this Part.

Section 6-803.
Minimum Standards Necessary to Protect and Preserve Water Quality

A. All development permitted under this

Plan, or under a certified county or municipal master plan or land use ordinance, shall be designed and carried out so that the quality of surface and ground water will be protected and maintained.

B. Except as specifically authorized in this part, no development shall be permitted which degrades surface and ground water quality.

C. No development shall be permitted which does not meet the minimum water quality and potable water standards of the State of New Jersey or the United States.

Section 6-804.
Minimum Standards for Point and Non-Point Source Discharges

The following point and non-point sources may be permitted in the Pinelands:

A. Commercial, industrial and waste water treatment facilities, provided that:

1. There will be no direct discharge into any surface body;
2. All discharges from the facility are of a quality and quantity such that ground water exiting from the parcel of land or entering a surface body of water will not exceed 2 parts per million nitrate/nitrogen;
3. All public waste water treatment facilities are designed to accept and treat septage; and
4. All storage facilities, including ponds or lagoons, are lined to prevent leakage into ground water.

B. On-site conventional septic waste water treatment systems, provided that:

1. The location of the system and its discharge point, and the size of the parcel on which the system is located, will ensure that ground water exiting from the parcel or en-

tering a surface body of water will not exceed 2 parts per million nitrate/nitrogen;

2. The depth to seasonal high water table is at least five feet;

3. Any potable water well will be drilled and cased to a depth of at least 100 feet, unless the well penetrates an impermeable clay aquiclude, in which case the well shall be cased to at least 50 feet; and

4. The system will be maintained and inspected in accordance with the requirements of Section 6-805 [INDIVIDUAL WASTEWATER TREATMENT FACILITY AND PETROLEUM TANK MAINTENANCE] of this Part.

C. On-site alternative and innovative technology wastewater disposal systems, provided that:

1. The parcel on which the system is to be located is located in a Pineland Village or Town or Regional Growth Area or is exempted from the density limitations of this Plan pursuant to Part 5 of Article 4;

2. The location of the system and its discharge point and the size of the parcel on which the system is located will ensure that ground water exiting from the parcel or entering a surface body of water will not exceed 2 parts per million nitrate/nitrogen;

3. The depth to seasonal high water table is at least five feet;

4. Any potable water well will be drilled and cased to a depth of at least 100 feet, unless the well penetrates an impermeable clay aquiclude in which case the well shall be cased to at least 50 feet; and

5. The alternative or innovative wastewater technology has been approved for use by the New Jersey Department of Environmental Protection;

6. The alternative or innovative system will be inspected and maintained in accordance with the requirements of Section 6-805 of this Part; and

7. Any effluent discharged from innovative and alternative technology facilities will be monitored at six-month intervals for a period of at least three years, and the results of each sampling period are provided to local boards of health and the Pinelands Commission.

D. Surface water run-off, provided that:

1. The volume and rate of runoff generated from the parcel by a fifty (50) year storm of a 24-hour duration as calculated in accordance with the United States Soil Conservation Service Technical Release No. 55 or the S.C.S. National Engineering Handbook §4 will not increase as a result of any development of the parcel;

2. Surface water runoff from impervious surfaces will be retained to facilitate infiltration into the ground water; and

3. Runoff shall not be recharged where depth to water table is more than 20 feet below the surface, wherever practical; and

4. Excessively and somewhat excessively drained soils, as defined by the Soil Conservation Service, should be avoided for recharge of runoff wherever practical.

Section 6-805.

Individual Wastewater Treatment Facility and Petroleum Tank Maintenance

A. The owner of every on-site conventional septic wastewater treatment facility in the Pinelands shall, as soon as a suitable septage disposal facility capacity is available, in accordance with the provisions of Chapter 326 of the Solid Waste Management Act, N.J.S.A. 13:1E-1 et seq. and Section 201 of the Clean Water Act:

1. Have the facility inspected by a qualified technician at least once every three years;

2. Have the facility cleaned at least once every three years; and

3. Once every three years submit to the municipality in which the facility is located a sworn statement that the facility has been inspected and cleaned, setting forth the name of the person who performed the inspection and cleaning and the date of such inspection.

B. The owner of every alternative technology on-site disposal facility shall have the facility inspected every three years and shall submit to the municipality in which the facility is located a sworn statement that the alternative system is in full and complete operation.

C. The owner of every commercial petrole-

um storage tank shall have the tank pressure tested at installation and every five years thereafter and shall submit a sworn statement to the municipality in which the tank is located that the tank is water-tight.

Section 6-806.
Water Management

A. Interbasin transfer of water between watersheds in the Pinelands should be avoided to the maximum extent practical. In areas served by central sewers, water-saving devices such as water-saving toilets, showers and sink faucets shall be installed in all new development.

B. Water shall not be exported from Pinelands counties except by natural surface and ground water flows.

Section 6-807.
Prohibited Chemicals and Materials

A. Use of the following substances is pro-

hibited in the Pinelands to the extent that such use will result in direct or indirect introduction of such substances to any surface, or ground ~~or surface~~ water or any land:

1. Septic tank cleaners; and
2. Waste oil

B. All storage facilities for deicing chemicals shall be lined to prevent leaking into the soil, and shall be covered with an impermeable surface which shields the facility from precipitation.

C. No person shall apply any herbicide to any road or public utility right-of-way within the Pinelands unless necessary to protect an adjacent agricultural activity.

D. No hazardous, toxic, chemical, petroleum (including oil spill pollutants), ~~septic or nuclear waste or liquid sludge~~ shall be discharged or disposed of on any land in the Pinelands, except as part of a land application of liquid sludge for agricultural purposes.

PART 9—AIR QUALITY

Section 6-901.
Purpose

Air quality in the Pinelands is important to the character and ecology of the Pinelands. It is the purpose of this Part to ensure that the quality of the air in the Pinelands region is protected and enhanced.

Section 6-902.
Pinelands Air Quality Review

In order to obtain certification under the provisions of Article 3 of this plan [CERTIFICATION OF COUNTY, MUNICIPAL AND FEDERAL INSTALLATION PLANS], the master plan and land use ordinances must ensure that any application for major development in the Pinelands where the proposed development will generate substantial vehicular traffic or space heating emissions, including development involving 100 or more dwelling units or more than 300 parking spaces, shall include, in

addition to the information required by Section 4-102(B) [APPLICATION REQUIREMENTS], the following information relative to the impact of the proposed development on air quality:

1. A summary of ambient air quality in the vicinity of the facility expressed in terms of levels of sulfur dioxide, particulates, and carbon monoxide concentrations compared with all applicable ambient air quality standards. This data may be obtained from on-site monitoring or, upon approval of the New Jersey Department of Environmental Protection, Division of Environmental Quality, from the nearest New Jersey state monitoring site.

2. An analysis of the use of all existing and proposed access roads, including:

(a) Current traffic volume, in vehicles per hour, for peak hours, peak eight-hour periods and for an average day; and

(b) Traffic capacity in vehicles per

hour calculated pursuant to the procedures set out in the Highway Capacity Manual 1965, Highway Research Board Special Report 87 and NAS-NRC Publication 1328.

3. An estimate of traffic volumes to be generated by the proposed development in vehicles per hour for peak hours and peak eight-hour periods at the time of completion of construction and 10 years after completion.

4. A description of parking facilities including:

- (a) locations;
- (b) number of parking spaces;
- (c) number of parking levels; and
- (d) whether the parking area is to be open or covered.

5. An analysis of emissions from space heating, including:

(a) type and amount of fuel used and pollution emission factors used to calculate emissions; and

(b) the emission rates of sulfur dioxide, particulates, carbon monoxide, hydrocarbons and oxides of nitrogen in tons per day averaged over the five-month heating season.

6. An analysis of motor vehicle emissions to be generated by the proposed development and, where appropriate, by growth induced by the proposed development based on annual average daily traffic and space heating emissions expressed as tons per day of carbon monoxide, hydrocarbons, nitrogen oxide, sulfur dioxide and particulates. The latest data available from the United States Environmental Protection Agency's publication AP-42, "Compilation of Air Pollution Emission Factors," is to be used to calculate emissions if more definitive information is not available.

7. An analysis of the effect of carbon monoxide emissions on air quality including anticipated carbon monoxide concentrations compared with ambient air quality standards and with concentrations in the absence of the proposed development at:

- (a) places of maximum concentration;
- (b) critical locations including monitoring sites and sensitive receptors such as hospitals, schools, nursing homes, residences and playgrounds.

This analysis should be prepared pursuant to the procedures established in the United States Environmental Protection Agency's publication "Guidelines for Air Quality Maintenance, Planning, and Analysis, Volume 9: Evaluating Indirect Sources," Publication No. EPA-450/4-750-001 OAQPS No. 1.2-028 or equivalent procedure.

8. An analysis of the availability of public transportation and, for housing projects, the accessibility, including distance, safety, and convenience of route, by automobile and by other modes of transportation of the following facilities:

- (a) medical (including professional offices and hospitals);
- (b) recreational;
- (c) educational;
- (d) commercial (including personal shopping); and
- (e) places of employment.

9. A description of measures taken in planning the proposed development which are intended to reduce vehicle miles travelled, including but not limited to those measures described in the United States Environmental Protection Agency's publication "Guidelines for Air Quality Maintenance, Planning and Analysis, Volume 3: Control Strategies" (Chapter II, Section E), Publication No. EPA-450/4-74-003 (OAQPS No. 1.2-002), and in Section 108(f)(i)(A) of the Clean Air Act Amendment of 1977, 42 U.S.C. §7410.

10. A description of measures taken in planning the proposed development which are intended to reduce emissions during construction and minimize dust emissions from the completed development in accordance with the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq. Applicable standards for dust control are available in the New Jersey Department of Agriculture publication "Standards for Soil Erosion and Sediment Control in New Jersey."

11. Information evidencing compliance with the provisions of the New Jersey Administrative Code, Title 7, Chapter 27, (New Jersey air pollution control regulations) and 45 F.R. 52676-52748 (August 7, 1980), (EPA Regulations for Prevention of Significant Deterioration).

PART 10—SCENIC

Section 6-1001.

Purpose

The Pinelands is a complex of environmental values that presents a definable visual character to residents and visitors. This character contributes substantially to the attractiveness of the area and therefore is an important element of the area's economy. This Part is intended to ensure that development will take advantage of and enhance the visual character of the Pinelands.

Section 6-1002.

Scenic Management Program

In order to be certified under the provisions of Article 3 [CERTIFICATION OF COUNTY, MUNICIPAL AND FEDERAL INSTALLATION PLANS] of this Plan, a municipal master plan or land use ordinance must provide a program for the protection of the scenic values of the Pinelands. It is not necessary that the municipal program incorporate the literal terms of the program set out in this Part; rather, a municipality may adopt alternative and additional techniques which will achieve equivalent protection of scenic values which would be achieved under the provisions of this Part.

Section 6-1003.

Scenic Corridors

A. All public, paved roads in the Preservation Area District, the Rural Development and Forest Areas shall be considered scenic corridors.

B. All navigable streams and all lakes and ponds in the Preservation Area District, the Rural Development and Forest Areas shall be considered scenic corridors; those rivers designated in Section 6-1004(D) shall be considered as special scenic corridors in any part of the Pinelands.

Section 6-1004.

Special Requirements for Scenic Corridors

A. Except as provided in this Section, no permit shall be issued for development other than for agricultural product sales estab-

lishments unless the applicant demonstrates that all buildings are set back at least 200 feet from the center line of the scenic corridor.

B. If compliance with the 200-foot setback is constrained by environmental or other physical considerations, such as wetland, or active agricultural operation, the building shall be set back as close to 200 feet as practical and the site shall be landscaped in accordance with the provisions of Part 2 of this Article [VEGETATION] so as to provide screening from the corridor.

C. If an applicant for development approval demonstrates that existing development patterns of the corridor are such that buildings are set back less than 200 feet within 1000 feet of the site proposed for development, then a setback shall be set for the proposed development which is consistent with the established development pattern, provided that the site is landscaped in accordance with the provisions of Part 2 of this Article [VEGETATION] so as to provide screening between the building and the corridor.

D. The following rivers are hereby designated to be wild and scenic rivers and scenic corridors of special significance to the Pinelands. All structures within 1000 feet of the center line of these rivers shall be designed to avoid visual impacts as viewed from the river:

Great Egg Harbor River—Great Egg Bay (Garden State Parkway) to Route 536.

Tuckahoe River—Great Egg Bay to the Route 552 crossing in Milmay.

Middle River—Great Egg Bay to Schoolhouse Lane crossing north of Corbin City.

Mullica River—Garden State Parkway to Medford Road crossing at the Medford, Waterford, and Shamong Township boundaries.

Wading River—Confluence with the Mullica River to Route 563 crossing at Speedwell.

Oswego River—Confluence with the Wading River to Sim Place reservoir dam.

Batsto River—Confluence with Mullica

River to Carranza Memorial Road crossing at Shamong and Tabernacle Township boundaries.

Bass River—Confluence with the Mullica River to Stage Road crossing in Bass River State Forest.

Nescochague Creek—Confluence with the Mullica River to confluence with Great Swamp Branch and Albertson Branch.

Great Swamp Branch—Confluence with Nescochague Creek to Route 206 bridge in Hammonton.

Rancocas Creek—Route 530 crossing in Browns Mills to the Pinelands boundary.

Cedar Creek—Route 9 crossing to the dam at Bamber Lake.

West Creek—Confluence with Delaware Bay to Pickle Factory Pond above Route 550.

Dennis Creek—Confluence with Delaware Bay to the headwaters of the mainstem in the Great Cedar Swamp west of Route 9.

North Branch of the Forked River—Garden State Parkway to the confluence with Cave Cabin Branch east of Howardsville.

Toms River—From the Central Railroad of New Jersey bridge to the Route 528 crossing east of Cassville.

Maurice River—Delaware Bay to Manumuskin River.

Manumuskin River—Confluence with the Maurice River to the Route 49 crossing near Cumberland Road.

Mount Misery Branch—Route 70 crossing to the Greenwood Branch continuing to the North Branch of the Rancocas Creek.

Section 6-1005. Signs

Each municipality shall adopt provisions governing signs in its municipal master plan and ordinances. Section 6-1006 (MANDATORY SIGN PROVISIONS) contains provisions which must be included in all municipalities; Section 6-1007 contains mandatory

provisions for municipalities in the Preservation Area District and Special Agricultural Production Areas; and Section 6-1008 contains suggested guidelines for additional sign provisions for other areas of the Pinelands.

Section 6-1006. Mandatory Sign Provisions

A. No sign, other than warning or safety signs, which is designed or intended to attract attention by sudden, intermittent or rhythmic movement, or physical or lighting change, shall be permitted in any area.

B. No sign, other than warning or safety signs, which changes physical position by any movement or rotation or which gives the visual impression of such movement or rotation shall be permitted in any area.

C. No outdoor off-site commercial advertising sign, other than signs advertising agricultural roadside stands, shall be permitted in the Pinelands.

D. No existing sign which does not conform to Subsections A, B, and C hereof shall be permitted to continue beyond ten years after the effective date of this Plan.

E. To the maximum extent practical, the character and composition of construction materials for all signs shall be harmonious with the scenic values of the Pinelands.

Section 6-1007. Mandatory Sign Provisions in the Preservation Area District and Special Agricultural Production Areas

A. No sign shall be constructed, repaired or maintained except in accordance with the provisions of Section 6-1006 and this Section.

B. The following signs are permitted in the Preservation Area District and the Special Agricultural Production Areas:

1. Official public safety and information signs displaying road names, numbers and safety directions;

2. On-site signs advertising the sale or rental of the premises, provided that:

(a) the area on one side of any such sign shall not exceed twelve square feet;

(b) no more than one sign is located on any parcel of land held in common ownership.

3. On-site identification signs for schools, churches, hospitals, or similar public service institutions, provided that:

(a) the size of any such sign shall not exceed twelve square feet;

(b) no more than one sign is placed on any single property.

4. Trespassing signs or signs indicating the private nature of a road, driveway, or premises, and signs prohibiting or otherwise controlling fishing or hunting, provided that the size of such signs does not exceed twelve square feet;

5. On-site professional, home occupation, or name signs indicating the profession and/or activity and/or name of the occupant of the dwelling, provided that:

(a) the size of any such sign shall not exceed twelve square feet;

(b) no more than one sign is permitted for any individual parcel of land.

6. On-site business or advertising signs, provided that:

(a) no more than two signs are located on any one premise or on the premises leased or utilized by any one business establishment;

(b) the total area of such signs shall not exceed twenty square feet per side, with the maximum height to the top of the sign not to exceed fifteen feet from ground level.

7. Temporary signs advertising political parties or candidates for election, provided that the size of any such sign does not exceed four square feet.

8. Temporary on- and off-site signs advertising civil, social or political gatherings and activities, provided that the size of such signs does not exceed four square feet.

Section 6-1008.

Guidelines for Sign Provisions Outside the Preservation Area District and Special Agricultural Production Areas

The following guidelines may be used in formulating municipal sign ordinances:

1. Official public safety and information signs displaying road names, numbers and safety directions may be permitted;

2. On-site signs advertising the sale or rental of the premises may be permitted, provided that:

(a) the area on one side of any such sign does not exceed twelve square feet;

(b) no more than one sign is located on any parcel of land held in common ownership.

3. On-site identification signs for schools, churches, hospitals, or similar public service institutions may be permitted; provided that:

(a) the size of any such sign does not exceed twelve square feet;

(b) no more than one sign is placed on any single property.

4. Temporary signs advertising political parties or candidates for election may be permitted, provided that the size of any such sign does not exceed twelve square feet;

5. Temporary on- and off-site signs advertising civil, social or political gatherings and activities may be permitted, provided that the size of such signs does not exceed twelve square feet;

6. Trespassing signs or signs indicating the private nature of a road, driveway, or premise, and signs prohibiting or otherwise controlling fishing or hunting may be permitted, provided that the size of such signs does not exceed twelve square feet;

7. On-site professional, home occupation, or name signs indicating the profession and/or activity and/or name of the occupant of the dwelling may be permitted, provided that:

(a) the size of such sign does not exceed four square feet;

(b) no more than one sign is permitted for any individual parcel of land.

8. On-site business or advertising signs may be permitted provided that:

(a) no more than two signs are located on any one premise or on the premises leased or utilized by any one business establishment;

(b) the total area of such signs does not exceed twenty square feet per side with the maximum height to the top of the sign not to exceed fifteen feet from ground level.

**Section 6-1009.
Motor Vehicle Screening and Storage**

In order to obtain certification, municipalities shall adopt local ordinances which provide that no more than ten automobiles, trucks or other motor vehicles, whether or not they are in operating condition, shall be stored on any lot unless such motor vehicles are adequately screened from adjacent residential uses and scenic corridors. All vehicles not in operating condition shall be stored only if the gasoline tanks of such vehicles are drained. This section shall not apply to vehicles which are in operating condition and which are maintained for agricultural purposes.

**Section 6-1010.
Location of Utilities**

A. New utility distribution lines and telephone lines to locations not presently served by utilities shall be placed underground, except for those lines which are located on or adjacent to active agricultural operations.
 B. All electric utility transmission lines shall be located on existing towers or underground to the maximum extent practical.
 C. Above-ground generating facilities, switching complexes, pumping stations, storage tanks and substations shall be screened with vegetation from adjacent uses in accordance with Part 2 of Article 6 [VEGETATION].

PART 11—FIRE MANAGEMENT

**Section 6-1101.
Purpose**

Forest vegetation represents a significant wildfire threat to structures developed within the Pinelands. Therefore all development in the Pinelands shall conform to the requirements of this Part in order to protect life and property from catastrophic forest fires and to ensure the maintenance of the Pinelands forest ecosystems.

shall be used in determining the fire hazard of a parcel of land:

**Section 6-1102.
Fire Management Program**

In order to be certified under the provisions of Article 3 [CERTIFICATION OF COUNTY, MUNICIPAL AND FEDERAL INSTALLATION PLANS] of this Plan, a municipal master plan or land use ordinance must provide a fire management program. It is not necessary that the municipal program incorporate the literal terms of the program set out in this Part; rather, a municipality may adopt alternative and additional techniques which will achieve the equivalent management objectives as would be achieved under the provisions of this Part.

Fire Hazard Classification	
Hazard	Vegetation Type
Low	Atlantic white cedar. Hardwood swamps.
Moderate	Pine-oak or oak-pine greater than 20' tall and less than 20' spacing. Non-Pine Barrens forest Prescribed burned areas.
High	Pine-oak or oak-pine less than 20' tall and greater than 20' spacing.
Extreme	Immature pine-oak or oak-pine, including those less than 20' tall and less than 20' spacing. Pitch pine lowlands (all size classes).

**Section 6-1103.
Fire Hazard Classification**

The following vegetation classifications

**Section 6-1103.
Fire Hazard Mitigation Standards**

No application for development approval shall be granted in moderate, high and extreme fire hazard areas unless the applicant demonstrates that:

A. All proposed developments, or units or sections thereof, of 25 dwelling units or more will have two accessways of a width and surface composition sufficient to accommodate and support fire fighting equipment;

B. All dead-end roads will terminate in an area adequate to provide ingress and egress for fire fighting equipment;

C. The rights-of-way of all roads will be maintained so that they provide an effective fire break;

D. A fire hazard fuel break is provided around structures proposed for human use by the selective removal or thinning of trees, bushes, shrubs and ground cover as follows:

1. In moderate fire hazard areas a fuel break of 30 feet measured outward from the structure in which:

(a) shrubs, understory trees and bushes and ground cover are to be selectively removed, mowed, or pruned on an annual basis; and

(b) all dead plant material is removed.

2. In high fire hazard areas a fuel break of 75 feet measured outward from the structure in which:

(a) shrubs, understory trees and bushes and ground cover are to be selectively removed, mowed or pruned and maintained on an annual basis;

(b) all dead plant material is removed.

3. In extreme high hazard areas a fuel break of 100 feet measured outward from the structure in which:

(a) shrubs, understory trees and bushes and ground cover are to be selectively removed, mowed or pruned and maintained on an annual basis;

(b) no pine tree (*Pinus* spp.) is closer than 25 feet to another tree; and

(c) all dead plant material is removed.

E. All residential development of 100 dwelling units or more in high or extreme high hazard areas will have a 200-foot perimeter fuel break between all structures and the forest in which:

(a) shrubs, understory trees and bushes and ground cover are selectively removed, mowed or pruned and maintained on an annual basis;

(b) all dead plant material is removed;

(c) roads, rights-of-way, wetlands and waste disposal sites shall be used as fire breaks to the maximum extent practical; and

(d) there is a specific program for maintenance.

F. All structures will meet the following specifications;

1. Roofs and exteriors will be constructed of fire resistant materials such as asphalt rag felt roofing, tile, slate, asbestos cement shingles, sheet iron, aluminum, brick, or fire retardant-treated wood shingles or shakes.

2. All projections such as balconies, decks, and roof gables shall be constructed of fire resistant materials or materials treated with fire retardant chemicals.

3. Any openings in the roof, attic, and the floor shall be screened.

4. Chimneys and stovepipes which are designed to burn solid or liquid fuels shall be equipped with screens over the outlets.

5. Flat roofs are prohibited in areas where vegetation is higher than the roof.

PART 12—HOUSING

Section 6-1201.

Purpose

In order to ensure that low, moderate and middle income households will have adequate and reasonable housing opportunities under the Comprehensive Management Plan, it is necessary that master plans and land use ordinances of municipalities with land in the

Regional Growth Areas include a housing program that implements the minimum standards of this Part. There are a variety of methods by which a municipal housing program can implement the minimum standards of this Part. The primary consideration of the Commission will be whether the program is economically feasible and likely to result in the availability of housing opportunities for

low, moderate and middle income households. It is not necessary that a municipality incorporate the literal terms of this Part, provided that the municipal master plan and land use ordinances ensure the equivalent provision of housing opportunities as would be achieved under the provisions of this Part.

Section 6-1202.

Minimum Standards

In order to be certified under the provisions of Article 3 of this Plan (CERTIFICATION OF COUNTY, MUNICIPAL AND FEDERAL INSTALLATION PLANS), a municipal master plan or land use ordinance must include a housing program that:

A. Ensures that at least 10% of all available housing units in the portion of the municipality which is located in a Regional Growth Area will be affordable to low income households;

B. Ensures that in addition to the housing units which are affordable to low income households, at least 10% of all available housing units in that portion of the municipality which is located in a Regional Growth Area will be affordable to moderate income households;

C. Ensures that in addition to the housing units which are affordable to low and moderate income households, at least 5% of all available housing units in the portion of the municipality which is located in a Regional Growth Area will be affordable to middle income households;

D. Ensures that minimum floor area requirements are not applicable to dwelling units which meet the minimum standards of Subsection A, B and C of this Section;

E. Ensures that dwelling units that meet the minimum standards of Subsections A, B and C of this Section are compatible with surrounding land uses;

F. Ensures that the dwelling units required by Subsections A, B and C of this Section are available at approximately the same rate as is non-required housing;

G. Includes provisions that will ensure that the dwellings, required in Subsections A, B and C of this Section will continue to be

available to low, moderate and middle income households.

Section 6-1203.

Minimum Housing Standards in Uncertified Municipalities

In municipalities that have not received certification of their master plans and land use ordinances, all development shall meet the following minimum standards:

A. In developments involving 25 to 99 dwelling units, at least 25% of the dwelling units proposed for development shall be affordable to low, moderate and middle income households, provided that at least 4/5th's of the required low, moderate and middle income housing units are affordable to low and moderate income households.

B. In developments of 100 or more dwelling units, 25% of the dwelling units shall be affordable to low, moderate and middle income households as follows:

1. At least 10% of the dwelling units shall be affordable to low income households; provided, however, if a developer can demonstrate that low income housing units cannot be provided because of the inavailability of subsidy funds, the applicant may satisfy the low income housing requirement of this Subsection by dedication of land suitable for development of an equivalent number of low income housing units or by a payment in lieu thereof to a qualified public housing agency;

2. At least 10% of the dwelling units shall be affordable to moderate income households; and

3. At least 5% of the dwelling units shall be affordable to middle income households.

C. All required low, moderate and middle income housing units shall be compatible with the non-required housing units and uses in the vicinity of the proposed development.

D. Required low, moderate and middle income housing units shall be constructed at the same rate as non-required housing.

E. Deed restrictions or other legally enforceable provisions ensuring the availability of required housing for low, moderate and middle income households shall be provided for a period of at least thirty (30) years from the date of initial occupancy.

PART 13—RECREATION

Section 6-1301.

Purpose

The Pinelands are an important recreational resource. It is the purpose of this Part to protect those natural resources necessary for compatible recreational uses, promote diverse recreational opportunities in a manner that minimizes land use conflicts, promote the location of low intensity recreational uses in undeveloped areas, and promote intensive recreational uses in developed areas.

Section 6-1302.

Recreational Management Plan

In order to be certified under the provisions of Article 3 [CERTIFICATION OF COUNTY, MUNICIPAL AND FEDERAL INSTALLATION PLANS] of this Plan, a municipal master plan and land use ordinance must contain a program to protect and enhance recreational resources. It is not necessary that the municipal program be precisely the program set out in this Part; rather, a municipality may adopt alternative and additional techniques to protect recreational resources. In reviewing the municipal plan, the Commission shall consider the extent to which the plan and ordinances implement the standards and objectives of this Part.

Section 6-1303.

General Requirements

All recreational facilities in the Pinelands shall comply with the following requirements:

A. No power vessel in excess of 10 horsepower shall operate on state waters within the Pinelands Area except on:

1. That portion of the Mullica River downstream from Burlington County Route 542; and

2. That portion of the Wading River downstream from its confluence with the Oswego River.

B. No motor vehicle other than fire, police or emergency vehicles or those vehicles used for the administration or maintenance of any

public land shall be operated upon publicly owned land within the Pinelands. Other motor vehicles may operate on public lands for recreational purposes on public highways and areas on land designated prior to August 8, 1980 for such use by state and local governmental entities until designated as inappropriate for such use under Subsection C hereof.

C. The Commission shall from time to time designate areas which are inappropriate for use of motor vehicles. Such designation shall be based upon the following considerations and upon consultation with the New Jersey Department of Environmental Protection and other interested persons:

1. A need to protect a scientific study area;
 2. A need to protect the location of threatened or endangered plant or animal species;
 3. A need to provide a wilderness recreational area;
 4. A need to prevent conflicts with adjoining intensively used recreational areas;
 5. A need to protect historic or archaeological sites;
 6. A need to protect critical wildlife habitats;
 7. A need to address a situation of public health and safety;
 8. A need to protect extensively disturbed areas from further impact; and
 9. The extent to which such road closure would substantially impair recreation access to and uses of surrounding resources.
- D. Route maps for organized off-road vehicle events shall be filed with and approved by the Executive Director.
- E. All electrically powered equipment or machinery shall have battery boxes encased in containers to avoid accidental chemical spillage.
- F. All recreation areas and facilities shall be designed in accordance with the New Jersey Department of Environmental Protection publication "Administration Guidelines: Barrier-Free Design Standards for Parks and Recreational Facilities."

G. Improved bicycling facilities are provided only in conjunction with paved roads within the Preservation Area District and Forest Area.

**Section 6-1304.
Guidelines for Recreational Land
and Facilities**

In preparing the recreational program element of its master plan and ordinances, each municipality may consider the following requirements:

A. Lawn areas shall be permitted in association with commercial and industrial development provided that such lawns are designed and used for public recreational purposes, meet an identified public recreation need, and are dedicated to public recreation use.

B. Lawn areas developed in association with recreational development shall be limited to those which support recreation activities and shall, to the extent practical, be of a variety of grass which requires minimal fertilization.

C. Each municipality shall have ordinances which provide for open space and recreational facilities in association with residential developments. The following guidelines may be utilized to develop these ordinances:

1. All residential development of 25 units or more shall provide:

(a) 8 acres of land to be used for recre-

ational purposes for every 1,000 projected residents of the development; provided, however, that such acreage shall not be required to exceed 10% of the total acreage of the proposed development;

(b) land provided in accordance with paragraph (a) above shall be provided in a single area or in individual parcels at least one acre in size;

(c) all residential units for which the recreational land is provided in accordance with paragraph (a) above shall be located within 1/4 mile of such recreational land; and

(d) at least 50% of the recreational land provided in accordance with paragraph (a) above shall be turfed or landscaped with otherwise suitable materials to permit informal recreational activities.

2. All residential development of 50 units or more should provide recreational land in accordance with Subsection (1) above. Recreational facilities in accordance with the following schedule shall also be provided to the extent recreational needs are generated by the proposed development. An analysis of the recreational needs of a proposed development within a specified service area around the development shall be conducted by comparing the following schedule of facility standards with existing recreational facilities within the service area and the projected population of the service area:

Recreational Facility Guidelines

	Population	Minimum Facility Space Standards	Recreational Service Area Radius
Basketball courts	1 per 1000	Court dimensions range from 60' x 80' to 70' x 104'	1/2 mile
Tennis courts	1 per 2000	Court dimensions range from 60' x 120'—single court 45' x 120'—additional adjoining courts	1 mile
Multi-purpose paved areas	1 per 2000	.50 acre (including basketball and tennis courts)	1/2 mile

Recreational Facility Guidelines (continued)

	Population	Minimum Facility Space Standards	Recreational Service Area Radius
Passive area (sitting)	1 per 2000	.50 acre	1/2 mile
Senior citizen (bocce, shuffle- board, horseshoe)	1 per 1000 over 55	.50 acre	1/4 mile
Pre-school playground	1 per 2000	.25 acre	1/4 mile
Advanced playground	1 per 2000	.25 acre	1/2 mile
Multi-purpose turf area	1 per 2000	.50 acre	1 mile
Football/soccer fields	1 per 10,000	Field dimensions 140' x 280'—youth 190' x 420'—adult	1 mile
Baseball—regulation 90' diamond	1 per 6000	2.8 acres 325-foot outfield	1 mile
Baseball—youth Softball 60' diamond	1 per 6000	1.0 acre 200-foot outfield	1 mile
Picnic area	1.0 acre	8-foot tables	1 mile

PART 14—HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL PRESERVATION

Section 6-1401.

Purpose

The Pinelands Commission may designate historic districts and historic, archaeological or cultural resources in furtherance of the following public purposes:

(a) To effect and accomplish the protection, enhancement, perpetuation and use of improvements and areas of special historic and archaeological interest or value which represent or reflect significant elements of the Pinelands' cultural, social, economic, political and architectural history and pre-history;

(b) To safeguard the Pinelands' pre-historic, historic, and cultural heritage as embodied and reflected in such improvements and areas;

(c) To stabilize and improve property values in such areas;

(d) To prevent neglect and vandalism of historic, archaeological and cultural sites;

(e) To foster pride in the beauty and noble accomplishments of the past; and

(f) To preserve opportunities for traditional life styles related to and compatible with the ecological values of the Pinelands.

Section 6-1402.

Historic, Archaeological and Cultural Management Program

In order to be certified under the provisions of Article 3 [CERTIFICATION OF COUNTY, MUNICIPAL AND FEDERAL INSTALLATION PLANS] of this Plan, a municipal master plan or land use ordinance must provide a program for the protection of historic, archaeological and cultural resources. It is not necessary that the municipal program incorporate the literal terms of the program set out in this Part; rather, a municipality may adopt alternative and additional techniques which will achieve the equivalent protection provided under the provisions of this Part.

Section 6-1403.

Authority of Historic, Archaeological and Cultural Preservation Board

The Planning Board of each municipality shall serve as the Historic, Archaeological and Cultural Preservation Board (hereinafter Preservation Board) and have the powers and duties provided in this Part, unless the municipality designates a separate Board for this purpose. The Preservation Board or Planning Board, as the case may be, shall have the following powers and duties:

- A. To initiate, hear, review and make recommendations to the Pinelands Commission regarding designation of historic, archaeological and cultural resources and districts of Pinelands, national or state significance in accordance with the provisions of Sections 6-1404 of this Part;
- B. To initiate, hear, review and designate historic, archaeological and cultural resources and districts of local significance in accordance with the provisions of Section 6-1404 of this Part;
- C. To review and grant or deny certificates of appropriateness in accordance with the provisions of Section 6-1405 of this Part;
- D. To review and report on any matter related to this Part referred to it by the Pinelands Commission;
- E. To make its general knowledge and expertise available upon reasonable written

request to the Pinelands Commission or any agency of the municipality, county, state or federal government;

- F. To consult with any county, state, or national agency with special expertise in the area of historic and archaeological resources;
- G. To prepare and adopt plans and implementing measures to preserve the cultural heritage of traditional Pinelands Villages;
- H. To develop and maintain a manual of recommended rehabilitation techniques and the relationship of new construction to natural areas for the guidance of the public; and
- I. To adopt rules of procedure which are not in conflict with the provisions of this Part.

Section 6-1404.

Designation of Historic, Archaeological or Cultural Resources and Districts

A. Designation.

The Pinelands Commission hereby designates the following structures and sites as historic, archaeological and cultural resources of significance to the Pinelands:

- L.N. RENAULT AND SONS WINERY
Bremen Avenue and Leibig Street,
Galloway Township
- HANOVER FURNACE
Hanover Lake area,
New Hanover Township
- ATSION VILLAGE
Route 206,
Shamong Township
- BATSTO VILLAGE
Wharton State Forest,
Route 542,
Washington Township
- GRANT A.M.E. CHURCH
4th and Washington Streets,
Chesilhurst Borough
- DENNISVILLE HISTORIC DISTRICT
Petersburg Road and Main Street,
Dennis Township
- DOUBLE TROUBLE STATE PARK
HISTORIC DISTRICT,
Double Trouble State Park,
Berkeley and Lacey Townships

HANGAR NUMBER ONE,
LAKEHURST NAVAL AIR STATION
County Route 547,
Manchester Township
MULLICA RIVER-CHESTNUT NECK
HISTORIC DISTRICT
includes parts of Atlantic,
Burlington and Ocean Counties.

B. Standards for Designation.

The Pinelands Commission may designate additional historic, archaeological and cultural resources and districts if it determines one or more of the following:

1. The presence of structures, sites, or areas associated with events of significance to the cultural, political, economic or social history of the nation, state, local community or the Pinelands; or

2. The presence of structures, sites or areas associated with the lives of persons or institutions of significance to the cultural, political, economic or social history of the nation, state, local community or the Pinelands; or

3. The presence of structures which represent distinctive characteristics of a type, period or method of construction of significance to the cultural, political, economic or social history of the nation, state, local community or the Pinelands; or

4. The presence of a site or area which has yielded or is likely to yield significant information regarding the history or archaeological history of the Pinelands.

The Preservation Board or the Planning Board shall utilize these standards in designating areas, sites, structures or districts as resources of local significance.

C. Initiation of Designation.

The designation of historic, archaeological or cultural resources or districts of Pinelands significance may be initiated by the Pinelands Commission, the Executive Director, a Preservation Board, a Planning Board, or any other person.

D. Designation Application.

If the designation is proposed by a Preservation Board, a Planning Board or other person, the application shall be filed with the

Pinelands Commission. The application shall contain the following information:

1. A statement setting forth the basis for designation with specific reference to the standards set forth in Section 6-1404(A); *B*

2. One or more photographs, together with descriptive captions, illustrating the features of the proposal which support its designation;

3. A detailed description of the present and original, if known, physical appearance of any structure or site to be designated, including a detailed architectural description, if applicable;

4. Comments from the local planning board if the designation is proposed by a person who is not a member of the planning board;

5. Such additional information as may be required from time to time by the Pinelands Commission or applicable Planning or Preservation Board. *add Board, design!*

E. Review.

All proposed designations shall be reviewed and a public hearing held in the manner provided in Article 4 of this Plan [DEVELOPMENT REVIEW].

Section 6-1405.

Certificates of Appropriateness

A. General Requirement.

No construction, alteration, remodeling, removal or demolition of any structure, area or site designated in Section 6-1404(B), or as may be hereafter designated in accordance with the provisions of this Part, shall be permitted without first obtaining a certificate of appropriateness from the Planning Board.

B. Purpose.

The purpose for requiring a certificate of appropriateness is to provide a means for reviewing plans to alter, remodel, relocate, or demolish designated structures, areas or sites in order to ensure that such work will comply with the standards established to preserve the integrity of structures, areas, and sites which have been determined to merit special protection by designation.

C. Application for Certificate of Appropriateness.

An application for a certificate of ap-

appropriateness shall contain the following information:

1. Detailed plans depicting the exact work to be performed, including detailed renderings of the exterior of any proposed new structure or any exterior alterations to existing structures. A delineation of the relationship of the renderings of the proposal in relation to adjacent structures or surrounding lands may be requested.

2. A statement of the relationship of the proposed work to the standards for designation in Section 6-1404(B) [STANDARDS FOR DESIGNATION] and the standards for approval of certificates of appropriateness set forth in Section 6-1405(D) [STANDARDS FOR CERTIFICATES OF APPROPRIATENESS] hereof.

3. In the event the requested certificate of appropriateness, if issued, would permit the demolition of a designated structure, a detailed analysis of the economic feasibility of maintaining the structure in its present form, including the amount paid for the property; date of purchase; the current assessed value of the lands and improvements; real estate taxes for the previous two years; the annual debt service, if any, for the previous two years; gross income from property for the previous two years; and annual cash flow, if any.

4. A statement of measures to be taken to mitigate the adverse effects of the proposed work on a designated structure or area.

5. If the proposed work involves the disturbance of a designated archaeological site, a statement describing the mitigation program proposed and the qualifications of those professionals who will be conducting data recovery operations.

6. Such other information as may be required from time to time by the Executive Director, the Preservation Board or the Planning Board.

D. Standards for Certificates of Appropriateness.

The Preservation Board, or the Planning Board, as the case may be, shall consider the following in approving or disapproving applications for certificates of appropriateness:

1. The effect of the proposed work upon the purposes for which the designation was

originally granted, as set out in Section 6-1404(C) [APPLICATION FOR CERTIFICATES OF APPROPRIATENESS].

2. The extent of the alteration, destruction, or removal of the distinctive character or architectural features of the designated structure, including consideration of the harmony of materials, details, height, mass, proportion, rhythm, scale, setback, shape, street accessories, and workmanship.

3. The relationship of the designated site to the surrounding land and natural features.

4. The degree to which the proposed work would isolate the designated structures or area from their historical or architectural surroundings.

5. The degree to which the proposed work is compatible with the original design concept of the structure or with the general design characteristic of that era.

6. The degree to which the proposed building materials are compatible with the aesthetic and structural appearance of the designated structure or area, including the texture, style, color of the materials and the proposed combination of materials such as brick, stone, concrete, shingle, wood or stucco.

7. If the proposed work involves a designated archaeological site, the degree to which the proposed work disturbs the designated site or complies with the rules of the Department of the Interior governing the recovery of archaeological data, 43 C.F.R. §3 *et seq.*

8. If the proposed work involves the demolition of a designated structure, the degree to which the applicant has explored preservation options, such as the sale of the structure to an individual or group interested in preserving the structure.

9. The degree to which the proposed work is in conformity with the Department of the Interior's Standards for Historic Preservation Projects, 36 C.F.R. §1207 *et seq.*

E. Issuance of Certificate of Appropriateness.

The Preservation Board, or the Planning Board, may approve, disapprove or approve with conditions the issuance of a certificate of appropriateness upon determining that the

proposed plans are or are not in conformity with the standards set forth in Section 6-1405(D) [STANDARDS FOR CERTIFICATES OF APPROPRIATENESS].

F. Effect of Issuance of Certificate of Appropriateness.

The issuance of a certificate of appropriateness authorizes the applicant to apply for any additional approvals which may be required by the municipality or any other jurisdiction prior to the commencement of work. The issuance of a certificate of appropriateness may be appealed in accordance with Article 4, Part 8 [RECONSIDERATION AND JUDICIAL REVIEW] of this Plan.

Section 6-1406.

Emergency Provision

Notwithstanding any other provision of this Part, in any case where the Executive Director determines that alteration, remodeling, or demolition of a designated structure is necessary to remedy a condition that is dangerous to life, health or safety, a certificate of appropriateness which is required under the provisions of this Part may be issued under the signature of the Executive Director.

Section 6-1407.

Undesignated Historic and Archaeological Sites

A. A cultural resource survey shall accompany all applications for major development. Guidelines for this survey will be available at the principal offices of the Commission. In general, the survey shall include: a statement

as to the presence of any properties listed on the National and State Registers of Historic Places on the site or within the area of the project's potential environmental impacts; a thorough search of state, local and any other pertinent inventories to identify sites of potential cultural significance; a review of the literature and consultation with professional and avocational archaeologists knowledgeable about the area; a thorough pedestrian survey to provide reasonable evidence of the absence of archaeological resources, and a list of personnel involved and qualifications of the person(s) performing the survey.

B. An applicant for development approval in the Pinelands may request a letter of interpretation in order to determine the presence of significant archaeological sites on his property in accordance with the provisions of Article 4, Part 6 of this Plan.

C. Where archaeological or historic resources are present, the developer shall take all reasonable steps in planning his development to preserve the resource, or if on-site preservation is impractical, to protect the data in accordance with the guidelines established by the United States Department of the Interior, 43 C.F.R. §3 *et seq.* In addition, if at any time after construction has been commenced, archaeological data is discovered on a site, the developer shall immediately cease construction, notify the Commission and take all reasonable steps to protect the archaeological data in accordance with the guidelines established by the Department of the Interior governing the recovery of archaeological data.

ARTICLE 7

Amendments to the Comprehensive Management Plan

Section 7-101.

Purpose

This Part establishes a means for making changes in the text of this Plan and in the Land Capability Map. It is not intended to relieve particular hardships nor to confer special privileges or rights but is intended as a tool to adjust the provisions of this Plan and the Land Capability Map in light of changing, newly discovered or newly important conditions, situations or knowledge. The procedures established by this Part are designed to maximize public participation in the amendment process.

Section 7-102.

Authority for Amendments

The Commission may amend the text, maps, charts and illustrations of this Plan and the Land Capability Map after a public hearing and pursuant to the procedures set out in this Part and in the New Jersey Administrative Procedure Act, N.J.S.A. 52:14B-1 et seq. Amendments may be proposed by any member of the Commission, the Executive Director, any public agency, and, except in municipalities or counties with certified plans, any resident of the Pinelands Area or the owner of, or any person having a contractual interest in, any property in the Pinelands Area.

Section 7-103.

Petitions for Amendment

Any member of the Commission or the Executive Director may, at any time, submit to the Commission on his own initiative any proposed amendment for consideration. Any such submission shall include all information which the member of the Commission or Executive Director determines is necessary

or appropriate for full and proper consideration of the proposed amendment.

Any other person desiring to petition the Commission for an amendment to this Plan, in municipalities or counties with uncertified plans, shall file a petition with the Executive Director in such form and number as the Executive Director shall from time to time establish and containing at least the following information:

1. The petitioner's name and address;
2. The precise wording of any proposed amendment of the text of this Plan and a map or plat delineating any proposed change to the Pinelands Land Capability Map;
3. A statement of the need and justification for the proposed amendment;
4. A statement as to the conformity of any proposed amendment to this Plan or the reason for any deviation from the Plan;
5. In the event that the proposed amendment would change the classification of any property as shown on the Land Capability Map:
 - (a) the street address and legal description of the property proposed to be reclassified;
 - (b) the petitioner's interest in the subject property;
 - (c) the owner's name and address, if different from the petitioner's, and the owner's signed consent to the filing of the petition;
 - (d) the names and addresses of all owners of property required to be notified pursuant to Section 4-102(B);
 - (e) the present classification and existing uses of the property proposed to be reclassified; and
 - (f) the area of the property proposed

to be reclassified stated in square feet or acres, or fraction thereof.

Section 7-104.

Action by Executive Director

A. Review

Within thirty days of receipt of any petition for amendment filed pursuant to Section 7-103, the Executive Director shall review the petition and determine whether it raises substantial issues with respect to whether the proposed amendment should be adopted. If the Executive Director determines that such substantial issues are raised, he shall notify the Commission of his determination and that the petition is under consideration by the staff.

B. Notice

The Executive Director shall notify, by mail, the petitioner of all decisions made pursuant to Subsection (A) hereof.

Section 7-105.

Action by Commission

A. Decision to Review

Upon submission of any proposed amendment to the Commission by any member of the Commission or the Executive Director, the Commission shall determine whether a hearing should be held for the purpose of considering the proposed amendment. If the Commission determines that a hearing should be held, it shall conduct a hearing pursuant to the provisions of Section 4-103 [COMMISSION HEARING PROCEDURES] of this Plan and the New Jersey Administrative Procedure Act, N.J.S.A. 52:14B-1 et seq., at which the proposed amendment shall be considered. If it determines that no hearing need be held, it shall so order.

B. Final Decision by Commission

Within thirty days of the conclusion of any hearing held pursuant to Subsection (A) hereof, the Commission shall enter a final order either granting or denying the proposed amendment.

Section 7-106.

**Submission to
Pinelands Municipal Council**

All proposed amendments shall, at least

sixty days prior to any meeting at which the Commission will consider such amendment, be submitted by the Executive Director to the Pinelands Municipal Council for its review and recommendation.

Section 7-107.

Submission to Governor and Legislature

All amendments adopted by the Commission pursuant to Section 7-105(B) shall be submitted to the Governor and the Legislature within seven days of adoption.

Section 7-108.

Filing with Secretary of State

Any amendment adopted by the Commission shall be filed with the Secretary of State as required by N.J.S.A. 52:14B-5.

Section 7-109.

**Submission to Secretary
of the United States Department
of the Interior**

Any amendment to this Plan shall, within five days following adoption by the Commission, be submitted to the Secretary of the United States Department of the Interior.

Section 7-110.

Effective Date of Amendments

Amendments to this Plan shall be effective as provided in the Pinelands Protection Act and the Federal Act.

Section 7-111.

**Comprehensive Review
of Plan by Commission**

At least every three years after the adoption of this Plan, the Executive Director shall comprehensively review the Plan and all actions taken by the Commission or the Executive Director pursuant to Article 4 [DEVELOPMENT REVIEW] of the Plan and shall submit a report to the Commission detailing any recommended amendments to the Plan. Such report shall be submitted by January 15 of every third year after adoption of this Plan and shall include an explanation of the reasons for any recommended amendment.

ARTICLE 8
Enforcement

Section 8-101.
Enforcement

A. Civil Enforcement

In the event that any building or structure is erected, constructed, altered, repaired, converted or maintained or any building, structure or land is used in violation of this Plan, or in the event that construction is commenced on any building or structure in violation of this Plan, the Commission may, in addition to other remedies, institute any appropriate action or proceedings to prevent such unlawful erection, construction, reconstruction, alteration, repair, conversion, maintenance or use, to restrain, correct or abate such violation, to prevent completion

of construction of said building or structure, to prevent the occupancy of said building, structure or land or to prevent any illegal act, conduct, business or use in or about such premises.

B. Emergency Enforcement

If the Executive Director determines that any action provided for in Subsection (A) hereof need be initiated immediately in order to protect the Pinelands Area or the jurisdiction or authority of the Commission, he may initiate such action on behalf of the Commission and he shall notify the Commission of any action taken pursuant to this Subsection.

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Appendices

APPENDIX 1

Consultants to the Commission and Report Titles

Betz, Converse, Murdoch Inc., Plymouth Meeting, Pa.

- *Summary of Pinelands Surface Hydrology*
- *Flood Hazard Area Information, Issues, and Management Alternatives*
- *Inventory and Assessment of Surface Water Quantity*
- *Potential Impact of Development on Flow Regimes*
- *Summary of Pinelands Water Quality*
- *Surface Water Uses*
- *Criteria and Needs for Water Uses*
- *Water Quality Index*
- *Drainage Basin Assessment*
- *Land use/Water Quality Effects*
- *Controls for Nonpoint Pollution Sources*
- *Hydrogeology Assessment* (subcontract with Geraghty & Miller, Inc., Syosset, N.Y.)

South Jersey Resource Conservation and Development Council, Hammonton, N.J.

The Council prepared and interpreted soils base maps.

Kirk W. Brown, Bryan, Tex.

- *An Assessment of the Impact of Septic Leach Fields, Home Lawn Fertilization and Agricultural Activities on Groundwater Quality*

DSI Environmental Engineers, Boston, Mass.

- *Assessment of Innovative and Alternative Technologies for On-Site Wastewater Disposal*
- *A Procedure for Evaluating Environmental Impacts of Alternative Technologies*
- *Standards and Criteria for the Design and Maintenance of On-Site Wastewater Treatment Systems*

Andropogon Associates, Philadelphia, Pa.

- *Forest Vegetation of the Pinelands*

Center for Coastal and Environmental Studies, Rutgers University

- *Threatened and Endangered Vascular Plant Species of the New Jersey Pinelands and Their Habitats*

Conservation and Environmental Studies Center, Inc., Whitesbog, N.J.

- *Reptiles and Amphibians of the New Jersey Pinelands*

New Jersey Audubon Society

- *An Assessment of the Birdlife of the Pinelands National Reserve*

T. Lloyd Associates, Absecon, N.J.

- *Aquatic Ecology of the New Jersey Pinelands*

New Jersey Department of Environmental Protection

- *An Assessment of the Game Mammals and Birds and Small Mammals of the Pinelands* (Division of Fish, Game, and Wildlife)
- *Forestry and The Pinelands* (Bureau of Forest Management)
- *Fire Management Plan for The Pinelands* (Bureau of Forest Fire Management)
- *Air Quality Assessment of the New Jersey Pinelands* (Division of Environmental Quality)
- *Pinelands Recreation Program* (Task force report)

Monmouth College Department of Anthropology and Sociology

- *An Inventory and Assessment of Prehistoric Archaeological Resources in the New Jersey Pinelands*

Barbara Liggett, Philadelphia, Pa., and Budd Wilson, Green Bank, N.J.

- *Historical Archaeological Resources of the Pinelands* (inventory)

John W. Sinton, Stockton State College, Pomona, N.J.

- *An Inventory of Historic and Cultural Resource of the New Jersey Pinelands*

Jonathan Berger, University of Pennsylvania, Philadelphia, Pa.

- *Planning the Use and Management of the Pinelands: A Historical, Cultural, and Ecological Perspective*

Alan Mallach Associates, Philadelphia, Pa. and Trenton, N.J.

- *Land Market and Land Development Trends in the Pinelands*
- *Case Study Materials on Pinelands Growth Factors*
- *Growth Shapers*
- *Population Trends and Demand Pressures in the Pinelands*
- *Social and Economic Factors Capable of Influencing Pinelands Development*

Ross, Hardies, O'Keefe, Babcock, & Parsons, Chicago, Ill.

The following five volumes regarding land management techniques and programs were produced:

- (1) *Introduction, Summary and Analysis*
- (2) *Organizational, Structural and Procedural Elements*
- (3) *Substantive Elements*
- (4) *The Foreign Experience*
- (5) *The Taking Issue and Vested Rights*

This firm produced a separate background volume, *Local and State Regulations of Potential Relevance for the New Jersey Pinelands*, and drafted Part II of the Comprehensive Management Plan.

Rogers, Golden & Halpern, Philadelphia, Pa.

- *Critical Areas Study for the Pinelands*

Government Finance Associates Inc., Princeton, N.J.

- *Report to the Pinelands Commission Regarding Payment In Lieu of Taxes*
- *Report on a Financial Management Plan for the Pinelands Commission*

Gloria Christian, Avenel, N.J.

- *Study Area: Land Acquisition Cost Analysis*

Comitta Frederick Associates, West Chester, Pa.

- *Recreational Component of the New Jersey Pinelands Comprehensive Management Plan*

Beryl Robichaud, Rutgers University, New Brunswick, N.J.

- *A Conceptual Framework for Decision Making—A Report to the Pinelands Commission*

APPENDIX 2

Municipalities in the Pinelands

Atlantic County

Brigantine City**
Buena Borough
Buena Vista Township
Corbin City
Egg Harbor City*
Egg Harbor Township
Estell Manor City
Folsom Borough
Galloway Township*
Hamilton Township
Hammonton Town*
Mullica Township*
Port Republic City*
Weymouth Township

Burlington County

Bass River Township*
Evesham Township
Medford Lakes Borough
Medford Township*
New Hanover Township
North Hanover Township
Pemberton Township*
Shamong Township*
Southampton Township
Springfield Township
Tabernacle Township*
Washington Township*
Woodland Township*
Wrightstown Borough

Camden County

Berlin Borough
Berlin Township
Chesilhurst Borough
Waterford Township*
Winslow Township*

Cape May County

Dennis Township
Middle Township**
Upper Township
Woodbine Borough

Cumberland County

Maurice River Township
Vineland City

Gloucester County

Franklin Township
Monroe Township

Ocean County

Barnegat Township*
Beachwood Borough
Berkeley Township*
Dover Township**
Eagleswood Township*
Tuckerton Borough**
Jackson Township*
Lacey Township*
Lakehurst Borough
Little Egg Harbor Township
Manchester Township*
Ocean Township
Plumsted Township*
South Toms River Borough
Stafford Township*

*Municipalities totally or partially in the Preservation Area

**Municipalities in the Pinelands National Reserve only

APPENDIX 3

Cartography

All color maps in this document were prepared by Rogers, Golden & Halpern with the exception of the base map as indicated. Graphics for Plate 3 were also drafted by Rogers, Golden & Halpern.

All maps were compiled at a scale of 1:125,000 from maps and data generated by consultants and the Pinelands Commission staff as referenced below. The 1:125,000 scale maps were photographically reduced approximately 2.8 times for inclusion in the report.

Following is a list of credits for Plates 1-28 and the base map.

Plate Number	Source
Base Map	USGS 1:100,000 County Series; New Jersey Official Highway Maps, NJDOT; "Pinelands Region," Pinelands Environmental Council. Cartography by Pinelands Commission staff.
1	USGS 7.5 minute quadrangles with Pinelands Protection Act boundaries prepared by NJDEP, Bureau of Geology and Topography
2	NJDEP Bureau of Geology and Topography. Geologic Overlay sheets 28, 29, 30, 31, 32, 33, 35 and 36. Legend categories and base map information were revised for consistency by Rogers, Golden & Halpern.
3	Interpretation of USGS well logs and state and county well records by Geraghty & Miller, Inc.
4	Map and well log interpretation by Geraghty & Miller, Inc. Depth of unsaturated zone contours are inferred from well readings and NJDEP Topographic Atlas Sheets 28, 29, 31, 32, 33, 35, and 36.
5	USGS 7.5 minute quadrangles with watersheds added by NJDEP Division of Water Resources; Water Resources Data for New Jersey Volumes 1 and 2, USGS Water Data Report NJ-78-1 and NJ-78-2. Major watersheds were identified from the maps by the Commission staff and Rogers, Golden & Halpern. Water quality stations were mapped by Betz, Converse and Murdoch, Inc.
6-9	USDA, SCS Soil Surveys: Atlantic County, April, 1978; Burlington County, October 1971; Camden County, April 1966; Cape May County, February 1977; Cumberland County, April, 1978; Gloucester County, June, 1962; Ocean County (Interim Soil Survey Report), October 1978. Soil survey maps were compiled in 7.5 minute quadrangle format at 1:24,000 by the South Jersey Resource Conservation & Development Council. Soil interpretations were provided by SCS and the Commission staff and were mapped by Rogers, Golden & Halpern.
10	Aerial photo interpretation by Andropogon Associates using 1:12,000 true color photography from November 1978 and March 1979. "Old Mapping" indicates three flight lines not available for which the vegetation mapping prepared by Jack McCormick and Leslie Jones in 1973 was used.
11	Interpretation by NJDEP Bureau of Forest Fire Management. Plate 10—Vegetation.
12	Watershed aquatic assessment and classification by T. Lloyd Associates. Mapping is based on watershed map compiled by Rogers, Golden & Halpern. (See Plate 5 credits)
13	Prehistoric archaeological resources from "An Inventory and Assessment of Prehistoric Archaeological Resources in the New Jersey Pinelands: Phase 1 of a Regional Predictive Survey," by Alan Mounier and Jahn Cavallo, 1980.
14	Budd Wilson, Richard Regensberg, and Barbara Liggett based on their report to the Commission, February 28, 1980.
15	Field reconnaissance and interviews by Jonathan Berger et al., Department of Landscape Architecture and Regional Planning, University of Pennsylvania.
16	Aerial photography interpretation by the Commission staff.
17	County and municipal sewer plans. Compiled by Commission staff.
18	County and municipal water plans. Compiled by Commission staff.

- 19 Solid waste plans prepared by Pinelands area solid waste management districts.
- 20 New Jersey Official Highway Maps, NJDOT.
- 21 Public lands boundaries taken from Division of Parks and Forestry delineations on USGS 7 ½ minute quad maps.
- 22 Aerial photo interpretations by Commission staff.
- 24-26 Alan Mallach Associates, "Population Trends and Demand Pressures in the Pinelands" and "Social and Economic Factors Affecting Pinelands Development," 1980. Analysis and mapping by Alan Mallach Associates.
- 27 Rogers, Golden & Halpern, "New Jersey Pinelands Critical Area Study," 1980
- 28 Analysis by Commission staff. Coordination by Rogers, Golden & Halpern.

LIST OF PLATES

- 1 Pinelands Area Jurisdiction Boundaries
- 2 Surficial Geology
- 3 NW-SE Geologic Cross-Section
- 4 Hydrogeologic Features
- 5 Surface Water Hydrology
- 6 Agricultural Soils
- 7 Depth to Seasonal High Water Table
- 8 Hydrologic Soil Groups
- 9 Soil Factors Limiting Use of Septic Tank Absorption Fields
- 10 Vegetation
- 11 Wildland Fire Hazard Classification
- 12 Watersheds Supporting Characteristic Pinelands Aquatic Communities
- 13 Prehistoric Archaeological Resources
- 14 Historic Archaeological and Architectural Resources
- 15 Cultural Subregions
- 16 Land Use
- 17 Sewer Service Areas
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- 19 Solid Waste Disposal Sites
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- 24 Growth Scenario A: Unconstrained Growth at Moderately High Levels
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- 27 Ecological Critical Area Importance Values
- 28 Land Capability

Key to Plate 21—Major Public Land Holdings

Federal

- F-1 Barnegat National Wildlife Refuge
- F-2 Brigantine National Wildlife Refuge
- F-3 Fort Dix Military Reservation
- F-4 McGuire Air Force Base
- F-5 Naval Air Engineering Center at Lakehurst
- F-6 Warren Grove Target Area (leased land)
- F-7 Federal Aviation Administration Technical Center

State

- S-1 Wharton State Forest
- S-2 Winslow Fish and Wildlife Management Area
- S-3 Hammonton Lake Natural Area
- S-4 Colliers Mills Fish and Wildlife Management Area
- S-5 State Quail Farm
- S-6 Jackson State Forest
- S-7 Lebanon State Forest
- S-8 Pasadena Fish and Wildlife Management Area
- S-9 Manchester Fish and Wildlife Management Area
- S-10 Double Trouble State Park
- S-11 Penn State Forest
- S-12 Greenwood Forest Fish and Wildlife Management Area
- S-13 Warren Grove Recreation Area
- S-14 State Game Farm (Forked River)
- S-15 Island Beach State Park
- S-16 Bass River State Forest
- S-17 Manahawkin Fish and Wildlife Management Area
- S-18 Green Bank State Forest
- S-19 Swan Bay Fish and Wildlife Management Area
- S-20 Port Republic Fish and Wildlife Management Area
- S-21 Peaslee Fish and Wildlife Management Area
- S-22 Belleplain State Forest
- S-23 Lester G. McNamara Fish and Wildlife Management Area
- S-24 Heislerville Fish and Wildlife Management Area
- S-25 Dennis Creek Fish and Wildlife Management Area
- S-26 Absecon Fish and Wildlife Management Area
- S-27 Beaver Swamp Fish and Wildlife Management Area
- S-28 North Brigantine Natural Area
- S-29 Great Bay Fish and Wildlife Management Area
- S-30 Stafford Forge Wildlife Management Area
- S-31 Whiting Wildlife Management Area
- S-32 Coyle Field
- S-33 Leesburg State Prison
- S-34 Woodbine State School
- S-35 Stockton State College
- S-36 Ancora Psychiatric Hospital
- S-37 New Lisbon State School

County

- C-1 New Brooklyn County Park
- C-2 Miller Airpark and Recreation Area
- C-3 Estell Manor County Park
- C-4 Burlington County College
- C-5 Atlantic Community College

NEW JERSEY PINELANDS

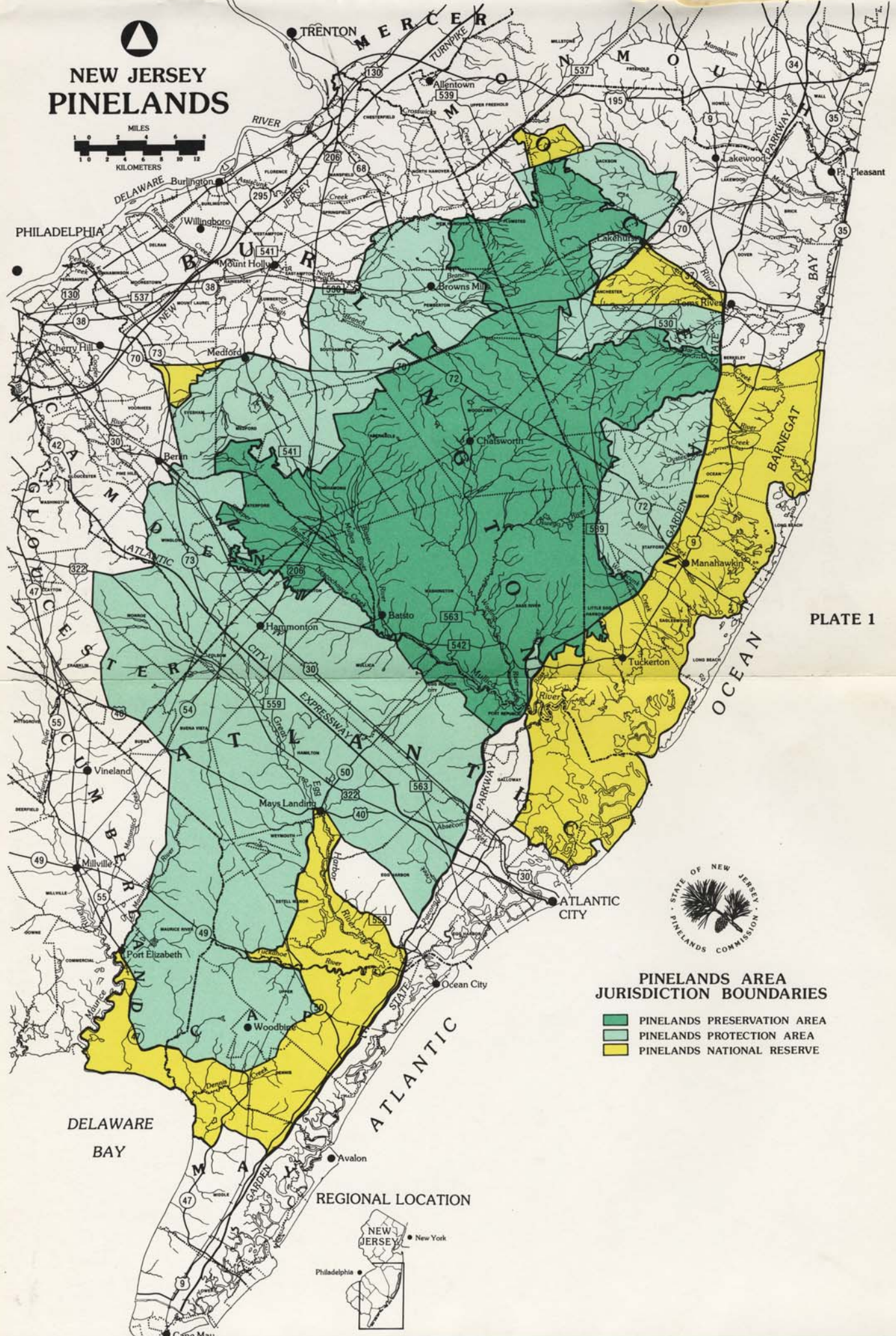


PLATE 1



PINELANDS AREA JURISDICTION BOUNDARIES

- PINELANDS PRESERVATION AREA
- PINELANDS PROTECTION AREA
- PINELANDS NATIONAL RESERVE

DELAWARE BAY

REGIONAL LOCATION



BAY

ATLANTIC

OCEAN

NEW JERSEY PINELANDS

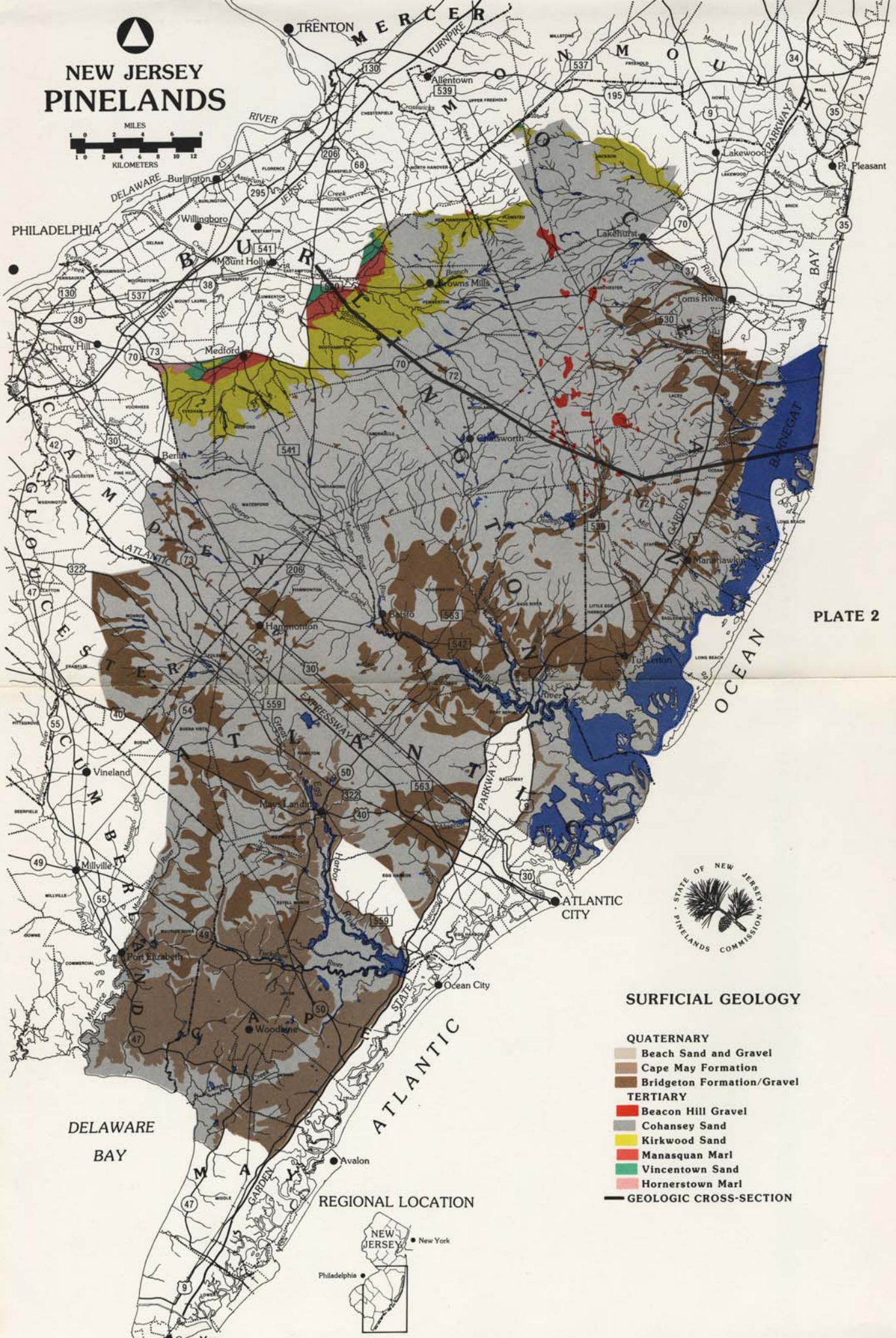


PLATE 2



SURFICIAL GEOLOGY

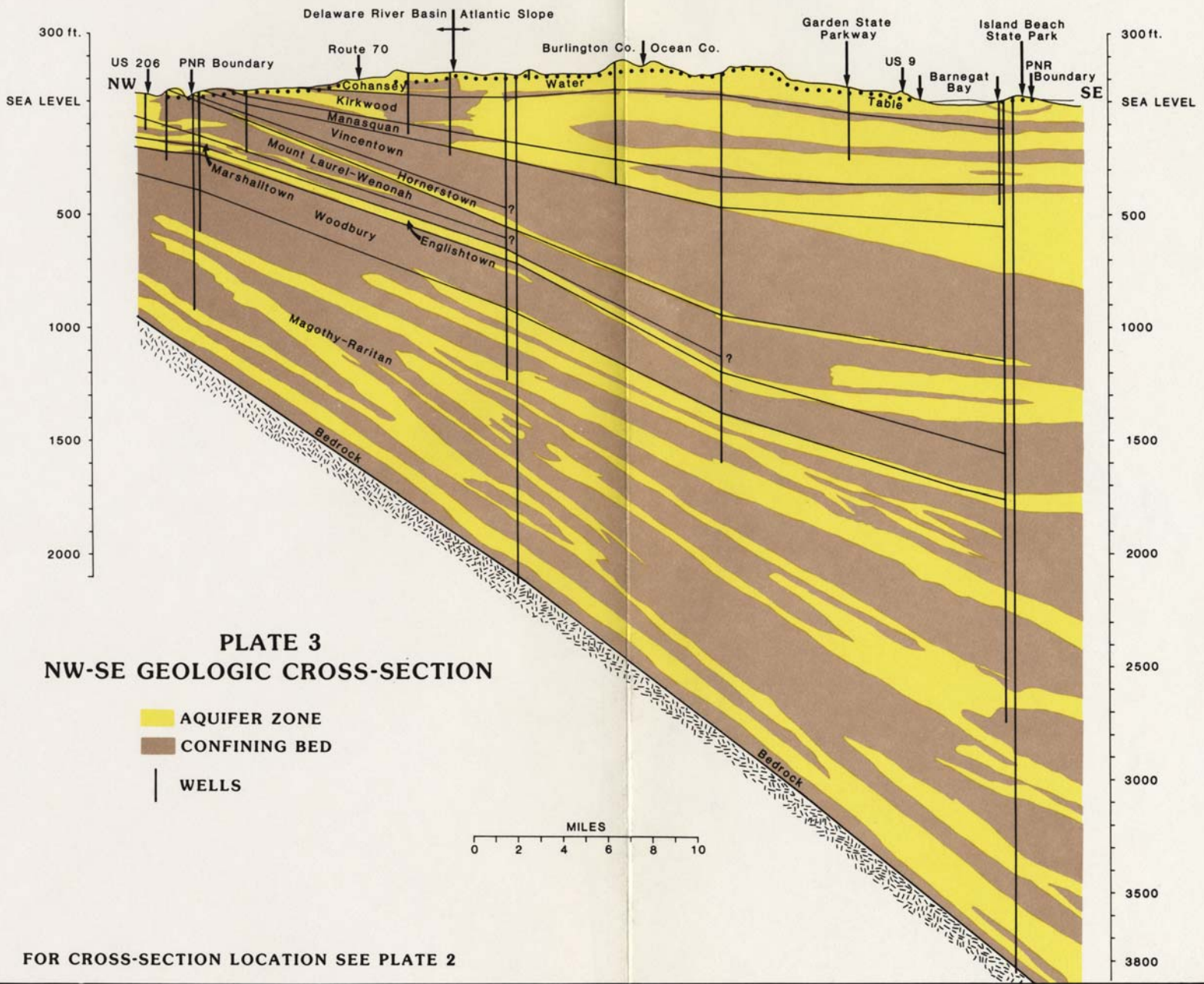
- QUATERNARY**
 - Beach Sand and Gravel
 - Cape May Formation
 - Bridgeton Formation/Gravel
- TERTIARY**
 - Beacon Hill Gravel
 - Cohansey Sand
 - Kirkwood Sand
 - Manasquan Marl
 - Vincentown Sand
 - Hornerstown Marl
- GEOLOGIC CROSS-SECTION

REGIONAL LOCATION



DELAWARE BAY

ATLANTIC OCEAN



NEW JERSEY PINELANDS

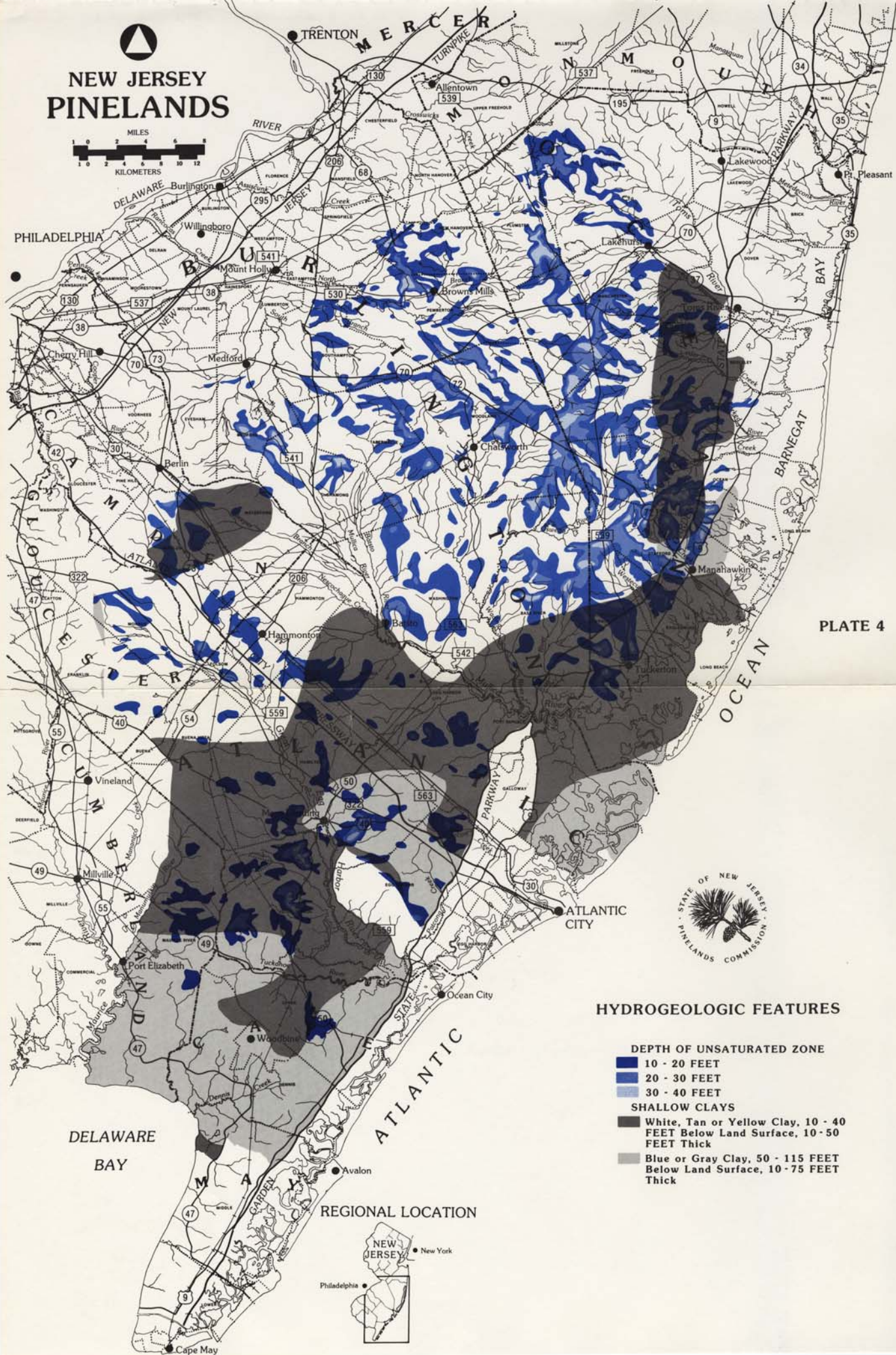


PLATE 4



HYDROGEOLOGIC FEATURES

- DEPTH OF UNSATURATED ZONE**
- 10 - 20 FEET
 - 20 - 30 FEET
 - 30 - 40 FEET
- SHALLOW CLAYS**
- White, Tan or Yellow Clay, 10 - 40 FEET Below Land Surface, 10 - 50 FEET Thick
 - Blue or Gray Clay, 50 - 115 FEET Below Land Surface, 10 - 75 FEET Thick

REGIONAL LOCATION



DELAWARE BAY

ATLANTIC OCEAN

NEW JERSEY PINELANDS

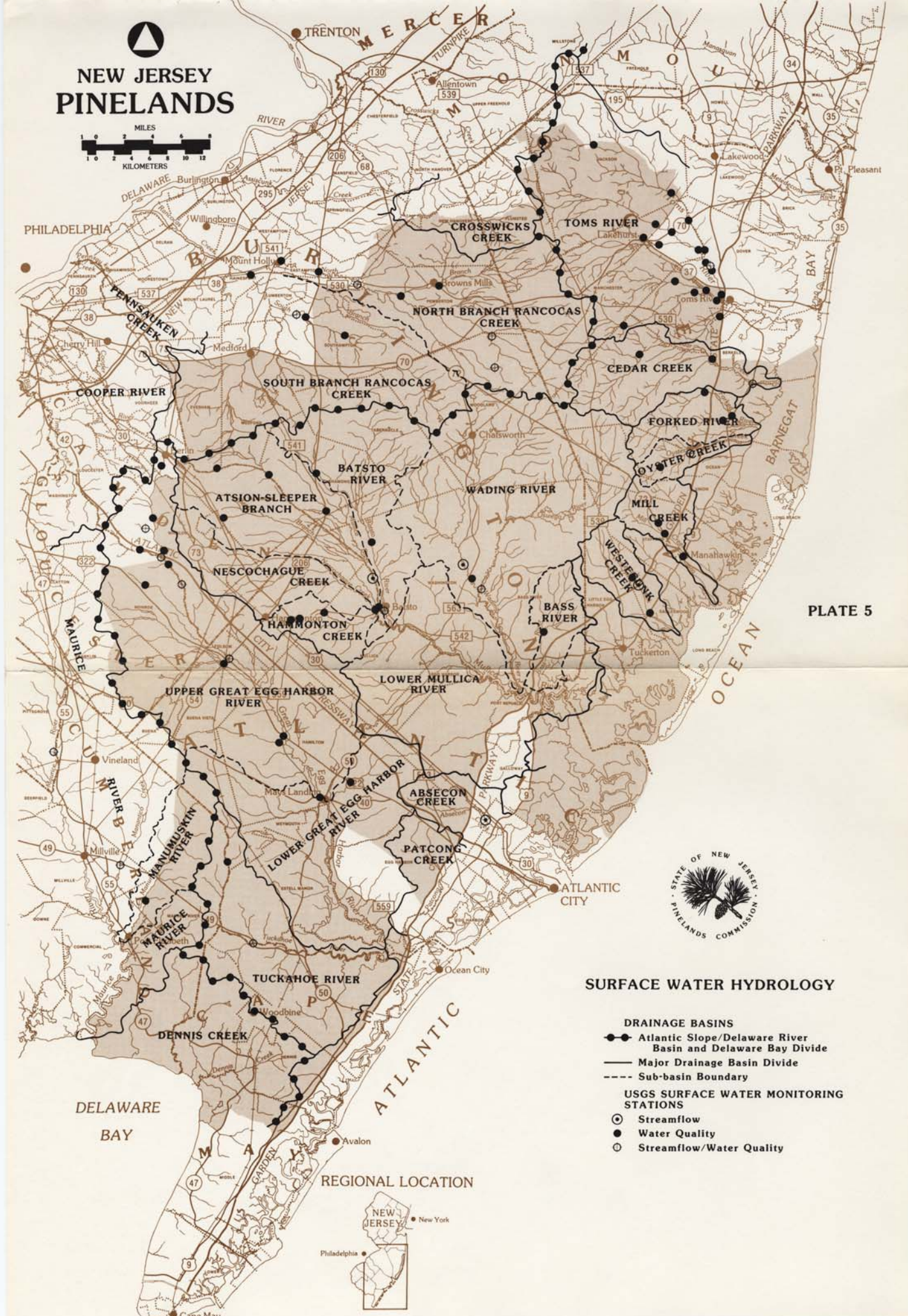


PLATE 5



SURFACE WATER HYDROLOGY

- DRAINAGE BASINS**
- Atlantic Slope/Delaware River Basin and Delaware Bay Divide
 - Major Drainage Basin Divide
 - - - Sub-basin Boundary
- USGS SURFACE WATER MONITORING STATIONS**
- Streamflow
 - Water Quality
 - Streamflow/Water Quality

REGIONAL LOCATION



DELAWARE BAY

ATLANTIC OCEAN

NEW JERSEY PINELANDS

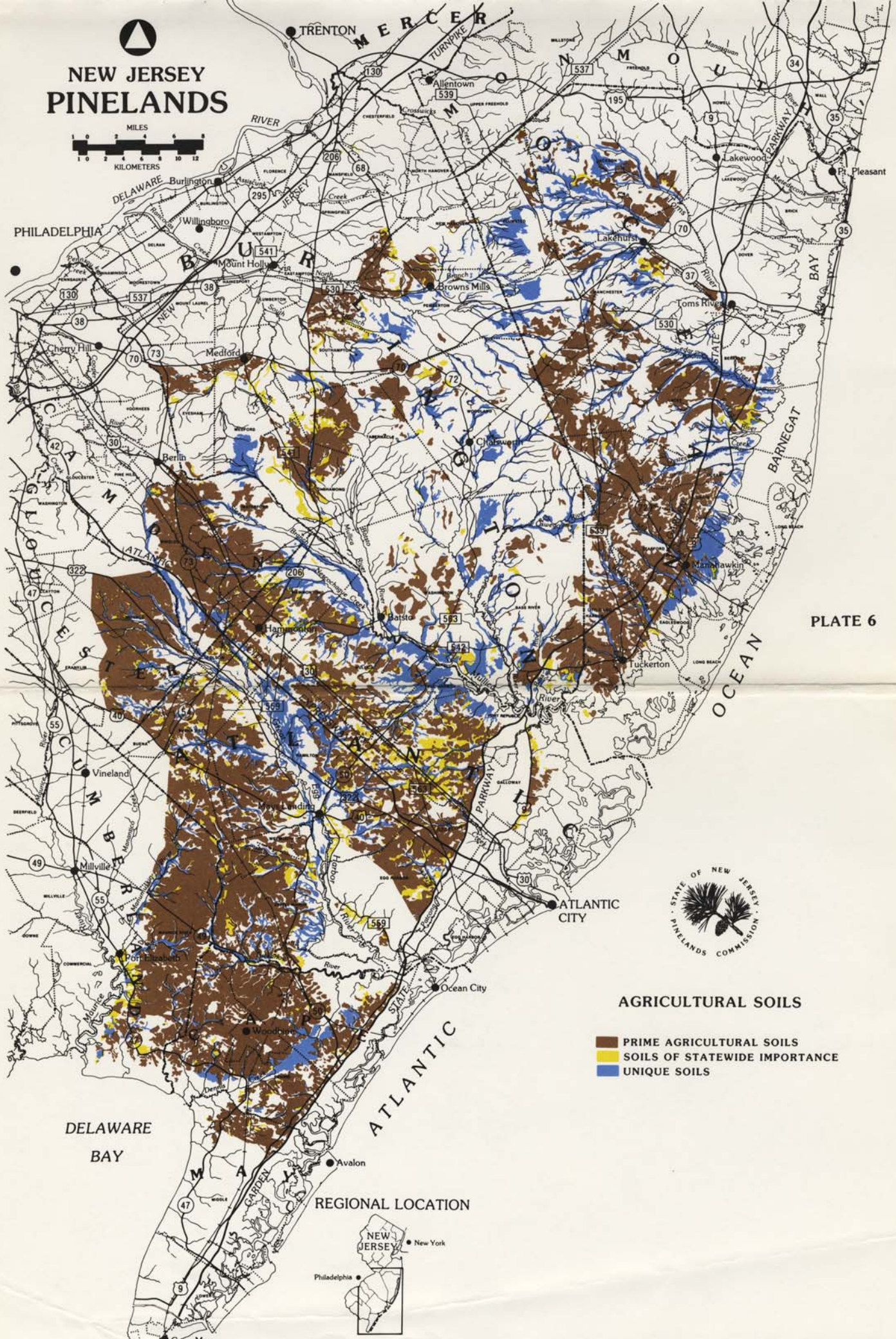


PLATE 6



AGRICULTURAL SOILS

- PRIME AGRICULTURAL SOILS
- SOILS OF STATEWIDE IMPORTANCE
- UNIQUE SOILS

DELAWARE BAY

REGIONAL LOCATION



NEW JERSEY PINELANDS

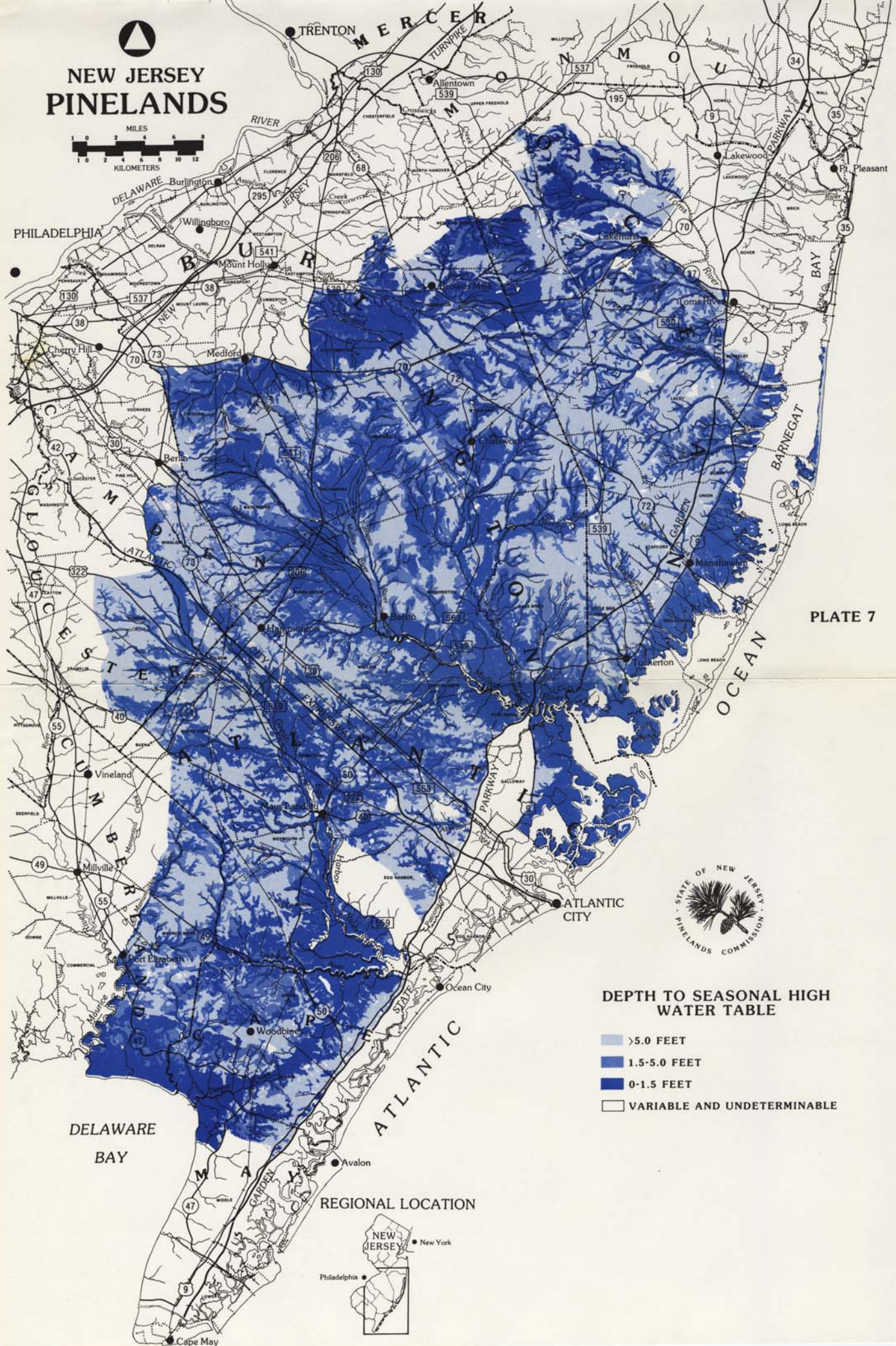


PLATE 7



DEPTH TO SEASONAL HIGH WATER TABLE

- >5.0 FEET
- 1.5-5.0 FEET
- 0-1.5 FEET
- VARIABLE AND UNDETERMINABLE

DELAWARE BAY

REGIONAL LOCATION



NEW JERSEY PINELANDS

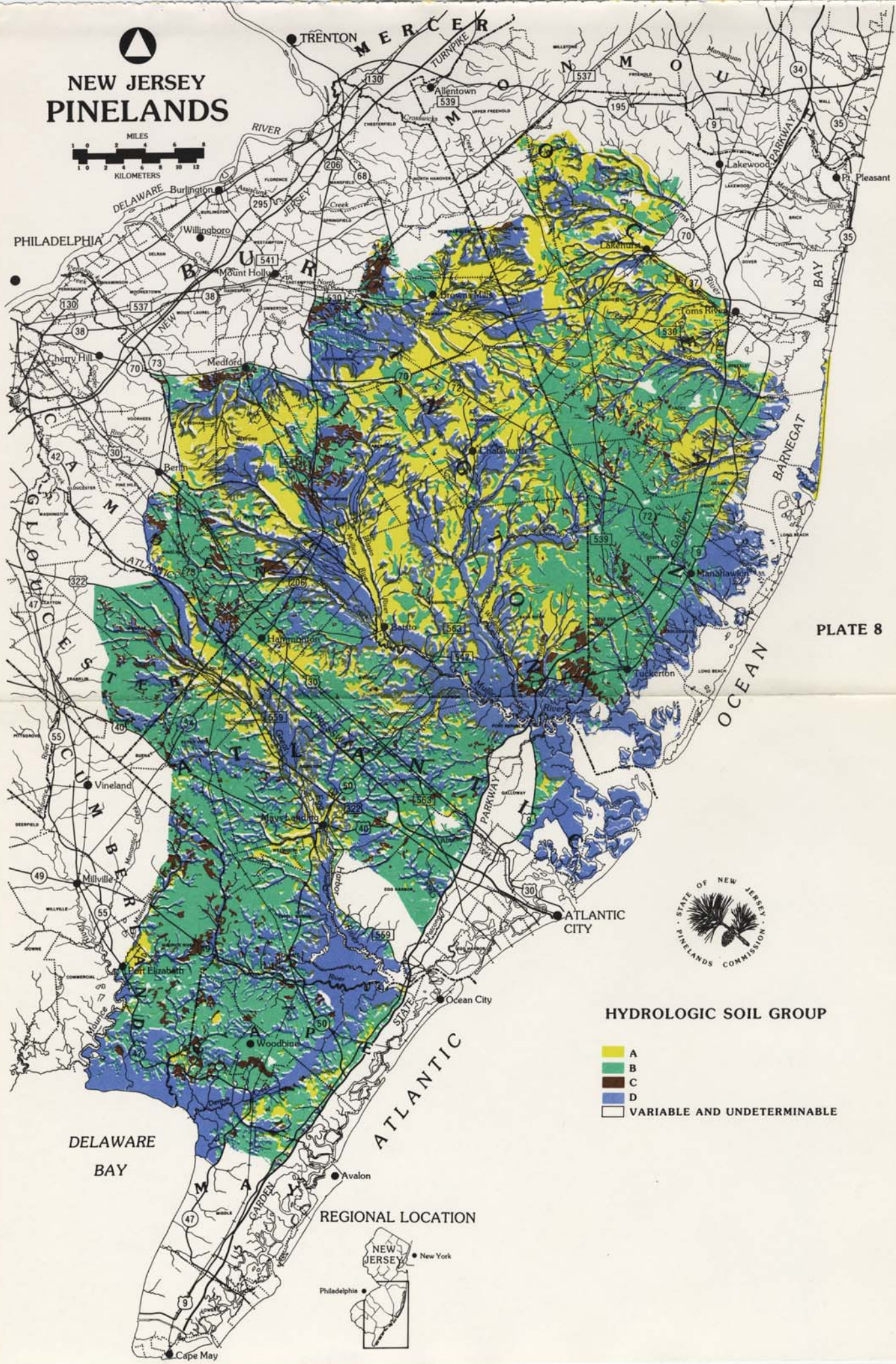


PLATE 8



HYDROLOGIC SOIL GROUP

- A
- B
- C
- D
- VARIABLE AND UNDETERMINABLE

REGIONAL LOCATION



DELAWARE BAY

ATLANTIC OCEAN

NEW JERSEY PINELANDS

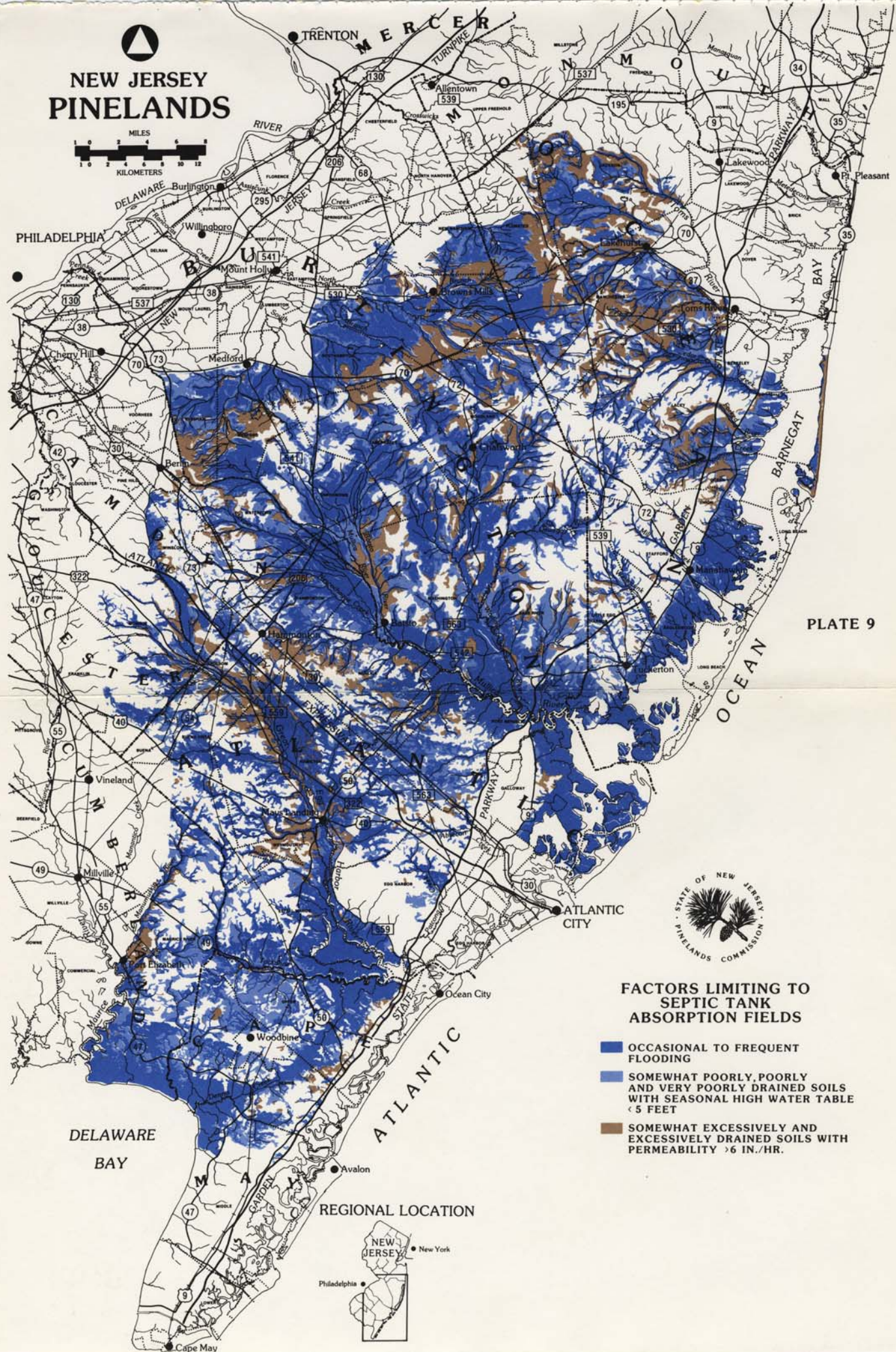


PLATE 9



FACTORS LIMITING TO SEPTIC TANK ABSORPTION FIELDS

- OCCASIONAL TO FREQUENT FLOODING
- SOMEWHAT POORLY, POORLY AND VERY POORLY DRAINED SOILS WITH SEASONAL HIGH WATER TABLE < 5 FEET
- SOMEWHAT EXCESSIVELY AND EXCESSIVELY DRAINED SOILS WITH PERMEABILITY > 6 IN./HR.

REGIONAL LOCATION



DELAWARE BAY

ATLANTIC OCEAN

NEW JERSEY PINELANDS

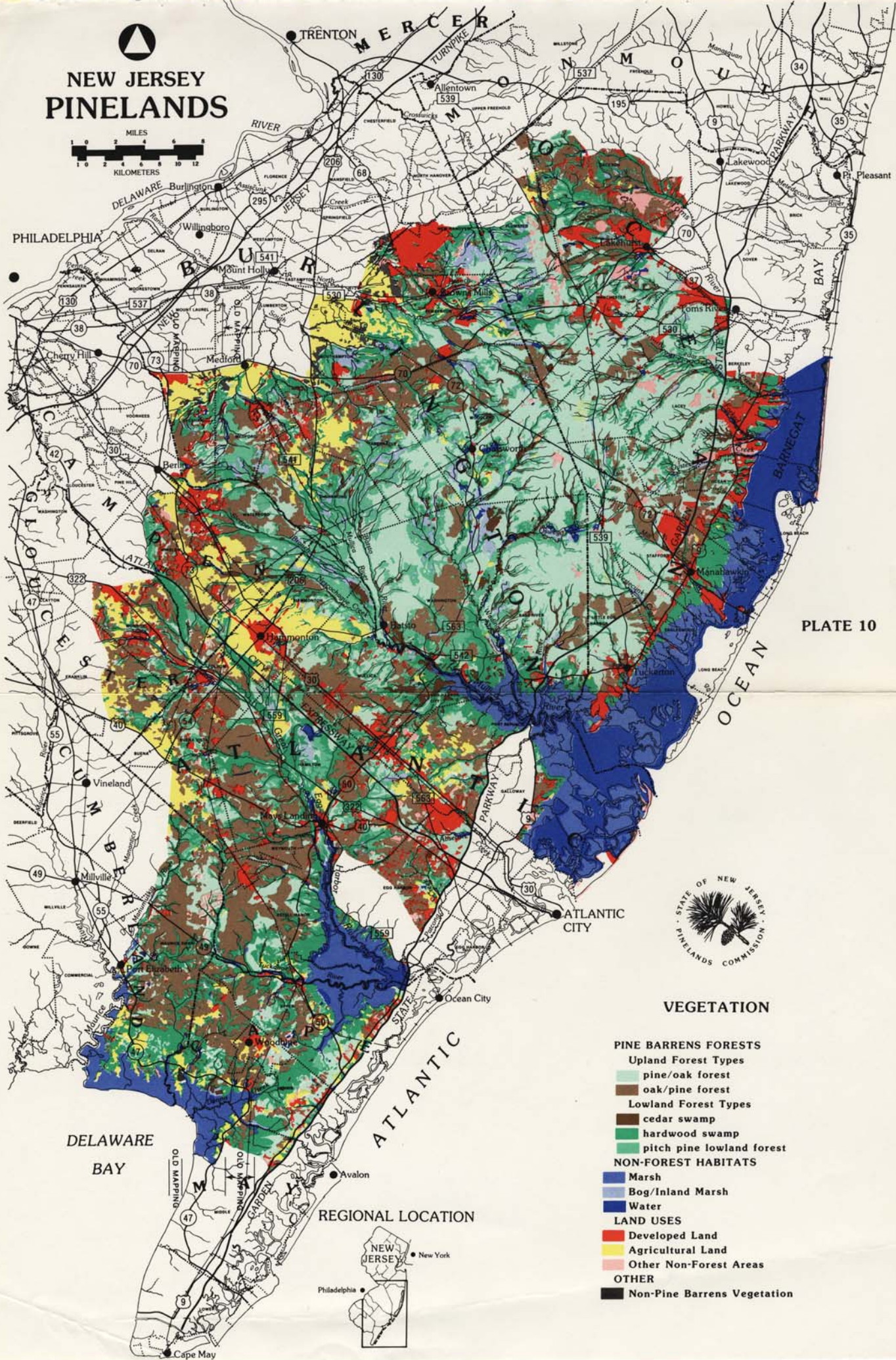


PLATE 10



VEGETATION

- PINE BARRENS FORESTS**
- Upland Forest Types**
- pine/oak forest
- oak/pine forest
- Lowland Forest Types**
- cedar swamp
- hardwood swamp
- pitch pine lowland forest
- NON-FOREST HABITATS**
- Marsh
- Bog/Inland Marsh
- Water
- LAND USES**
- Developed Land
- Agricultural Land
- Other Non-Forest Areas
- OTHER**
- Non-Pine Barrens Vegetation

REGIONAL LOCATION



NEW JERSEY PINELANDS

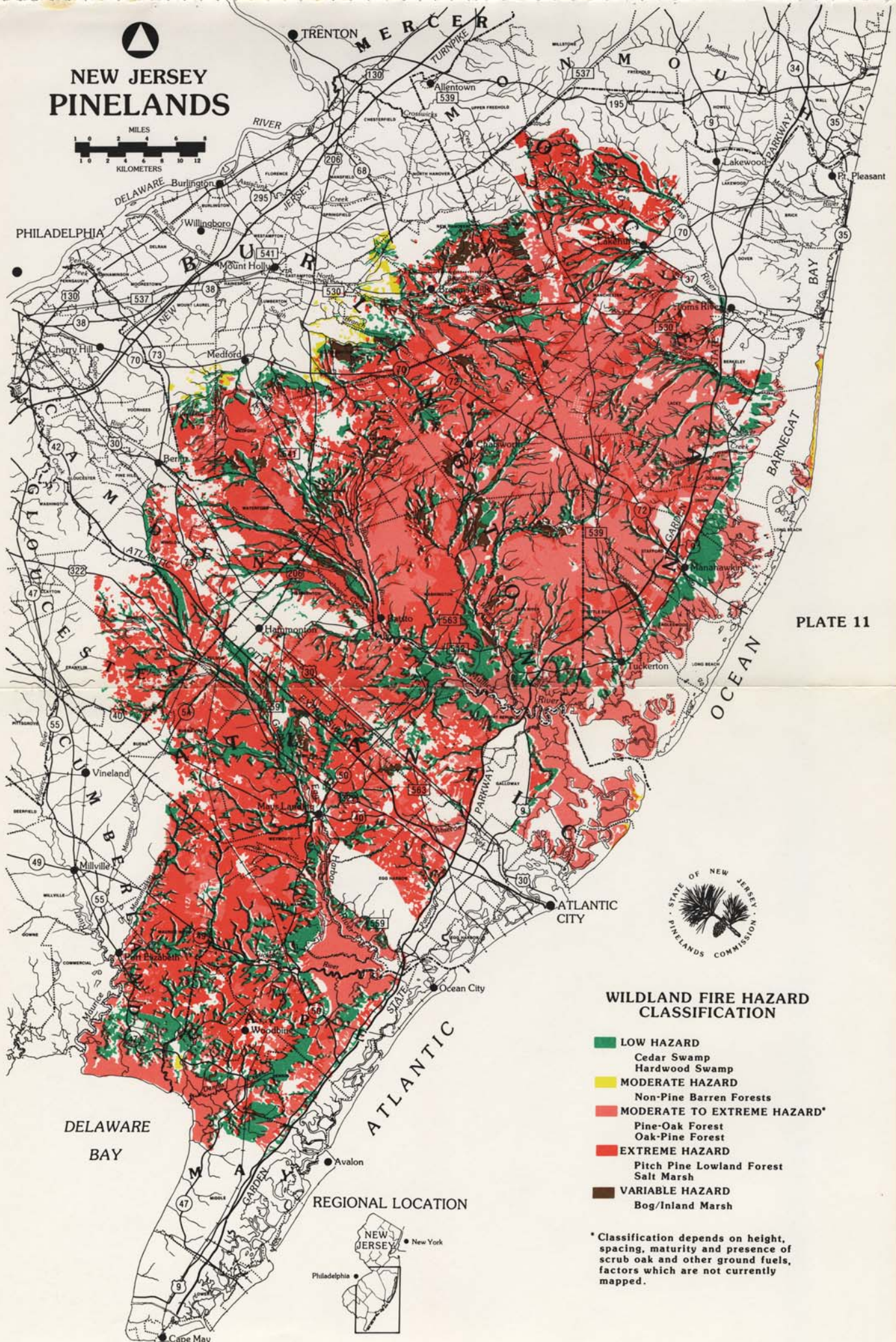


PLATE 11



WILDLAND FIRE HAZARD CLASSIFICATION

- **LOW HAZARD**
Cedar Swamp
Hardwood Swamp
- **MODERATE HAZARD**
Non-Pine Barren Forests
- **MODERATE TO EXTREME HAZARD***
Pine-Oak Forest
Oak-Pine Forest
- **EXTREME HAZARD**
Pitch Pine Lowland Forest
Salt Marsh
- **VARIABLE HAZARD**
Bog/Inland Marsh

* Classification depends on height, spacing, maturity and presence of scrub oak and other ground fuels, factors which are not currently mapped.

DELAWARE BAY

ATLANTIC OCEAN

REGIONAL LOCATION



NEW JERSEY PINELANDS

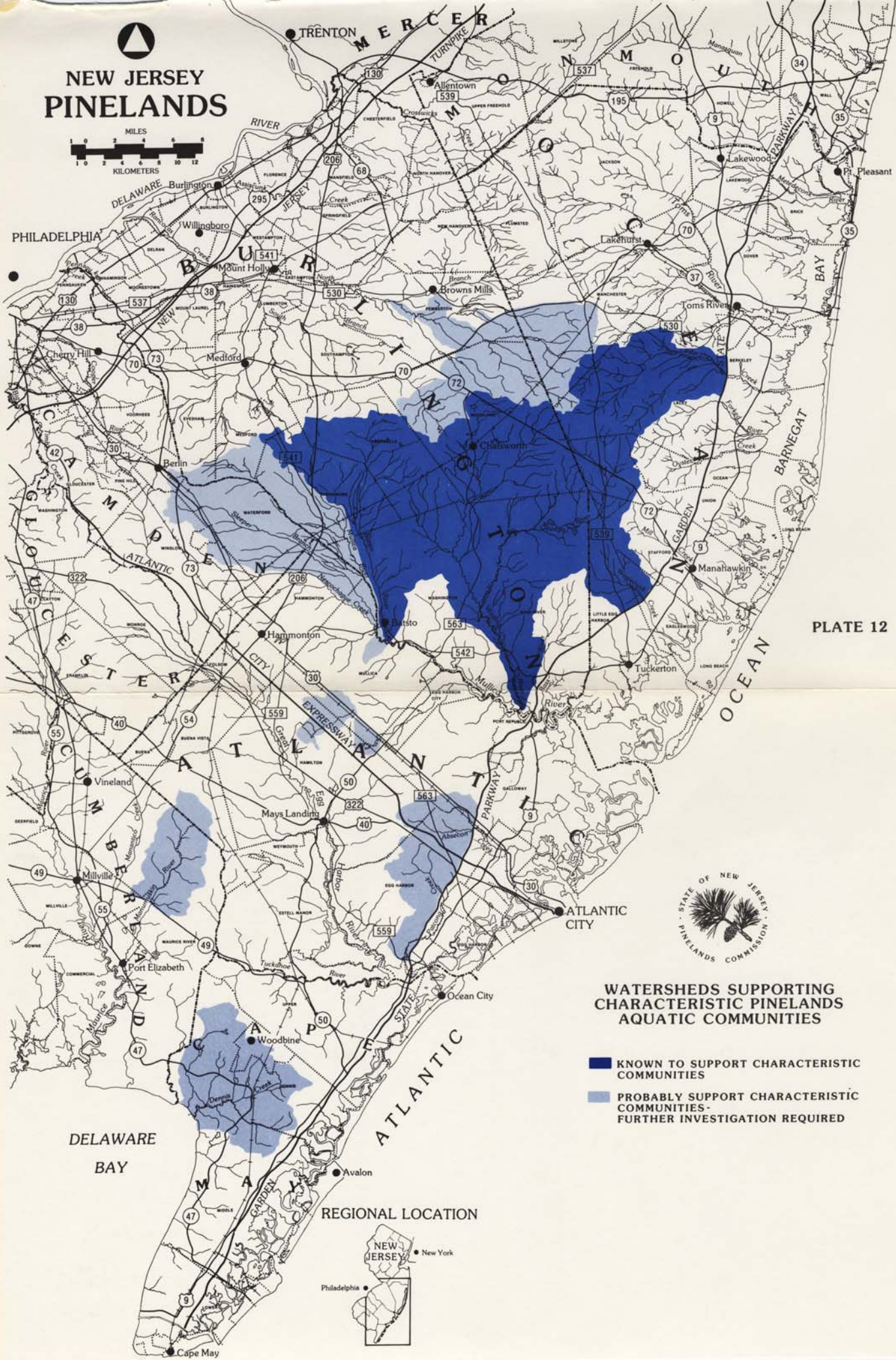


PLATE 12



WATERSHEDS SUPPORTING CHARACTERISTIC PINELANDS AQUATIC COMMUNITIES

- KNOWN TO SUPPORT CHARACTERISTIC COMMUNITIES
- PROBABLY SUPPORT CHARACTERISTIC COMMUNITIES - FURTHER INVESTIGATION REQUIRED

DELAWARE BAY

REGIONAL LOCATION



NEW JERSEY PINELANDS

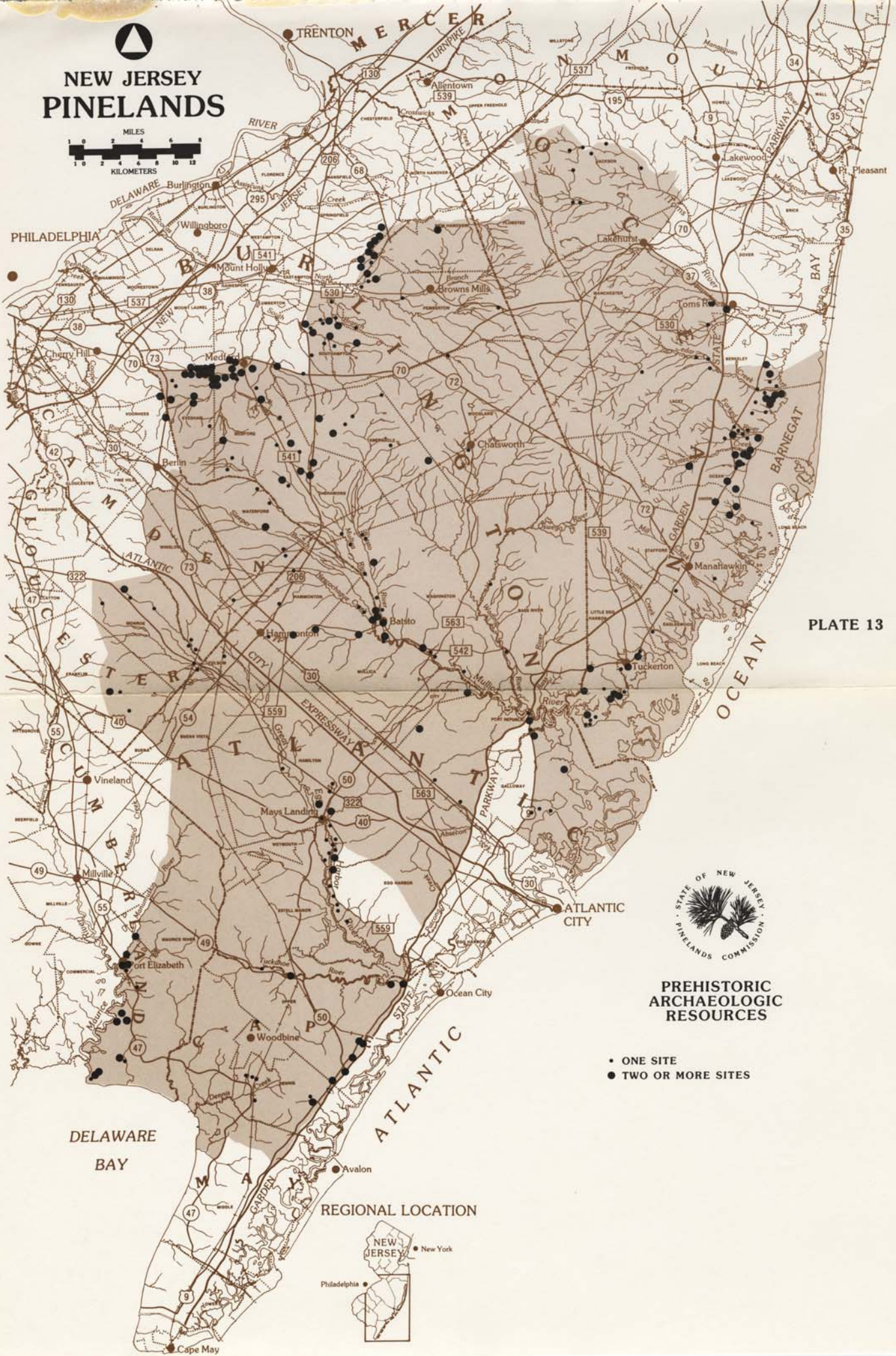


PLATE 13



PREHISTORIC ARCHAEOLOGIC RESOURCES

- ONE SITE
- TWO OR MORE SITES

REGIONAL LOCATION



DELAWARE BAY

ATLANTIC OCEAN

ATLANTIC CITY

Avalon

Woodbine
Ocean City
Cape May

PHILADELPHIA

TRENTON

MERCER

MILBURN

MONTICELLO

MONROE

MURRAY

BURLINGTON

WILLINGBORO

MOUNT HOLLY

ALLENTOWN

LAKEHURST

LAKEWOOD

LAKEWOOD

PLEASANT

CHERRY HILL

MEDIA

BERLIN

CHATEAUX

LOMS RIVER

BERKELEY

MANAHAWKIN

LONG BEACH

SPRINGFIELD

SPRINGFIELD

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NEW JERSEY PINELANDS

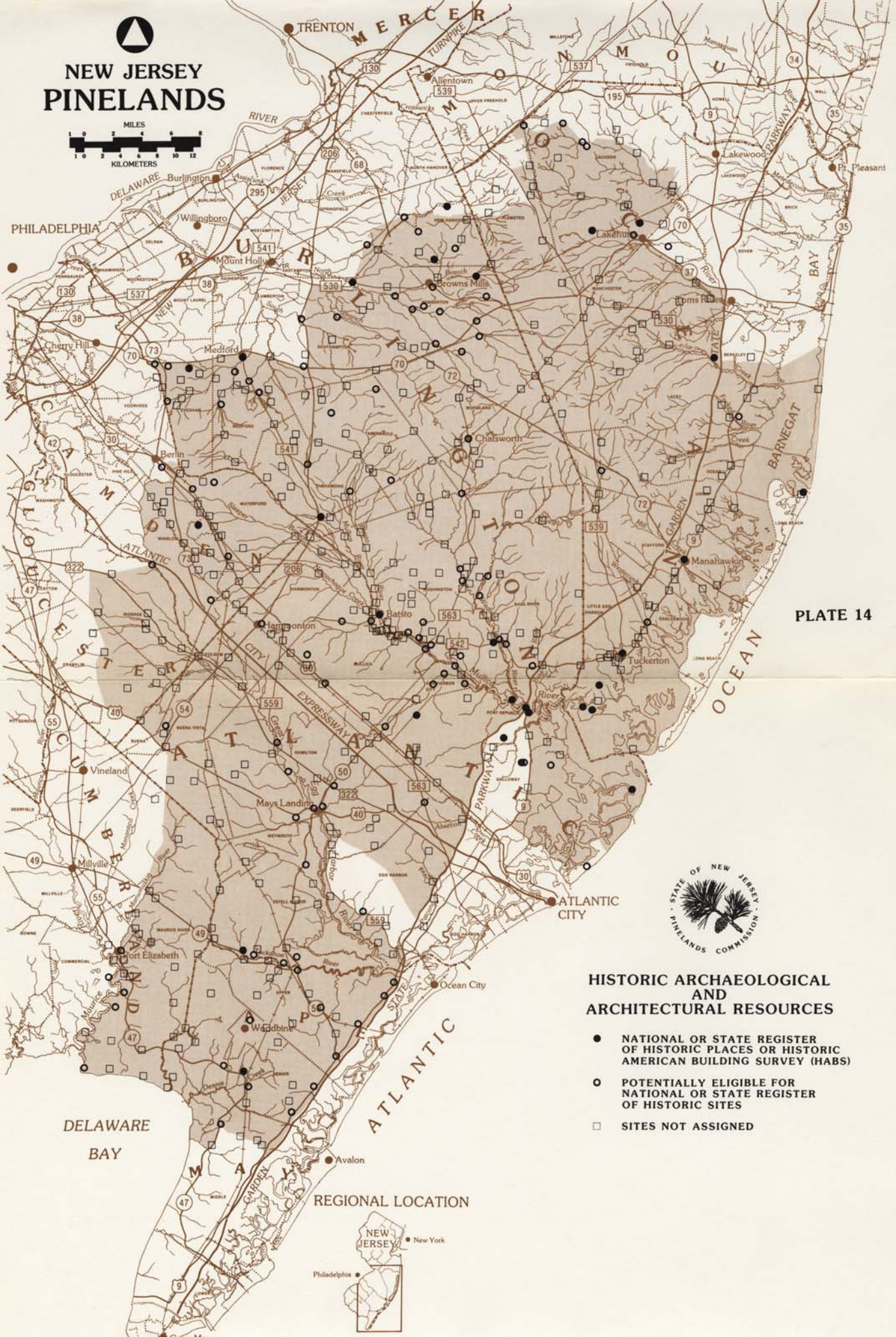


PLATE 14



HISTORIC ARCHAEOLOGICAL AND ARCHITECTURAL RESOURCES

- NATIONAL OR STATE REGISTER OF HISTORIC PLACES OR HISTORIC AMERICAN BUILDING SURVEY (HABS)
- POTENTIALLY ELIGIBLE FOR NATIONAL OR STATE REGISTER OF HISTORIC SITES
- SITES NOT ASSIGNED

REGIONAL LOCATION



DELAWARE BAY

ATLANTIC

OCEAN

NEW JERSEY PINELANDS

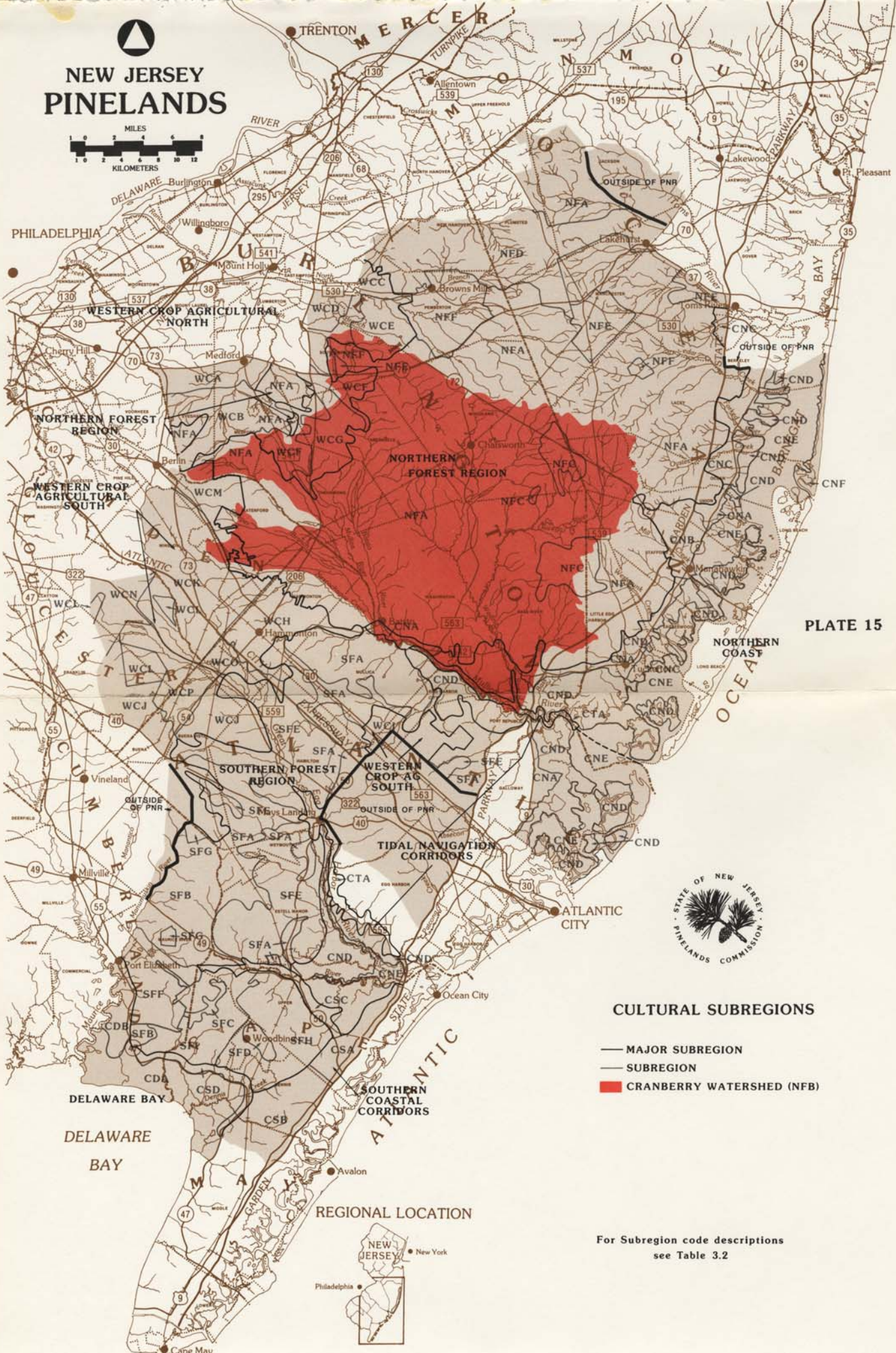


PLATE 15



- CULTURAL SUBREGIONS**
- MAJOR SUBREGION
 - SUBREGION
 - CRANBERRY WATERSHED (NFB)

DELAWARE BAY

REGIONAL LOCATION



For Subregion code descriptions see Table 3.2

NEW JERSEY PINELANDS

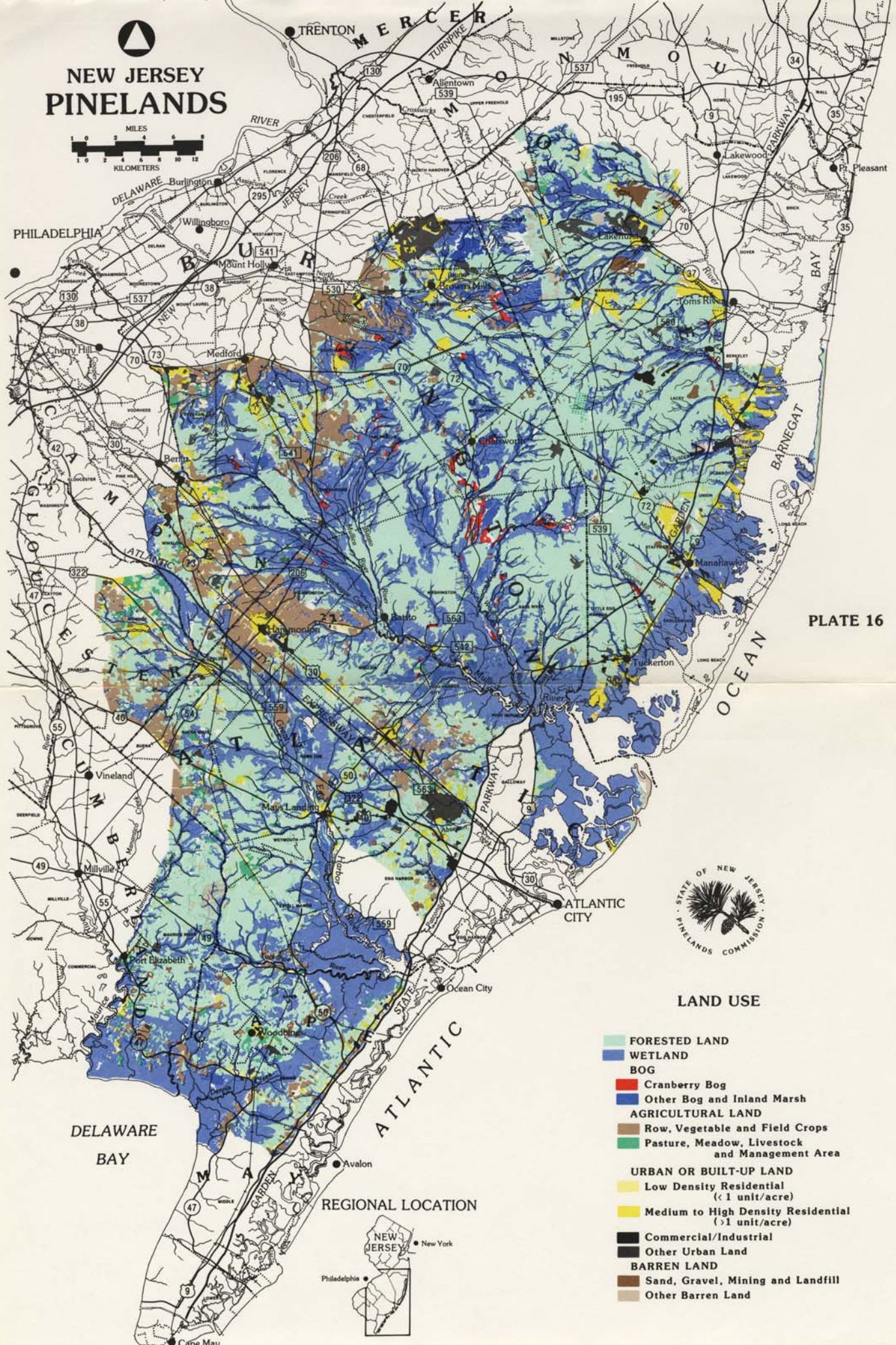


PLATE 16



LAND USE

- FORESTED LAND
- WETLAND
- BOG
- Cranberry Bog
- Other Bog and Inland Marsh
- AGRICULTURAL LAND**
- Row, Vegetable and Field Crops
- Pasture, Meadow, Livestock and Management Area
- URBAN OR BUILT-UP LAND**
- Low Density Residential (< 1 unit/acre)
- Medium to High Density Residential (> 1 unit/acre)
- Commercial/Industrial
- Other Urban Land
- BARREN LAND**
- Sand, Gravel, Mining and Landfill
- Other Barren Land

DELAWARE BAY

REGIONAL LOCATION



NEW JERSEY PINELANDS

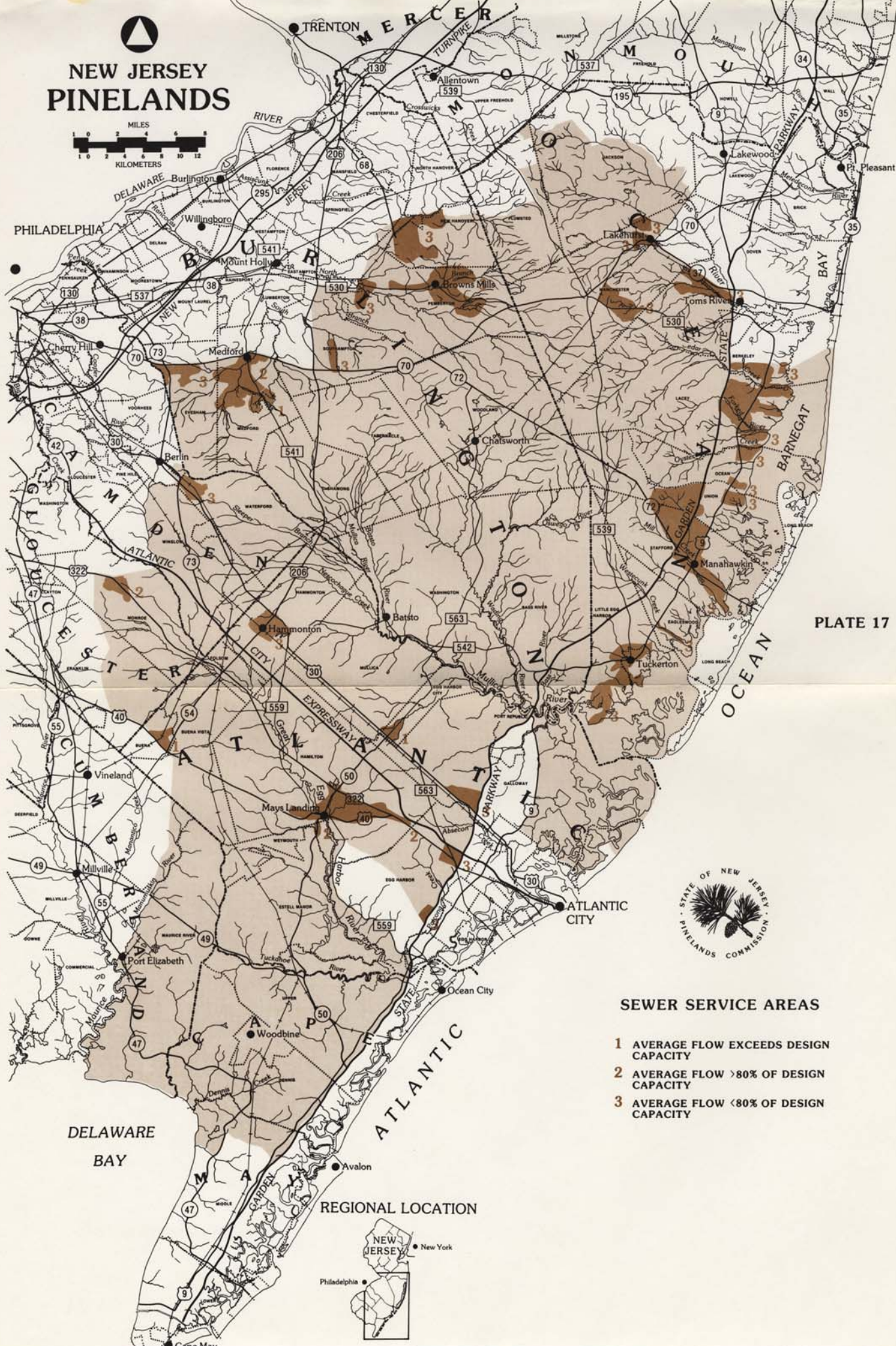


PLATE 17



SEWER SERVICE AREAS

- 1 AVERAGE FLOW EXCEEDS DESIGN CAPACITY
- 2 AVERAGE FLOW > 80% OF DESIGN CAPACITY
- 3 AVERAGE FLOW < 80% OF DESIGN CAPACITY

REGIONAL LOCATION



DELAWARE BAY

ATLANTIC OCEAN

NEW JERSEY PINELANDS

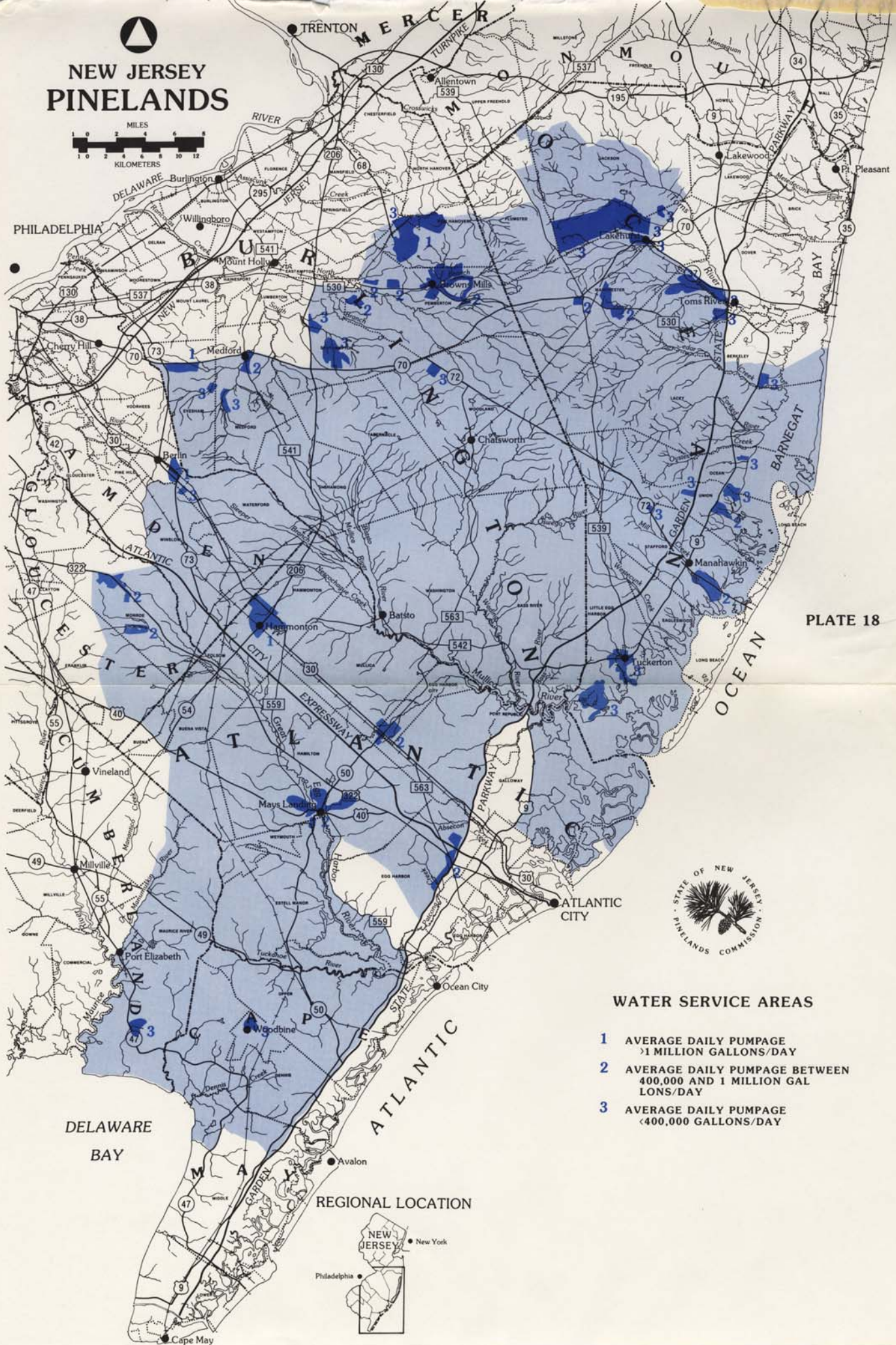


PLATE 18



WATER SERVICE AREAS

- 1 AVERAGE DAILY PUMPAGE >1 MILLION GALLONS/DAY
- 2 AVERAGE DAILY PUMPAGE BETWEEN 400,000 AND 1 MILLION GALLONS/DAY
- 3 AVERAGE DAILY PUMPAGE <400,000 GALLONS/DAY

REGIONAL LOCATION



DELAWARE BAY

ATLANTIC OCEAN

NEW JERSEY PINELANDS

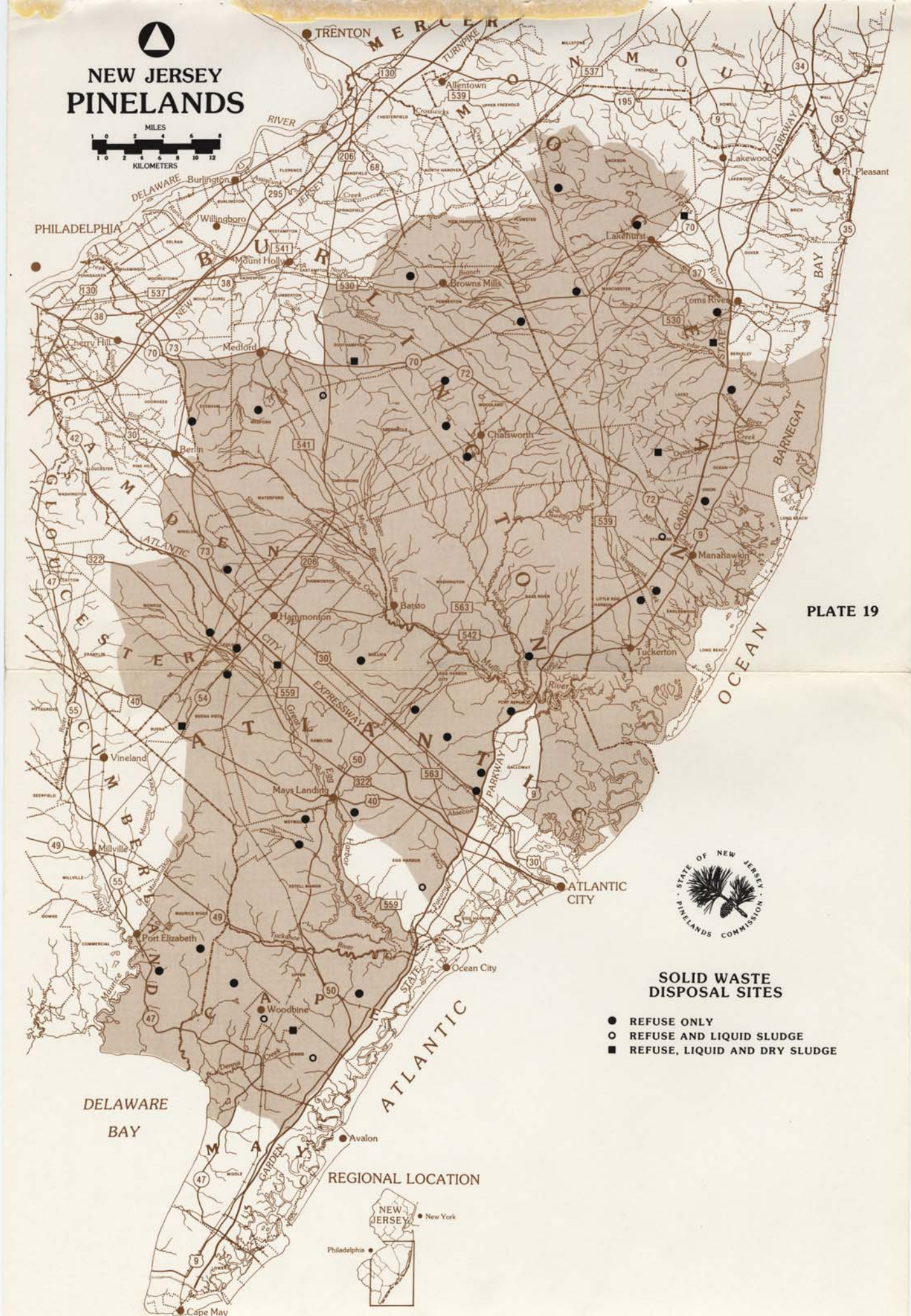


PLATE 19



SOLID WASTE DISPOSAL SITES

- REFUSE ONLY
- REFUSE AND LIQUID SLUDGE
- REFUSE, LIQUID AND DRY SLUDGE

DELAWARE BAY

REGIONAL LOCATION



NEW JERSEY PINELANDS

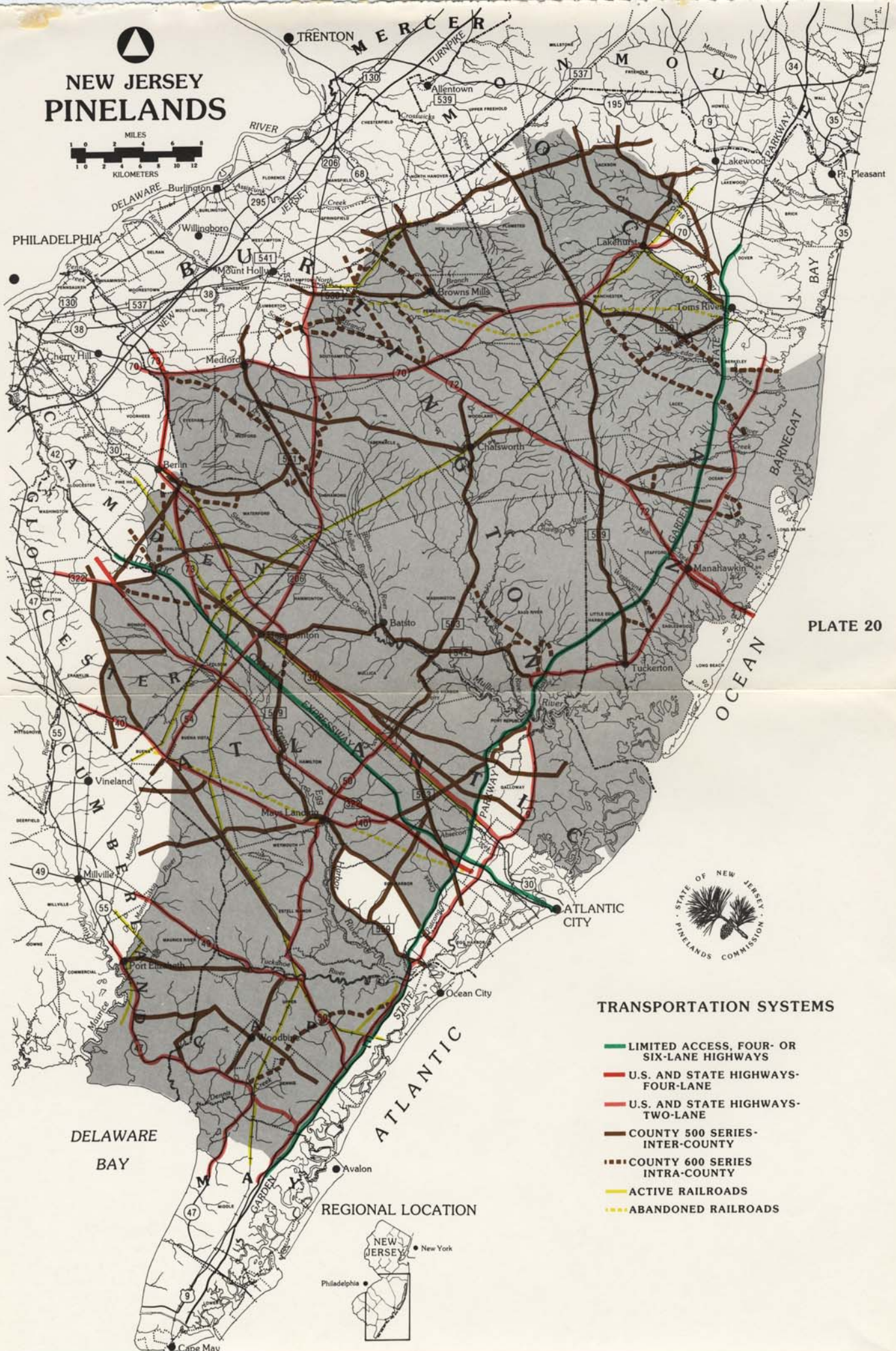


PLATE 20



TRANSPORTATION SYSTEMS

- LIMITED ACCESS, FOUR- OR SIX-LANE HIGHWAYS
- U.S. AND STATE HIGHWAYS-FOUR-LANE
- U.S. AND STATE HIGHWAYS-TWO-LANE
- COUNTY 500 SERIES-INTER-COUNTY
- - - COUNTY 600 SERIES INTRA-COUNTY
- ACTIVE RAILROADS
- - - ABANDONED RAILROADS

REGIONAL LOCATION



DELAWARE BAY

ATLANTIC OCEAN

NEW JERSEY PINELANDS

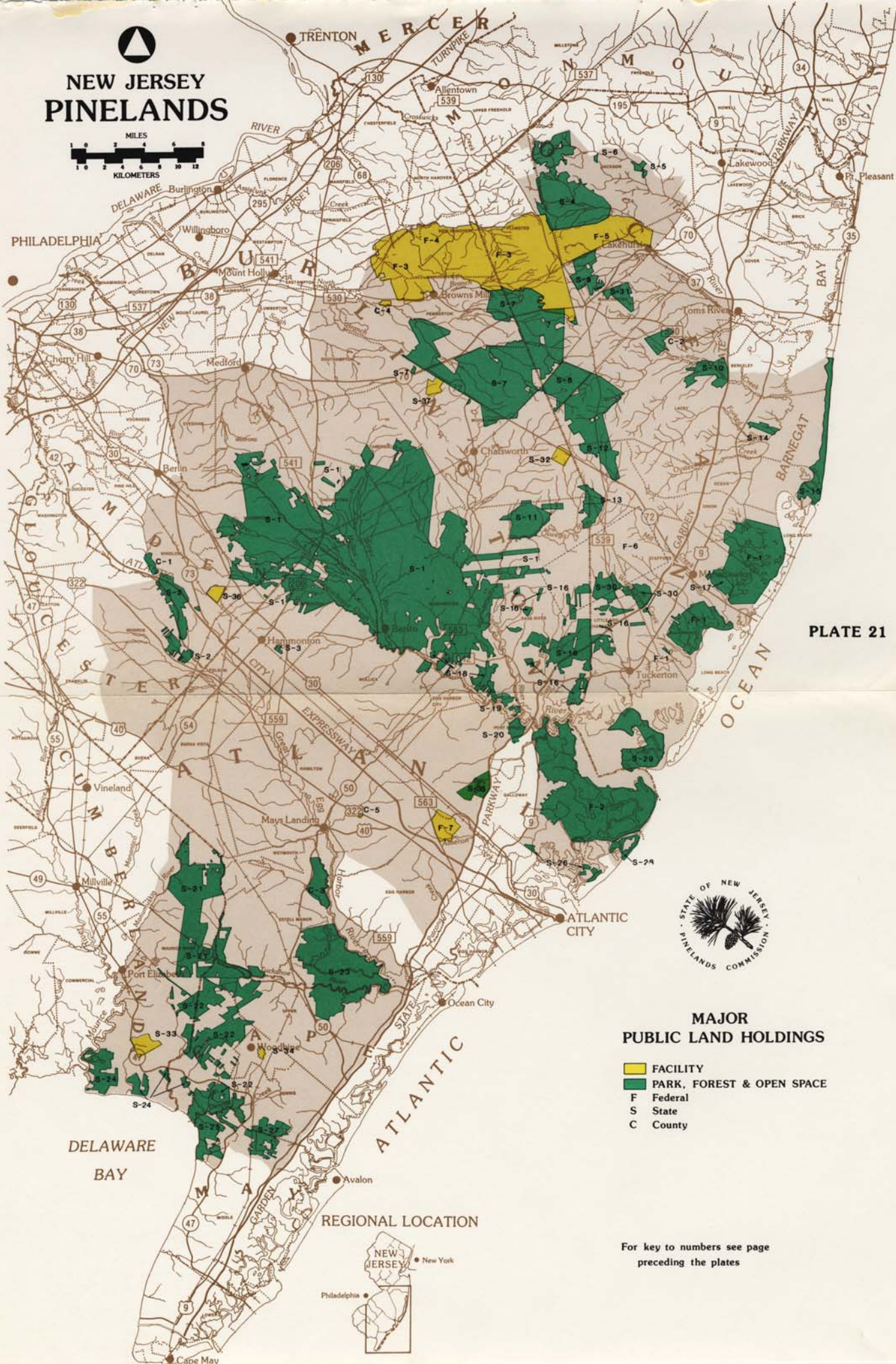


PLATE 21



MAJOR PUBLIC LAND HOLDINGS

- FACILITY
- PARK, FOREST & OPEN SPACE
- F Federal
- S State
- C County

For key to numbers see page preceding the plates

REGIONAL LOCATION



NEW JERSEY PINELANDS



PLATE 22



RESOURCE EXTRACTION AREAS

RESOURCE EXTRACTION AREA

REGIONAL LOCATION



DELAWARE BAY

ATLANTIC OCEAN

NEW JERSEY PINELANDS

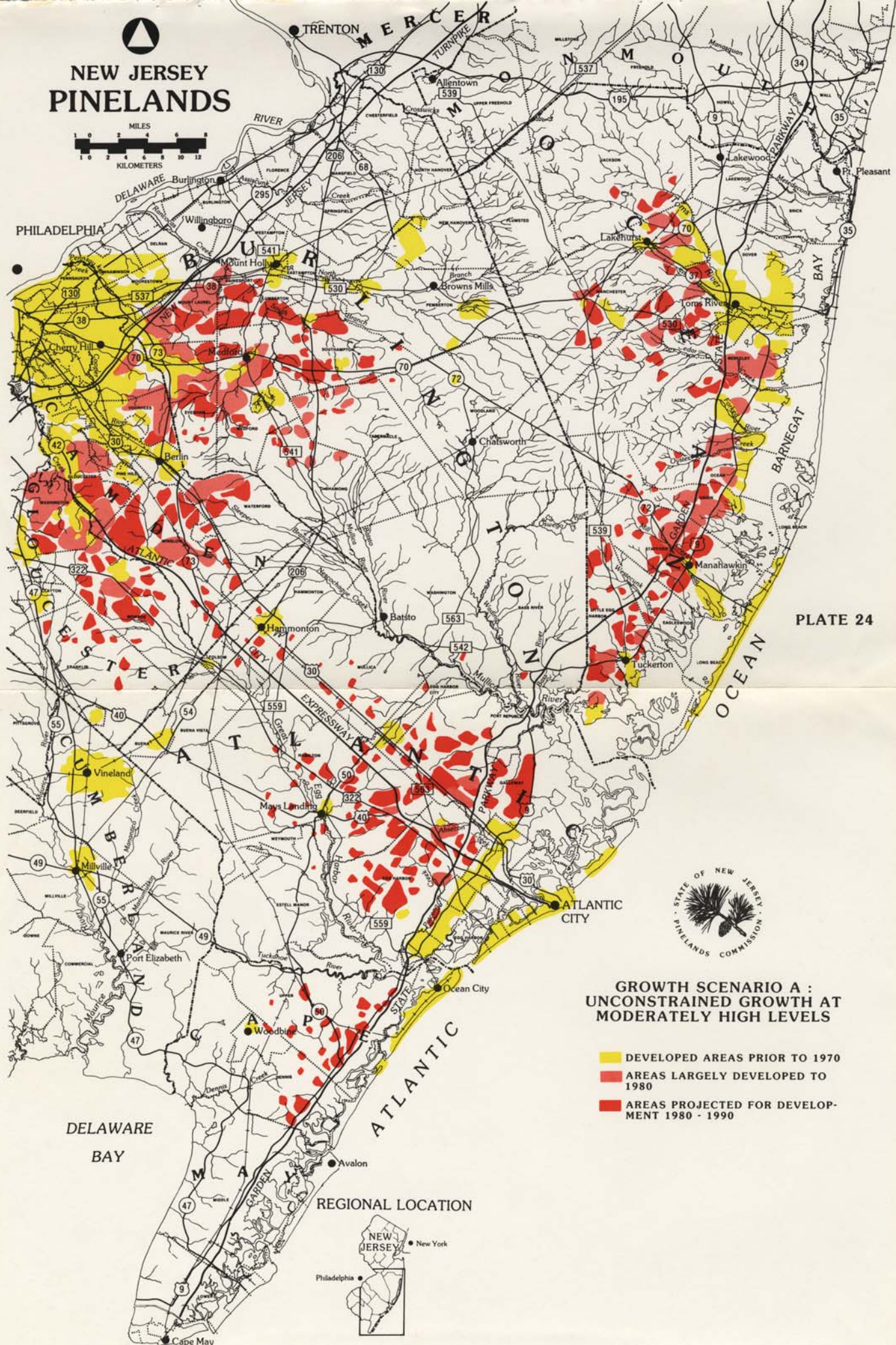


PLATE 24



GROWTH SCENARIO A : UNCONSTRAINED GROWTH AT MODERATELY HIGH LEVELS

- DEVELOPED AREAS PRIOR TO 1970
- AREAS LARGELY DEVELOPED TO 1980
- AREAS PROJECTED FOR DEVELOPMENT 1980 - 1990

DELAWARE BAY

REGIONAL LOCATION



NEW JERSEY PINELANDS

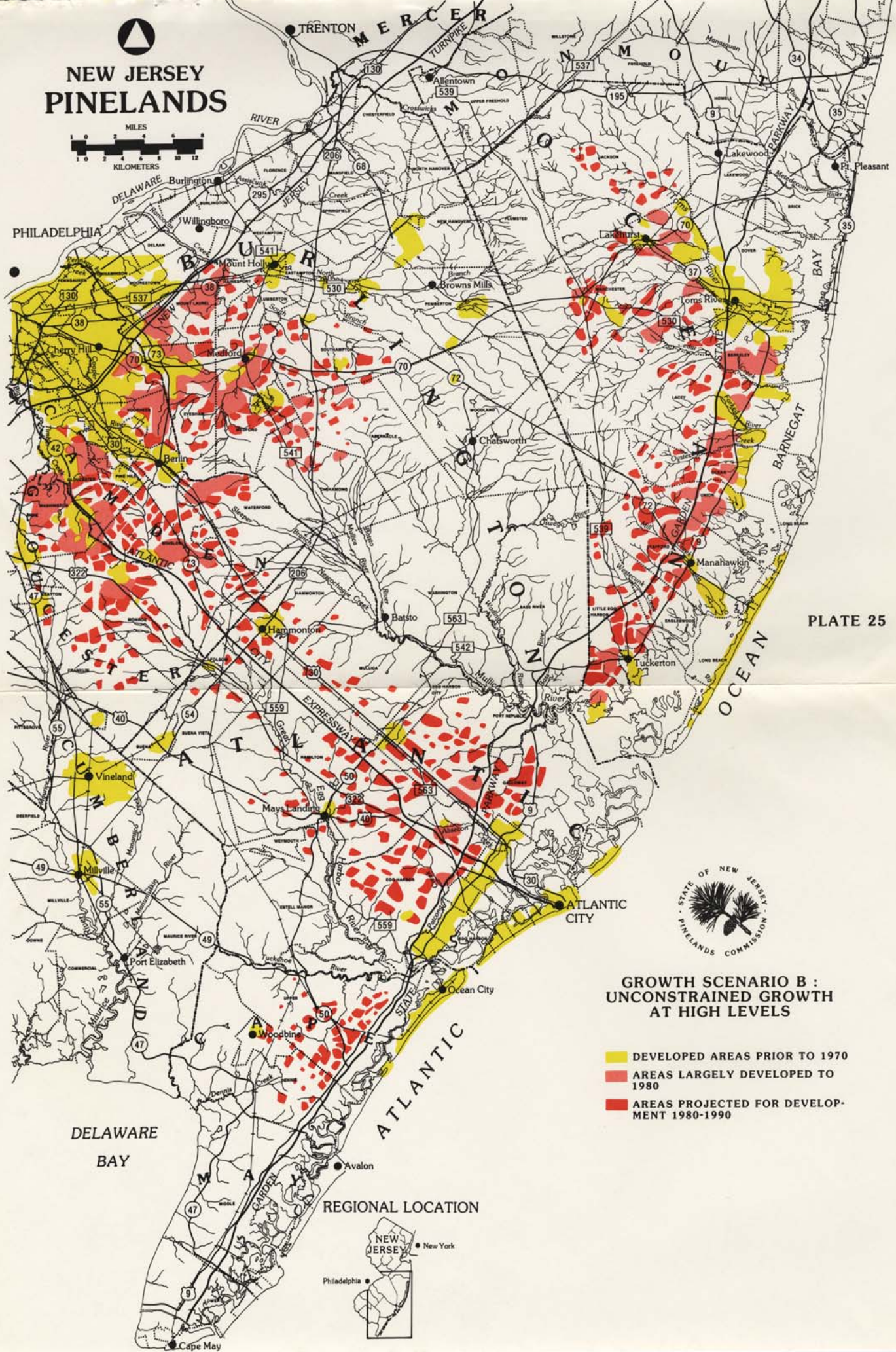


PLATE 25



GROWTH SCENARIO B : UNCONSTRAINED GROWTH AT HIGH LEVELS

- DEVELOPED AREAS PRIOR TO 1970
- AREAS LARGELY DEVELOPED TO 1980
- AREAS PROJECTED FOR DEVELOPMENT 1980-1990

DELAWARE BAY

REGIONAL LOCATION



NEW JERSEY PINELANDS

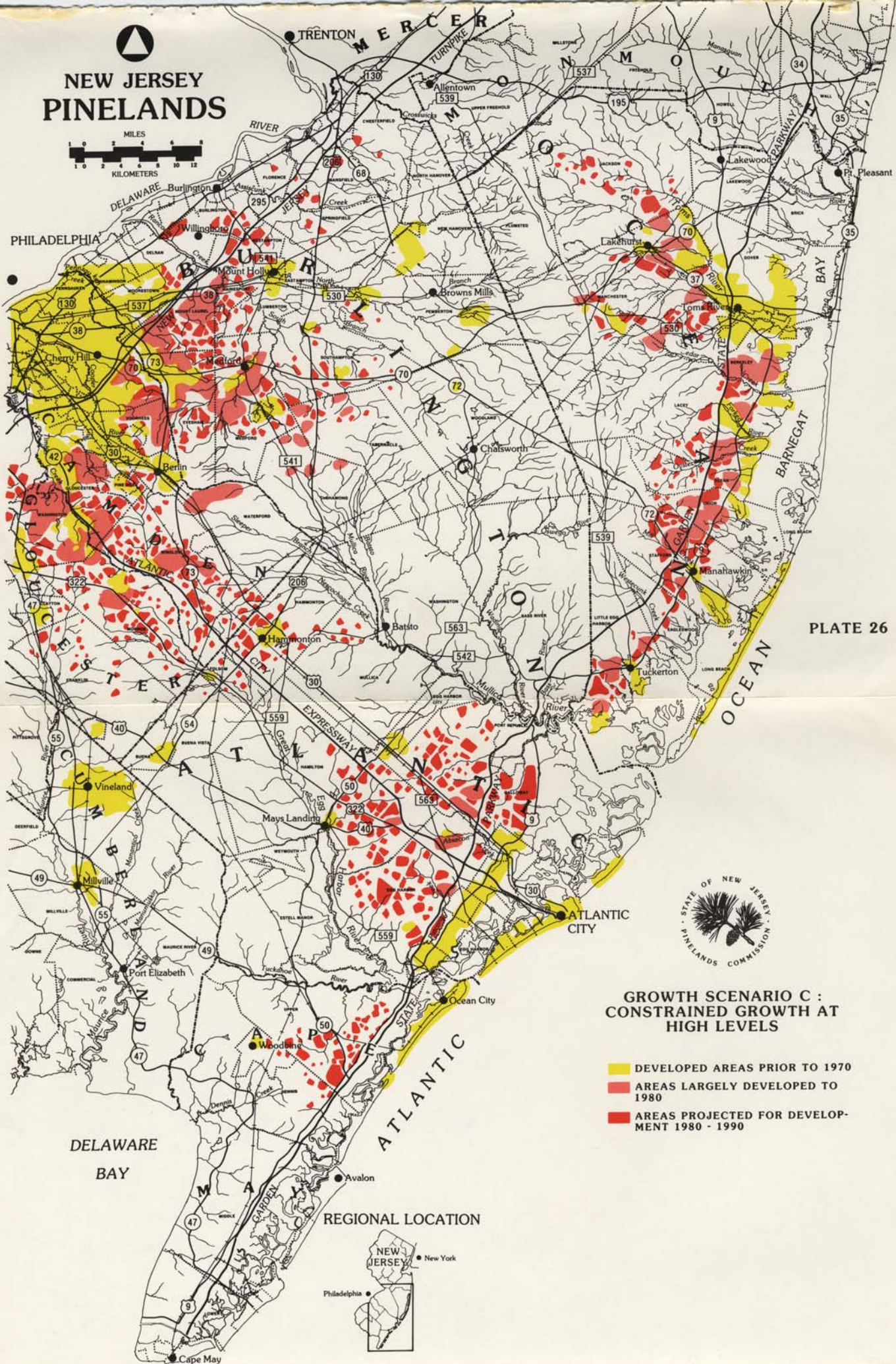


PLATE 26



GROWTH SCENARIO C : CONSTRAINED GROWTH AT HIGH LEVELS

- DEVELOPED AREAS PRIOR TO 1970
- AREAS LARGELY DEVELOPED TO 1980
- AREAS PROJECTED FOR DEVELOPMENT 1980 - 1990

DELAWARE BAY

REGIONAL LOCATION



NEW JERSEY PINELANDS

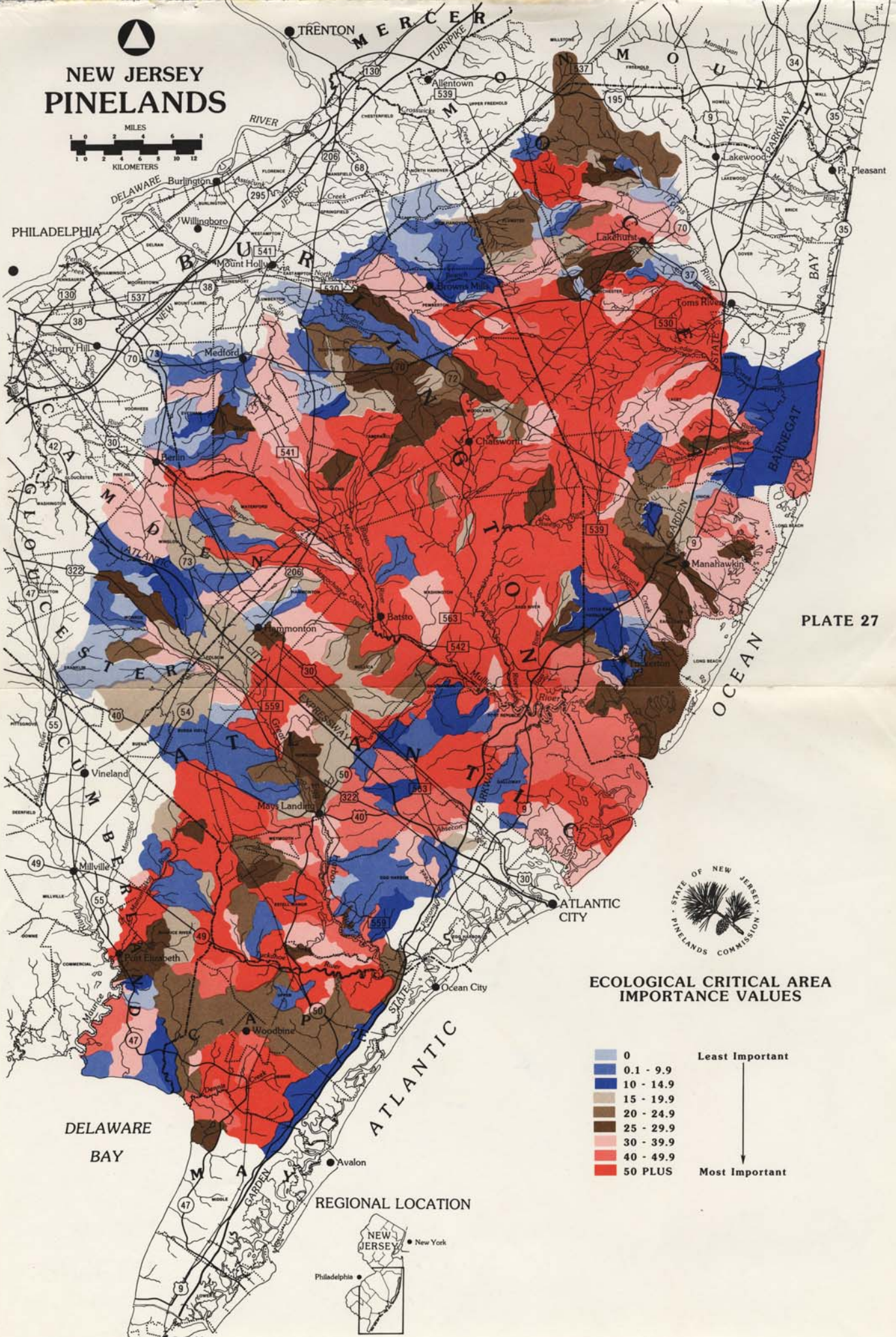
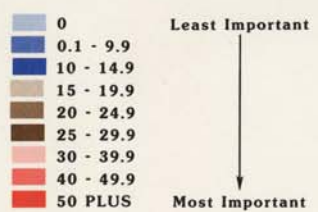


PLATE 27



ECOLOGICAL CRITICAL AREA IMPORTANCE VALUES



DELAWARE BAY

ATLANTIC OCEAN

REGIONAL LOCATION



NEW JERSEY PINELANDS

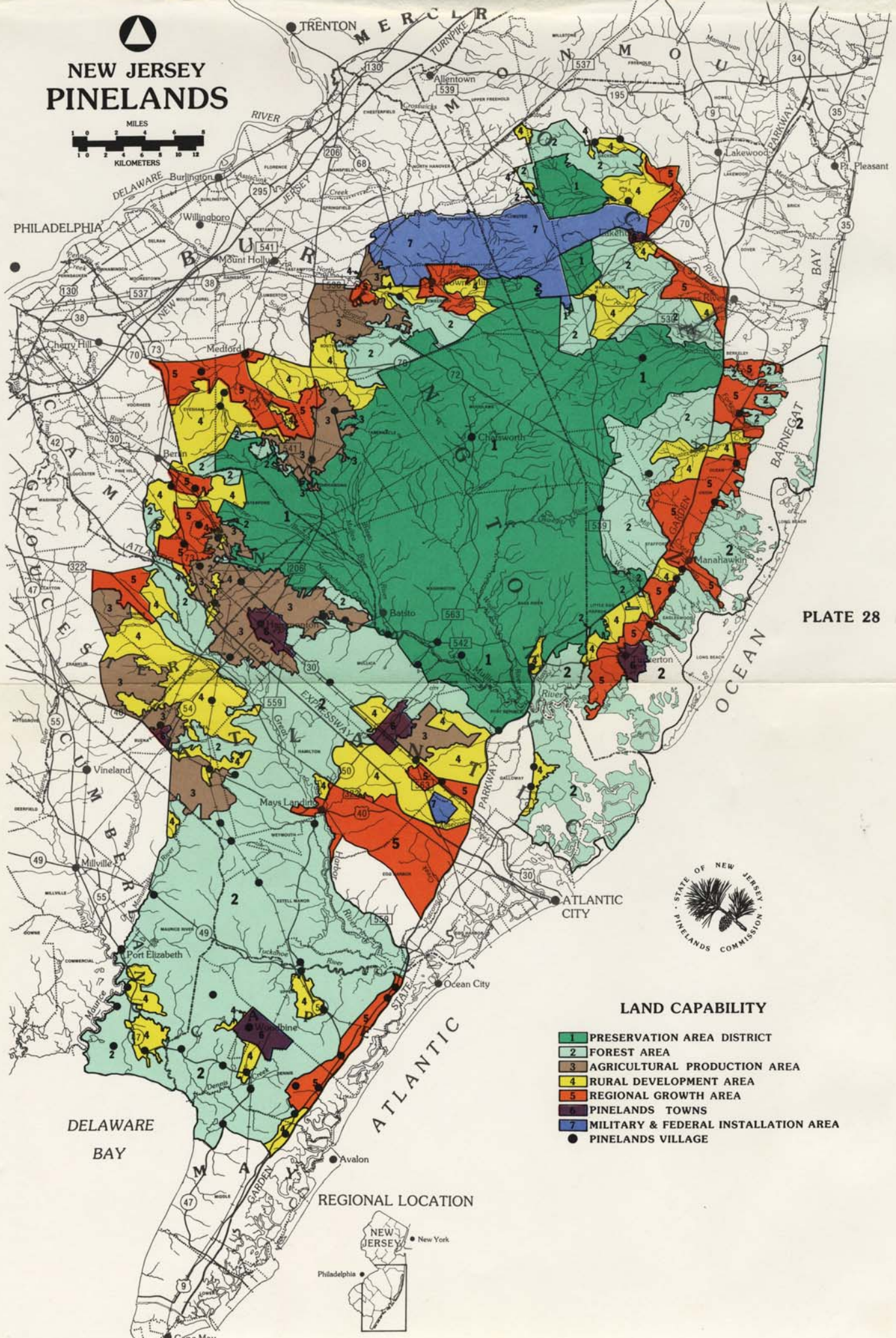


PLATE 28



LAND CAPABILITY

- 1 PRESERVATION AREA DISTRICT
- 2 FOREST AREA
- 3 AGRICULTURAL PRODUCTION AREA
- 4 RURAL DEVELOPMENT AREA
- 5 REGIONAL GROWTH AREA
- 6 PINELANDS TOWNS
- 7 MILITARY & FEDERAL INSTALLATION AREA
- PINELANDS VILLAGE

DELAWARE BAY

REGIONAL LOCATION

