



The Century Plan

A Study of One Hundred Conservation Sites in the Barnegat Bay Watershed

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Researched and Written for the Trust for Public Land

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“I only went out for a walk, and finally concluded to stay out until sundown, for going out, I found, was really going in.”

John Muir

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Introduction

The Century Plan \ 'sench-(-)re 'plan \

- 1: a Trust for Public Land study of one-hundred (100) unique conservation and public access sites in the Barnegat Bay watershed area
- 2: a regional land conservation blueprint for the Barnegat Bay in the 21st Century
- 3: a citizen's guide to ordinary and extraordinary natural and cultural landscapes along the central New Jersey shore

If the late House Speaker Thomas P. “Tip” O’Neill’s assertion that “All politics is local” was adapted by naturalists, then they would likely decree, “All conservation is local.” And nowhere in New Jersey does this statement ring with greater importance than in the Barnegat Bay watershed of Ocean County. Covering more than 450 square miles of tidal shoreline, backbay islands, marsh creeks, and pine/oak forests, the Barnegat Bay region is a delight to those whose primary interest is natural resources. With a resident population of 450,000, which doubles (and sometimes triples) during the summer months, the Barnegat Bay region functions as a premier tourist and vacation destination in the New Jersey-Pennsylvania-New York area. Yet a surprisingly small percentage of residents and visitors are knowledgeable about Barnegat Bay’s astonishing ecological diversity, integrity, and long-term conservation requirements. It was to address the need for a better awareness and understanding of open space in the Bay watershed and to celebrate the Barnegat Bay region that the Trust for Public Land undertook the Century Plan.

By way of background, the Barnegat Bay is a coastal estuary (some scientists label it a coastal “lagoon”) roughly 40 miles long and one to four miles wide. As an estuary, Barnegat Bay is a place where fresh and salt water combine in a shallow, productive, and delicately balanced aquatic environment which allows sunlight to reach the Bay floor. About 75 percent of the Bay is less than six feet deep at mean low tide, while overall depth varies from three to twenty feet. Perhaps most astonishing is the Barnegat Bay's low rate of tidal exchange (defined as the proportion of water escaping seaward each tidal cycle). With a nearly unbroken chain of barrier islands that form a seaward cap, the complete turnover of water in the Barnegat Bay occurs once every 96 tidal cycles, about every 50 days. Given this incredibly low rate of “flushing,” the pollutants, sewer effluent, and urban runoff that enter the Bay — directly or through upland creeks and watersheds — remain for a decidedly long time!

As our population continues its inevitable growth and coastal expansion, so must we redouble our activities to “buffer” the Barnegat Bay by conserving for future generations key recreational lands and remaining open spaces. Since 1991 the Trust for Public Land (TPL) has managed to acquire and protect over 3,500 acres in the Barnegat Bay watershed with a market value exceeding \$18 million. However, we cannot do it alone. True land conservation is a partnership effort — one that combines the ideals of citizens with the capacity of government and enlightened action of private property management. There are great benefits in creating parks and reserves by placing open space under municipal, county, state, or federal jurisdiction. It must be stressed, however, that private land ownership remains an effective conservation approach, particularly when reinforced with ecological information and preferred management techniques.

As a study of potential conservation lands, the Century Plan serves as a compendium of sites that TPL believes are of long-term importance to the Barnegat Bay as an ecosystem and a treasured public resource. The order of site listing does not, in any fashion, constitute a ranking.

The *Century Plan* was meticulously researched and written over an eighteen-month period by Peter P. Blanchard, III, TPL's field biologist, whose eye for habitat, history, and culture was enhanced by many friends and interviewees throughout the Bay region, to whom we owe so very much. From the tidal flats to the bog to the forested upland, from sites of two acres to those of twenty thousand, Peter gained a profound respect for the intricacies and mysteries of the Bay region, a respect that we trust will be communicated through the pages which follow.

Beyond its role as a catalyst for land protection efforts, the Century Plan is a celebration of the Barnegat Bay and its watershed. We hope the Century Plan will survive as a "good read" for those who use the Barnegat Bay: the naturalists, boaters, fishermen, hunters, beachcombers, birdwatchers, and (yes) motorists, who might pause to recall that all conservation is, ultimately, local.

Andrew L. Strauss
The Trust for Public Land
Morristown, New Jersey

Bay Islands

Seemingly suspended in time and yet forever changing, islands lie at the heart of the Bay landscape. In meeting the dictionary definition of "a land mass, especially one smaller than a continent, entirely surrounded by water," an island, in whole or in part, must be exposed at high tide. Thus the thousands of shoals, sandbars, and mudflats that are rimmed by salt water and exposed only at low tides do not qualify. An approximate number of islands in Barnegat Bay and its southern reach, Little Egg Harbor, is 165. The exact number of islands is hard to pin down, as dynamic change characterizes the meeting of marine and terrestrial environments. Over decades and centuries, islands have been created as high tides and storm surges carved out pieces of larger landforms or as inlets in the Bay's barrier islands have permitted the Atlantic Ocean to bring in sediment. Man has had a distinctive role in island creation through the dredging of channels and the deposition of dredge spoil. Islands marked on nautical charts in this decade have disappeared beneath the waves, victims of erosion, augmented by rising sea level. Bay islands generally fall into two categories, sedge islands or dredge spoil islands. Sedge islands are composed chiefly of marsh grasses and their substrate — a peat mat containing plant materials and sediment. Dredge spoil islands consist of sand and sediments removed from the Bay floor in dredging operations. The latter largely artificial land masses are discussed in the section on restoration/recreation sites. Sedge islands constitute the majority of islands selected for this report, although there is some overlap between the two categories.

However similar in appearance, each island bears its own peculiar impress of human and natural history. The sedge islands of Barnegat Bay and Little Egg Harbor range from a mere sliver, a fraction of an acre, to over 200 acres in size. Twenty-eight mostly privately owned island sites have been selected for this report, based on high habitat quality and conservation potential.

Coastal/Near Shore Sites

From the northernmost site, Beaver Dam Creek, to the southern site terminus at Otis Bogs, the western shoreline of Barnegat Bay and of Little Egg Harbor stretches over forty miles. Along this shoreline or in proximity to it lie 36 Century Plan sites, ranging from 40 acres to 1,300 acres in size. The western boundary of these tracts is often Route 9 or its attendant development. Several sites, however, are westward extensions of coastal tracts, proceeding as far west as the Garden State Parkway. Numerous sites demonstrate a full gradation from intertidal zone, salt marsh, high marsh and broadleaf swamp forest to upland forest, following a very gradual rise from sea level, often six feet or less. In this area, two highly productive ecosystems meet — the coastal marsh and upland forest. Included within the coastal and near shore category are two marshes on the barrier islands that define the Bay's eastern flank. From numerous vantage points provided by these lands, it is still possible to obtain a feeling for the grandeur and full sweep of the Bay landscape as experienced by Native Americans over countless centuries and by early European settlers.

Change, both natural and man made, has been at work on this landscape. Sea level rise, production of flood tide deltas by currents, erosion by wind and wave, onslaught of coastal storms, and scouring by Bay ice continue to sculpt the landforms. The greatest changes, however, have occurred at the hand of man. A process of "land improvement" for human habitation, agriculture, and commerce, which began on a small scale following European settlement in the seventeenth and eighteenth centuries, has gathered great momentum in the mid- to late-twentieth century. Some facets of this process are longstanding, others are more recent: road construction, filling of marshes, dredging, diking and lagoon construction, clearing of woodland, partitioning and paving of the landscape. A comparison between aerial photographs of the western shore of the Bay taken in the 1950s and 1990s reveals the extent to which the natural Bayshore is embattled. Granted a measure of immunity by the New Jersey Wetlands Act of 1970, the salt marshes appear to be holding their own at present. The contiguous uplands and freshwater areas continue to be under assault.

Despite the press of civilization, the majority of coastal sites on the western shore of Barnegat Bay and Little Egg Harbor retain an "integrity of function" both as ecosystem and viewscape. Once they are preserved, an eventual integration of these sites may be possible through the restoration of marsh belts and natural corridors. Coastal and near shore sites harbor outstanding resources for the preservation of biological diversity. These sites also hold out the promise of a higher quality of human life in the years ahead: offering recreation and nurturing the spirit by providing solitude and contact with nature in an increasingly crowded world.

Pinelands

Well to the west of the islands and the Bay coastal and nearshore lands lie the pinelands, at the heart of the Barnegat Bay watershed. To the west of the Garden State Parkway, the pinelands are a manifestation of a large geographic region — the New Jersey Pine Barrens. The Pine Barrens has a distinctive geology, ecology, and human history of its own. This inland region encompasses “some 2,000 to 2,250 square miles or 1.25 to 1.4 million acres of generally flat, sandy, acidic, and sterile soils which constitute a major part of the Outer Coastal Plain section of the Atlantic Coastal Plain in New Jersey” (Boyd, 1991). From Toms River, Metedeconk River, and Forked River, to Kettle Creek and Cedar Run Creek, to Cabin Branch and Slab Branch, and finally to rivulets and seeps, the many watercourses that eventually wend their way to Barnegat Bay carry water which has arisen from within the Cohansey/Kirkwood aquifers. These water bearing rock formations may hold up to 17 trillion gallons of water at one time. It should be noted, however, that the ability of an aquifer to maintain the depth of its watertable and to produce potable water is not limitless, particularly if increasing demands are being made on the aquifer.

In its classic sense, the Pine Barrens landscape is dominated by one species. Pitch pine sets great swards of olive green against the light green of subordinate deciduous trees and shrubs and against the white of sand. Even though referred to as pinelands, however, the uplands of the Bay watershed may not always have pitch pine as the dominant component. Geologic history, topography, depth of water table, and the presence or absence of fire are among the major determinants of the prevalence of pitch pine. Upland woods in this region may range from almost pure pine stands to pure deciduous stands, with numerous gradations in between. Whether natural in origin or the result of human carelessness or design, fire has favored the pitch pine and has augmented its germination and distribution. Within the pinelands, lowland areas exist that differ in their plant species composition, reflecting differences in the type of soil and in the availability of water. In drier habitats with sandy soil, through which water percolates rapidly, pitch pine lowlands are found. In areas where the soil has a higher clay content and where water is more plentiful, the hardwood swamp or red maple/black gum swamp may develop. Predominantly water-logged areas along the creeks and branches favor the Atlantic white cedar swamp. The cedar swamp may grade into a bog habitat, where mats of *Sphagnum* moss and bog plants such as pitcher plant, sundew, and cotton grass abound.

The pinelands, therefore, embrace a subtle diversity of landscape and habitat. The largest undeveloped lands of the Barnegat Bay watershed fall within this category. Large-scale urbanization and conversion of sensitive uplands and watersheds challenges the integrity of the watershed and may adversely affect the long-term viability of the Barnegat Bay ecosystem.

Recreation / Restoration Sites

Over the course of centuries, most of the landscape of the Barnegat Bay watershed has been influenced or altered by the hand of man. Given enough time and a lack of disturbance, this landscape will revert to a natural state by the process of succession. Following colonization of a site, each successive plant community sets the stage for the next community until a stable, long-term association is achieved, thereby giving a region its “character.” A classic example is that of old field succession. Following abandonment, an old field is first invaded by herbaceous growth, such as broom sedge, goldenrods, and ragweed. The pioneer herbaceous species are followed in the course of a few years by shrubs such as steplebush and staghorn sumac. Grey birch and eastern red cedar, tree species that thrive in open, sunny conditions and grow rapidly, soon become established but are, in their turn, displaced by species whose seedlings are shade-tolerant and grow more slowly than the pioneers. Given an adequate seed source in the vicinity, pitch pine and various species of oak gain a foothold. Eventually, a pine oak woods may prevail, with Norway spruce, lilacs, and Japanese barberry (introduced species) marking a former farmstead.

Restoration of disturbed sites involves knowledge of the natural succession of plant communities native to a region. Removing introduced exotic plant species and planting of native species generally augments biological diversity of an area. The ability of nature to restore itself in the face of change (both human and natural) and to restore itself independent of the hand of man are themes frequently encountered in this report.

The sites described under the heading of Recreation/Restoration have one or two features in common —

- 1.) prior modification of a natural setting by man, and
- 2.) significant potential for passive recreation and/or research and education. The listing of diverse sites includes dredge spoil island and peninsula sites, abandoned marinas, inactive sand and gravel mining sites, a town park, and a living history museum. Once a site has been restored, access to the site by the public may be encouraged, with or without restrictions. Public access to the dredge spoil island, for example, is discouraged between mid-May and mid-October, a period during which seabirds use the islands for nesting. The restoration of other sites, such as Berkeley Harbor Marina, may be fully attuned to the recreational demands of kayakers and canoeists.

"We simply need that wild country available to us, even if we never do more than drive to its edge and look in. For it can be a means of reassuring ourselves of our sanity as creatures, a part of the geography of hope."

Wallace Stegner

Member, TPL National Advisory Board 1983-1993

Bay Islands

"Out there, between the point where you can take your last dry step and the faint horizon of your mind's eye, lies another world, apart. A world of islands — part sea, part land; part wild, part subdued; part fish, part man; and with winged birds between."

Philip Conkling, *Islands in Time*

Black Whale Sedge

Little Egg Harbor Township

13 Acres

Located one mile west of Beach Haven Manor on Long Beach Island, Black Whale Sedge sits on the southeastern flank of the Hither Island group of sedge islands. About 75 percent of the land mass of this group is protected and within the boundaries of the Forsythe Refuge. Black Whale Sedge is approximately 600 feet south of its protected neighbor, Bunting Sedge.

Black Whale Sedge is a very beautiful and instructive place and belies any stereotype that one might have about the sedges or about Barnegat Bay islands in general. The 13 acres of Black Whale Sedge harbor the essential magic of the sedge islands, a magic unknown to those who view the islands from a distance. To a passing boater, the low green or brown profile of marsh grasses (depending upon the season) speaks of a sameness and monotony of the sedge islands. To the uninitiated, these places are to be avoided rather than investigated, as their attendant mud flats can readily snare and hold a boat on the falling tide.

The landscape of Black Whale Sedge is revealed at a particularly intimate scale that combines light, water, white-ribbed sand, and marshes. An everchanging scene is created. The arena is small but biologically rich. Horseshoe crab exoskeletons are strewn over a portion of the beach, reminders of the annual massing of the species on similar mudflats and beaches — a congregation that has occurred over hundreds of millions of years. Bright yellow clumps of seaside goldenrod hum with bee and fly pollinators that have made the overwater journey in search of pollen and nectar. On their migration south, monarch butterflies also commandeer the goldenrod flowerheads. A small flock of sharp-tailed sparrows, salt marsh specialists, forage for sand fleas. The shadow of a marsh hawk or northern harrier glides beneath the bird as it searches

The Identity of Sedges

In contrast to the granitic islands of the New England coast and sand islands (such as the dredge spoil islands of Barnegat Bay), sedges are characterized by salt marsh grasses. Substrate for the sedges is provided by trapped sediment and by the decaying plants themselves, in the form of peat.

for prey in the *Spartina* grasses. A black-crowned night heron stalks crabs and shrimp in the intertidal zone.

The spring and summer months witness a surge in activity by colonial nesting seabirds in Barnegat Bay, in Little Egg Harbor, and in the Hither Island complex in particular. A colony or two of Forster's terns, counting 20 to 100 birds per colony, can be found within the island group each season. The island actually utilized varies from year to year. Common terns and laughing gulls also nest in the island complex. Snowy egrets, great egrets, black-crowned night herons, and glossy ibises form nesting colonies as well, drawn to areas of high marsh vegetation and *Phragmites* (Joanna Burger, personal communication).

Underlying the biological activity is the structural diversity of the habitat: tide pools, mud flats glistening with algae, sand spits, pocket beaches, small islets in the process of formation, expanses of marsh, and miniature hammocks of bayberry and Marsh-elder — the salt marsh's equivalent of a forest. Black Whale Sedge is a minute world in flux between water and land.

Bonnet Island

Stafford Township

15.4 Acres

A large and relatively pristine salt marsh occupies over half the area on Bonnet Island. The marsh offers a fine complement to the protected eastern marsh of nearby Cedar Bonnet Island and the broad marshes of southern Cedar Bonnet Island, which recently have been added by the Trust for Public Land to the Forsythe Refuge. Aerial photography, on the other hand, confirms the spread of development on marshes at various points of contact with Route 72.

Despite mosquito ditching and the placement of a subsurface sewer line within the southwestern section of the marsh, the Bonnet Island marsh remains an impressive area. Like the prow of a great ship, the island's northern end juts northeastward into Little Egg Harbor. On windy days, gusts drive waves and foam up onto the western shoreline. Mallards and common mergansers, a fish-eating duck, ride out the winds in the lee of the island. The primary components of the marsh vegetation are the two *Spartinas*, salt marsh cord grass and salt meadow cord grass. Marsh-elder, in its gray winter aspect, is present in clumps and in lines along mosquito ditches. In late summer and early fall, salt marsh rosemary, also known as sea lavender, proclaims its presence with spangles of deep-blue to lavender flowers.

The entire area of marshes, stretching from Cedar Bonnet Island to Surf City (which was then a continuation of the wetlands to the barrier island's Atlantic shore), was apparently under one ownership in the nineteenth century. Salt hay, primarily salt meadow cord grass, was harvested regularly from the wetlands for use as cattle fodder and building insulation. As a crop, salt hay was regarded as receiving a unique form of fertilizer:

“The frequent inundations which sweep over [the marshes] in the winter season, when overwhelming tides are driven on the shore by hard easterly storms, leave a rich deposit of all the roiled-up ingredients of the vast ocean’s drift, and serve, as do the freshets of the Nile, to maintain their undiminished annual crops” (Price, 1878).

Man’s need for living space and his claims upon open space have been relentless. From an aerial view, Bonnet’s marsh is islanded on three sides by residential development as well as by water. On the western quarter lies open water and a protected marsh. Full protection and reintegration of surviving Barnegat Bay and Little Egg Harbor marshes remain both a dream and a possibility.

Cedar Bonnet Island /Northern and Southern Marshes

Stafford Township

199 Acres (Total)

Cedar Bonnet Island occupies a strategic position in Barnegat Bay and represents, in part, a conservation success story. Carrying Route 72 across Barnegat Bay to Long Beach Island, the Manahawkin Bridge divides Cedar Bonnet Island, with the marshes of the southern portion (133 acres) acquired by the Trust for Public Land and conveyed to the Forsythe Refuge in late 1992. The northern third of the island consists of three peninsulas. The easternmost and largest of these contains 39.3 acres of low and high marsh and is also owned and managed by the federal government as part of the Forsythe Refuge. The western peninsula and the central peninsula, holding 6.6 and 20 acres of open land respectively, are in private ownership. When viewed in the context of the magnificent areas already protected, a persuasive argument can be made for further consolidation by public ownership of this vital marsh complex.

Commercial and residential development has occurred north of the Manahawkin Bridge on former marshes, ranging from bulkheading and dock construction to clearing and erection of buildings on filled land. The impacts are very evident and contrast with the beauty and function of intact marshes. At Cedar Bonnet, there is a gradation of characteristic marsh habitat, ranging from native marsh with and without marsh creeks to marsh with mosquito ditching and bulkheading. The most biologically productive marshes are those with the fewest man-made impediments or manipulations. The marshes of northern Cedar Bonnet Island show the full range of possibilities. In contrast, the more pristine marshes of southern Cedar Bonnet Island are richer and more productive, with the low marsh playing a vital role as nesting area for common terns. These birds rely on nearby eel grass wrack to build their nests on elevated sections of marsh.

The western peninsula of northern Cedar Bonnet contains development in the form of two buildings and a winter boat storage area near Route 72. Most of the peninsula is occupied by salt hay marsh, with a line of upland salt-tolerant shrubs halving the marsh area.

Land use on the central peninsula is more intensive, characterized by marina slips, limited bulkheading, mowed fields (where small boats are hauled out in the winter), and a large parking area with a number of outbuildings. It is encouraging that a facility of this size provides significant Bay access while still

maintaining sizeable areas of undeveloped land. The eastern portion of the central peninsula has an open tract with trails, bounded by a dredge spoil berm, both of which are vegetated by high marsh and upland shrubs, such as bayberry, groundsel tree and autumn olive.

Views across the eastern peninsula and across the southern marshes of Cedar Bonnet Island evoke the image and the splendor of the pre-colonial salt marshes of New Jersey. Conservation of Cedar Bonnet Island marshes will protect the aesthetic impression for those visitors entering Long Beach Island by its only access point. More importantly, restoration, consolidation (if possible), and care of existing marshes should be priorities within an overall program to promote the health of the Bay.

Drag Sedge and Hester Sedge

Little Egg Harbor Township

32.1 Acres

Drag Sedge and Hester Sedge are classic Barnegat Bay sedge islands under private ownership. These two sedges are components of the Hither Island group, which defines the southern reaches of Little Egg Harbor-Barnegat Bay. The entire group comprises a flood tide delta produced by sediment deposition. This island group provides a critical habitat link between three management areas: the Holgate Unit of the Forsythe Refuge on Long Beach Island; mainland sections of the Forsythe Refuge along the western shore of the Bay; and the Great Bay Wildlife Management Area (New Jersey Department of Environmental Protection) to the south. The numerous elements of this small archipelago (14 islands in excess of 9 acres and some 13 islets) are closely associated and argue for the conservation of the entire Hither Island group.

Drag Sedge, by far the largest and most complex of the two sedges, may have been split from Story Island, from which it is now separated by a narrow channel. In addition to extensive low salt marsh with marsh-elder, Drag Sedge sports three serpentine tidal creeks. Aerial photographs reveal that the western tidal meander continues on across the northern neck of Story Island, further demonstrating the common origin of the two islands. The number of creeks and interior tidal marshes at Drag Sedge is exceptional, and helps establish the high habitat quality of this island site.

Salt marshes have long been recognized as one of the most productive ecosystems on earth. Tidal creeks greatly augment that productivity by transporting nutrients to and from the interior of the marsh and allowing the denizens of the Bay — the bivalves, crabs, shrimp, and fishes — direct access into the marsh. A marsh with creeks and riparian “edge” is more valuable to fishes. For example, killifish are residents of marsh creeks and provide a critical link in the food chain as they transfer nutrients from the marsh detritus, on which they feed, to larger organisms which feed on the killifishes. Other fish utilize marsh creeks as nurseries in which the young fry gain weight and size. Summer flounder, for example, spend their first summer in marsh creeks, growing at a rate of 2mm/day, one of the fastest rates for any estuarine fish (Ken Able, personal communication).

A tidal marsh with creeks is also a highly favored hunting ground for herons, egrets, and gulls that prey on available marine life. In fact, the Hither Island group is particularly rich in colonial nesting birds — common terns and laughing gulls.

An effective approach to both conservation and management of the Hither Island group would be to assimilate all the island components, no matter how small, under one jurisdiction or ownership. Like West Sedge, East Sedge, and Middle Sedge, Hester Sedge is an outrider of the main island group. Hester Sedge is only protected by other islands to the south and its small size and exposure to wind and waves underscore its fragile nature.

East Sedge

Little Egg Harbor Township

9.7 Acres

Located 1.5 miles to the west of Beach Haven Borough on Long Beach Island, East Sedge is the northern outlier of the Hither Island sedge island group.

East Sedge is the smallest of three privately-owned islands that are encountered northwest of Barrel Island and northeast of Johnny Sedge — both protected areas within the Forsythe Refuge. Along with other members of the Hither Island group, East Sedge is part of a flood tidal delta, created when sediment, flushed up through the Beach Haven Inlet, settled at varying rates in shallow water. In general, an island group west of the barrier island usually indicates the existence or pre-existence of an inlet, which may have closed up after the islands had formed (Ken Able, personal communication).

As is typical of sedge islands, East Sedge presents a low profile from the water. *Spartina* marsh makes up most of the northern half of the island, while shrubs of the high salt marsh, chiefly marsh-elder, constitute the southern half. Several small pools, one of them with an islet of its own, are found on East Sedge. Trailing off to the southwest are two sand shoals or “sub-islets.” The sedge islands, then, are portions of a delta system and serve as stepping stones for the Bay’s flora and fauna. At each low tide, the islands regain their more ancient configuration and connectedness.

The conservation of one sedge island by itself may not seem to make much of a difference. The conservation of a system of sedges, however, is very significant, particularly in light of the widescale and ongoing fragmentation of the natural world. A system of sedge islands helps to insure that a diversity of habitat is available to various Barnegat Bay organisms. Moreover, a system with numerous components has greater resiliency and ability to buffer or withstand external forces. Increasing boat traffic and visitation of islands, for example, will be less disruptive to a natural system sufficiently large and diverse to dilute such impacts. Furthermore, the island group to which East Sedge belongs is very close to a large, protected area

on the mainland. Islands and mainland refuges serve to protect each other from disturbance and also serve as reciprocal genetic reservoirs for the reestablishment of species, in the event of a local population's elimination.

As part of the Hither Island Group, East Sedge shares the rich avifauna of that group. For any given breeding season, there is always a colony of Forster's terns established on one of the islands of the group. Nesting snowy egrets, great egrets, black crowned night herons, and glossy ibis add to the great mating activity so evident in the sedges during the spring and summer months. It should be noted that common terns and laughing gulls also nest in the island group, although exact locations of colonies do change from year to year (Joanna Burger, personal communication).

The desirability of island links or corridors is recognized in the proposal to have the Mullica/Great Bay System established as a National Estuarine Research Reserve. Such a reserve would also encompass the Hither Island Group (Ken Able, personal communication).

Flat Island and Islets

Long Beach Township

72 Acres (Total)

Flat Island and its four attendant islets are located 1,200 feet west of Long Beach Island (north of Brant Beach), one half mile southeast of Cedar Bonnet Island and one half mile northeast of Egg Island. Flat Island's shoreline is extensive, varied, and has many embayments. The islets, three of which do not exceed .1 acre in size, were calved from the main island by currents and storm tides. The process of producing islets continues. Points on the northern and western shores appear to be prime candidates for future islets. A short tidal stream snakes its way into the interior at the midpoint of Flat Island's western shore.

Nearly seventy-five percent of the 67-acre Flat Island is occupied by salt marsh, with the largest pockets of shrub vegetation, at a slightly higher elevation, being along the southern and western edges of the island. At many points along the shoreline, Phragmites or giant reed grows right to the water's edge and is present in two tiers. The more advanced fall coloration and shorter stature of plants at the shore's edge may indicate the increased stress faced by these plants. Bayward of the Phragmites, a thin skirt of salt marsh grasses, characterized by a greater tolerance for salinity, is often encountered. Habitat diversity beneficial to both terrestrial and marine faunas is best developed on the northern and western shores. Lagoons, mudflats, and tidal rivulets provide haven and feeding areas for sandpipers, egrets, herons, and ducks. In the summer months, the embayments are predicted to harbor bountiful marine life, including

Preserves as Islands of Life

The view of all preserves and refuges as islands (whether or not they are bounded by water) has provided conservation biologists and natural resource managers with a powerful conceptual tool. A high degree of interconnectedness between the islands or patches of habitat allows biologists to be optimistic about the future of the organisms that inhabit or utilize these circumscribed pieces of ground.

silversides, mullet, and blue crabs. The “upland” flora, often separated by only half a foot from the level of the marsh grasses, is characteristic of the Bay: marsh-elder and groundsel tree on lower ground, with bayberry at slightly higher elevations. Deciduous trees are found at the northern end of the largest island and offer a safe roost for herons and egrets.

Flat Island presents the image of a beautiful refuge in vivid contrast to neighboring heavily developed Long Beach Island. The remains of a trail east of the center of the island and several sandy clearings at higher elevation may hold clues about prior human activities. As was the case for many of the marsh islands when water access and transport were the norm, salt water hay was probably harvested on Flat Island in the 18th and 19th centuries. Mosquito ditching is not in evidence, a factor which makes Flat Island’s marshes more appealing from a research standpoint. In studying how wetlands function, biologists understandably favor more pristine areas over areas which have been manipulated by man, whether through ditching, diking, lagoon construction, or filling.

Ham Island and Islets

Long Beach Township

21.5 Acres

Ham Island and its islets lie approximately .5 miles west of Beach Haven Borough on Long Beach Island and 1.8 miles east of the Forsythe Refuge on the Bay’s western shore. The largest islet (3.1 acres) lies .1 mile south of Ham Island while the smallest islet is nearly contiguous to Ham’s eastern shore. As indicated by the shallow depths of the surrounding waters, these three land masses may have been united in recent geological time. Alternatively, the island and islets may have arisen due to tide-borne sediments carried in through the barrier island by an inlet that has since closed or shifted its location. The latter explanation is most likely whenever a number of island aggregates form in the lee of a barrier island, such as Long Beach Island.

The largest island’s name may derive from its overall shape, which resembles, in an aerial view, the cross-section of ham steak. With a bit of imagination, one can even equate the circular interior pond with a sectioned ham bone! A more likely origin of the name is a habitation by pigs at some point in the island’s history. The main island has an extensive shoreline with marsh meadows and mud flats. At least half of the island has shrub cover, consisting of marsh-elder, groundsel tree, and bayberry, with a preponderance of shrubs at the southern end. Phragmites is present at the salt marsh fringes.

Colonial nesting seabirds have enjoyed varied success on Ham Island and islets. The easternmost islet is so low that laughing gulls and common terns have nested on it but are not always successful because of flooding. The largest island does have an active herring gull colony in the spring and summer. A small number of laughing gull and common terns have nested there as well. Given sufficient eel grass wrack on which to place their nests, black skimmers have found the island a productive place. Sometimes, 20 - 30 pairs of black skimmers can be found on Ham Island, each bird resplendent with its striking black and

white plumage and scarlet, black-tipped bill (Joanna Burger, personal communication).

Ham Island has a wild, untrammled look to it, and appears, even outside of the seabird breeding season, to function as a refuge. The presence of an osprey platform and of foraging snowy egrets, the absence of duck blinds and trails, and the overflights by a marsh hawk (on the state and federal endangered species lists), underscore the utility of this site as a refuge. Furthermore, Ham is posted with signs that read, “No trespassing or hunting — endangered species habitat.” If Ham is indeed a private nature reserve, such a use serves as an important private conservation alternative to the use of sedge islands as federal or state reserves.

Harbor Island (with Al’s Island)

Dover Township

81.6 Acres

Lying close to Ortley Beach and Mike’s Island, Harbor Island is the southernmost link of the Dover Islands and is immediately impressive because of its large size. The Dover Islands probably had their origin in currents generated by a former inlet of the adjacent barrier island. Extensive saltmarshes occupy at least 60 percent of Harbor Island’s area. A person who attempts to hike into the marshes soon finds myriad mosquito ditches which lace the marshes, making land passage difficult. As revealed by aerial photography, mosquito ditching efforts have been extremely thorough here and on many sites around Barnegat Bay. Mosquito ditching brings the tides more completely into a marsh, preventing stagnation and increasing the salinity of waters, thereby reducing mosquito-breeding activities. The nearby community at Ortley Beach evidently regarded Harbor Island as a major mosquito breeding ground. While mosquito ditching does detract from the pristine environment that would be encountered in an unditched marsh, it also compromises its value for scientific research.

The hand of mankind is further evident in the expansive landscape of Harbor Island. High marsh vegetation, such as groundsel tree and Marsh-elder, and hammocks of northern bayberry, red cedar, and assorted small hardwood trees (maples and cherries) occupy higher ground, largely along the western shore of Harbor Island. Some of this vegetation is found in the remains of filled channels and ditches, producing linear patterns evident through aerial photography. Other areas of shrub vegetation probably occupy dredge spoil deposits, a situation encountered on Mike’s Island and on the southeast corner of Stooling Point Island. Dredging and maintenance of the Inward Thoroughfare and two broader channels leading westward into the Bay have produced copious sandy fill. This fill has then been deposited on islands which were previously saltmarsh. To a degree, then, habitat diversity on many Bay islands can be an artifact, a product of human alteration of the landscape.

Harbor Island, Mike’s Island, Bill’s Island, Al’s Island, and Wilde’s Island all fall under the same ownership. At present, these are surprisingly open and “wild” places. Residential development of the upland portions of these islands is a possibility; such development would forever change the islands’

character and impact their ability to act as refuge or as a wildlife corridor. Tax maps indicate that much of the southern shoreline of Harbor Island has been subdivided into 13 lots, presumably for the construction of seasonal homes.

High Island

Long Beach Township

17.4 Acres

A link in the Barnegat Bay-Little Egg Harbor Island chain, High Island is located .3 mile west of Brant Beach on Long Beach Island and .6 miles southeast of Egg Island, part of the Forsythe Refuge.

With the loss to development of the vast bulk of the barrier beach island between the Barnegat Inlet and the Holgate Unit of the Forsythe Refuge (south of Beach Haven Borough), the islands have, in essence, become a surrogate linear wilderness, a green corridor for wildlife. Avian flyways, resting areas, and feeding areas have been displaced to the east by the growth of Long Beach Island as a residential and recreational area. The maintenance of the Bay islands as open space is therefore a critical element in safeguarding the biological integrity of the Bay and in buffering the major mainland sections of the Forsythe Refuge.

Lying immediately west of the Inland Waterway, High Island has undoubtedly been the site of dredge spoil deposition, which has occurred either on a previously existing sand shoal or on a lowlying sedge island. As is characteristic of dredge spoil islands, High Island has only a narrow fringe of native salt marsh, a ribbon of about four to five feet in width. Next inland is the aggressive giant reed, *Phragmites*, a dominant member of the island's flora. At a higher elevation of six inches to several feet, northern bayberry and groundsel tree take over from *Phragmites*. Eastern red cedar is also frequently encountered in High Island's interior. While the original area of salt marsh is reduced, modified sedge islands and dredge spoil islands can offer a greater diversity of habitat, particularly to upland insect, bird and mammal species. Common terns have been known to nest on High Island. During our visit, a great blue heron quietly shadowed its prey at the water's edge, indicating that life was proceeding as normal, even in a reduced marsh fringe.

It is conceivable that removal of the *Phragmites*, a daunting task in itself, could augment colonial seabird nesting habitat. Islands with elevation are infrequently encountered in the Bay and deserve a high level of stewardship (Willie deCamp, Jr., personal communication).

Hither Island

Little Egg Harbor Township

175 Acres (Total)

43.2 Acres (Private)

The centerpiece of a large sedge island complex, Hither Island lies approximately one mile northeast of Tuckerton Borough and 1.6 miles west of Beach Haven Borough and the Holgate Unit of the Forsythe Refuge.

The significance of Hither Island's geographical position in the southern reaches of the Bay and its significance for conservation can be better appreciated in light of evolutionary biology. The Theory of Island Biogeography, developed by MacArthur and Wilson in 1967, has had important implications for the design of reserve systems. The theory predicts that larger islands and islands closer to a mainland source of potential plant and animal colonists will experience greater diversity and lower extinction rates than small islands far from the mainland. In other words, organisms on smaller, remote islands run a high risk of being wiped-out due to the vicissitudes of nature (such as storms, high tides, diseases, and predation). These organisms face a high risk of not being replaced by other members of their species due to the difficulty of transport to remote island sites.

Second in size only to Story Island, its neighbor to the west, Hither Island provides a rich and diverse habitat for Bay plants and animals. Its great sweep of salt marsh, bands of high marsh shrubs, tidal creeks (which from the air appear more like small rivers), pools, peninsulas, and embayments make this a predictably fertile area for marine and terrestrial organisms. Two facets of a sedge island habitat are of great importance to fishes. Of greatest significance are the marsh creeks, where juveniles of many species shelter and feed (Ken Able, personal communication). In addition, the associated shoal water of the island is also attractive to many fishes as a feeding ground and refuge from larger predatory fishes.

Osprey poles on Hither Island indicate man's successful intervention to reverse the ravages of DDT on "fish hawk" populations. Hither Island shares a rich avifauna with the other members of its island group. In fact, colonies of gulls, terns, and egrets tend to shift from island to island from year to year.

A patchwork of public and private ownership exists on Hither Island. Approximately 75 percent of the 175 acre island lies within the Forsythe Refuge. One private inholding of 18.6 acres occupies a portion of the northwestern shoreline and interior. Forming a wide belt at the middle of the island is a private parcel of 25 acres, which is owned by the same gunning club that owns Drag Sedge and Hester Sedge to the northwest. Given the low horizon of a sedge island, two wooden buildings on the privately-owned portions of Hither are very apparent.

Private owners, whether individuals or associations, can be fine stewards of the land in their possession. In fact, private owners may be more sensitive and responsive to actual and potential problems than the

professional land manager of a preserve system, who has greater ground to cover and limited time and financial resources. Concern arises from the limited longevity of the individual owner and from the changing needs and desires of family and of future owners, should the land be sold. The open space of Hither Island is worthy of long-term protection, either through acquisition in fee or through the use of such conservation strategies as easements, deed restrictions, or management agreements.

Little Island

Beach Haven Borough

4.9 Acres

Located .7 mile west of North Beach Haven on Long Beach Island and 3.2 miles east of the Forsythe Refuge on Barnegat Bay's western shore, Little Island presents the low and uniform profile of a classic sedge island. The salt marsh cordgrass totally dominates, lending its auburn color to the autumn landscape. Little Island is even devoid of the marsh shrubs found on slightly higher ground on other Bay Islands, indicating frequent, periodic immersion. Three minute interior tidal pools lend variety of habitat. On the northern and western shores, cuts are being formed by wave and tidal action. The island's exposed position in the Bay is facilitating the erosion process.

There is little imprint of human presence on this small island, beyond a few poles or pilings of uncertain significance. Duck blinds are not in evidence. Higher ground would be needed for any permanent structures to be built, so the island's natural topography abets its protection.

Even with minimum habitat diversity, a Bay island or islet can still meet the needs of organisms, serving as temporary shelter, resting point, or foraging area. No insular piece of land is too small to be functional in this regard. In this capacity, Little Island continues to be the haunt of cormorants, gulls, egrets, and herons. The island has supported limited nesting by laughing gulls and common terns. Its tidal creeks provide shelter for small fishes, including killifish and silversides, and marine invertebrates, such as shrimp and crabs. The shallows associated with each sedge island are also important areas to marine life for foraging and for retreat from predators of deeper waters (Ken Able, personal communication).

The theme of island utility regardless of diminutive size is further borne out by Bear Island (in Little Egg Harbor Twp.), now a sandy shoal fully awash at high tide. The old pilings remaining above the water surface provide a roost and perch for seagulls, terns, cormorants, and herons, just as the shallows provide attractive feeding grounds for schools of fish.

Little Sedge Island

Dover Township

34.7 Acres

Whittled down to two islands by erosion and rising sea level, Little Sedge Island lies in the middle of a four-member group known as the Lavallette Islands, located north of the Mathis Bridge (Route 37). Along with Little Sedge, the Lavallette Islands include Middle Sedge, Northwest Point, and Marsh-elder Islands. High quality marsh and upland vegetation is concentrated in the site's southern section.

The island's geographic position in the north of the Bay, far removed from Barnegat Inlet, accounts for Little Sedge's importance as wildlife habitat. Its relatively sheltered location protects Little Sedge from storm tides, thereby making it more appealing to marsh nesting birds. Its separation from the mainland (in this case the barrier beach island to the east) prevents terrestrial predators such as rats, dogs, and raccoons from gaining access to eggs and young birds. The Lavallette Islands have been actively used as a nesting site by common terns and have proved the most successful area for the reproduction of least terns in the Bay. Unfortunately, herring gulls have moved onto the two northernmost islands (Northwest Point and Marsh-Elder) over the past ten years. The gulls have almost completely displaced the two tern species in competition for nesting habitat (Joanna Burger, personal communication). Additionally, gulls will procure tern eggs as food. The greater black-backed gull has also been expanding its range and is voracious in its appetite, taking eggs, chicks, and adult birds of less robust species. In the absence of aggressive gull management (in essence, a gull eradication program) in the Lavallette Islands, terns will be unable to make a recovery. As seen on neighboring Marsh-Elder Island (a Century Plan site), shrub areas with bayberry, black cherry, and giant reed have potential as prime nesting habitat for great egrets, snowy egrets, glossy ibis and black-crowned night herons (Joanna Burger, personal communication).

The 35-acre island, inclusive of both sections, is under private ownership. For appropriate management of the natural resource for the long term, future consolidation of ownership, conservation measures, and/or adoption of a wildlife management program are encouraged.

Lower Little Island (Post Island)

Beach Haven Borough

5.6 Acres

Situated .3 mile west of Beach Haven Borough on Long Beach Island and .1 mile west of the dredge spoil island known as the Beach Haven Wild Bird Refuge, Lower Little Island is the only island encountered with an abandoned or vacant residence on it. The building is a two-story structure made of cinderblock with wooden dormers. The structure appears well-built and the owner apparently has plans to continue its renovation.

An orderly progression of vegetation characterizes this island. Circumnavigation of the island reveals a line of heavily eroding peat (the marsh substrate), colonized by algae. This immediate shoreline is followed by a belt of salt marsh cordgrass with beds of sea lavender or saltmarsh rosemary. The next vegetative belt toward the island interior consists of giant reed. The highest elevation, on which the house sits, carries a patchwork of bayberry.

Despite the present condition of the residence, Lower Little Island evokes the dream of an insular retreat, a small parcel of nature with all the comforts of home. The remains of an old pier facing Mordecai Island and Long Beach Island suggest historically a more active human presence on Lower Little Island. Visually, the building dominates the landscape, and the island is sufficiently visited by humans and their pets to discourage seabirds from nesting.

Marsh-Elder Islands

Long Beach Township

72.5 Acres

The most easterly of the paired Marsh-Elder Islands lie less than .2 miles west of Silver Beach on Long Beach Island, across a channel with a depth of six feet at mean low water. The group is located 1.7 miles southeast of the Forsythe Refuge's Brigantine Unit. A shallow channel of less than .1 mile separates the two Marsh-elders. As indicated by the shoal water surrounding them, the islands may have been connected at one point in their history. Powered by currents, storm tides, and rising sea level, an early embayment of the parental island could have broken through and become enlarged. On the other hand, the two islands may represent a small flood tidal delta, formed when sediment was carried into Little Egg Harbor through a now closed inlet.

With the exception of Mordecai Island, the Marsh-Elder Islands represent the largest insular, wild area closely situated to the developed reaches of Long Beach Island. A highly irregular shoreline, tide pools, interior ponds, a meandering tidal creek, peninsulas, and sand beaches lend visual beauty and habitat diversity to the two islands. As illustrated by Bear Island (Little Egg Harbor Township), which supports flocks of cormorants on its pilings, no Bay island is too small to provide resting and feeding areas for avian residents and migrants. Bay islands, in effect, serve as way stations between larger protected areas, such as Island Beach State Park and the mainland portions of the Forsythe Refuge and other state wildlife management areas. Apparently, the Marsh-Elders are too high in elevation and too close to the mainland (in this case, a barrier island) to support colonial seabird nesting. Rats and mice, once transported to the islands, persist in the shrub areas and would thrive on the eggs (Joanna Burger, personal communication).

The two Marsh-Elders are predictably similar in their vegetation. The Eastern Marsh-Elder has the greatest expanse of *Spartina* marsh (approximately 50 percent of the land area) with marsh-elder asserting itself as the dominant shrub. Northern bayberry and groundsel tree, sporting in November the white tufts of its seed heads or pappi, are frequently encountered. Stands of giant reed are ubiquitous, just inland from the swath

of marsh grasses. Myriad inpockets of the peat shoreline point to the activity of fiddler crabs. Great blue herons and snowy egrets stalk small fish and crustacea in the tide pools.

Evidence of human presence and influence on the Marsh-Elders is difficult to decipher. A few duck blinds indicate that the islands are frequented in season by hunters, but the hunting pressure seems to be less here than on other Bay islands. Aerial photography reveals the remains of a former bulkheaded inlet on the eastern shore of Eastern Marsh-Elder, a rectangular area that has been naturally filled in with sediment and is now colonized by shrubs and grasses from adjacent marshes.

The fact that 12.8 acres of Eastern Marsh-Elder is under Federal protection (as part of the Forsythe Refuge) is encouraging. The remaining 72.5 acres, encompassing both islands, are in multiple private ownership. Securing the long-term protection of both islands in their entirety is an important goal, to be achieved either through acquisition or through privately-assisted land conservation tools such as conservation easements, deed restrictions, or management agreements.

Middle Sedge

Little Egg Harbor Township

18 Acres

Along with its neighboring islands, East and West Sedge, Middle Sedge forms the northeastern flank of a large assemblage of sedge islands known locally as the Hither Island group. Middle Sedge is located approximately 1.25 miles west of Beach Haven Borough on Long Beach Island and is 2.2 miles northeast of the Forsythe Refuge (Foxboro Point) on the mainland.

In this position, Middle Sedge rides near the middle of Little Egg Harbor, the southern extension of Barnegat Bay, and provides an important resting and foraging point for birds on seasonal migration and for birds that are present in the Bay for longer periods during the year. Fall migrants, for example, including the spotted sandpiper, pectoral sandpiper, semipalmated sandpiper, ruddy turnstone, and semipalmated plover, fatten up on crustacea and other marine invertebrates inhabiting sandy shores and mud flats. Winter residents, such as the black-bellied plover, sanderling, and dunlin are expected to continue their use of insular resting and feeding grounds, as much as snow and ice permit. Along with other sedges in the Hither Island Group, Middle Sedge has served as a breeding ground for seabirds such as the common tern and laughing gull, and for wading birds such as the snowy egret and the black crowned night heron, which take advantage of shrubs and small trees for nesting purposes.

True to form as a Bay sedge island, Middle Sedge is composed primarily of two *Spartinas*, salt marsh cord grass and salt marsh hay grass. Pockets of brush in the form of marsh-elder are evident. A mysterious set of pilings provokes contemplation about earlier patterns of land use. One wonders whether livestock was ever pastured here. Salt hay was likely harvested from the sedges as early as the 18th century, a practice which continued into the early years of this century.

Proximity to land already conserved is an important criterion in evaluating priorities for potential conservation land. Of the three privately-owned islands (West, Middle and East Sedge), Middle Sedge is most closely associated with the protected islands, Barrel Island and Bunting Sedge. A very narrow channel separates Middle Sedge from Barrel Island. From a geological perspective, Middle Sedge is a northern extension of the more varied and complex Barrel Island. Wide shoals, exposed at low tide, actually unite Barrel with Middle Sedge twice within a 24-hour period. It should be noted that all islands of the Hither sedge group are the byproduct of a flood tide delta, created by sediment-carrying current.

Ultimately, the island group deserves to be preserved in its entirety, in recognition of nearby development pressures and continuing island erosion. Other than the dredge spoil islands and the shifting sand shoals, which crest above the water at low tide, islands are not being created anew but are being slowly consumed by a rising global sea level.

Middle Sedge Island

Dover Township

89 Acres

Despite the fact that 80 percent of its land is under public ownership, the size, complexity, and proximity to a heavily developed barrier island argue for the inclusion of Middle Sedge in the Century Plan. Harboring 73 acres under the jurisdiction of Dover Township and 16 acres in private ownership, Middle Sedge is the largest island in the northern reaches of the Bay, north of the Mathis Bridge (Route 37). Middle Sedge is located only .1 mile west of the Dover Township community of Silver Beach, just north of Lavallette Borough.

Middle Sedge Island, with its many tidal pools, meandering channels, pocketed shoreline, peninsulas, and pervasive *Spartina* marsh, is a remnant of the vast marshes that once covered the western shore of the great barrier island, covering some 38 miles from the Metedeconk River in the north to Holgate and the Beach Haven Inlet in the south. The presence of neighboring and undeveloped Marsh-Elder Island and Northwest Point Island to the southwest greatly augments the significance of Middle Sedge Island as a natural area. Adding to the beauty and complexity of Middle Sedge is the tidal “river” that snakes its way into the island’s interior from north to south and which some day may successfully cleave the island in two. An aerial view confirms that fragmentation of the island’s land mass is an ongoing and dynamic process. The storm tides, high winds, and wave surges of a nor’easter (or, more rarely, a hurricane) can greatly accelerate such a process.

Middle Sedge presents, on a grand scale, the predictable pattern of marsh vegetation encountered in the majority of sedge islands in the Bay. Saltwater cordgrass, with its high tolerance for salt water, lies seaward of the salt marsh hay grass, a shorter grass with a cowlicked, tossed appearance. The latter was harvested over the last several centuries as winter fodder for cattle. At elevations usually slightly above the *Spartinas*

and positioned further inland are the shrubs of the high marsh — groundsel tree and marsh-elder. Northern bayberry forms hammocks at elevations that are even slightly higher. The overall difference in elevation between low marsh and high marsh may be on the order of less than 0.5 to 2.0 feet. Botanically, Middle Sedge harbors a pleasant but not unexpected surprise; growing in the midst of the marsh grasses are found the clustered pink flowerheads of salt marsh fleabane. This wildflower is a marsh specialist, uninhibited by the frequent incursions of salt water.

The hand of mankind has also introduced change to Middle Sedge Island in a dramatic but spatially-limited manner. A mariner approaching Middle Sedge from the northeast, the south, or along the Middle Thoroughfare (which separates the island from Silver Beach) would see a fairly uniform natural landscape, scarcely impacted by human activity except for mosquito ditching and shoreline erosion caused, in part, by boat traffic. An approach from the west reveals a different picture. On the southwestern peninsula of Middle Sedge, known as Cormorant Point, sits a grand edifice, a large private residence complete with docking facilities and a helicopter landing pad. The building is so large, unexpected, and isolated that one, at first, has trouble seeing it as a part of Middle Sedge Island. Rather, the house appears to have risen from the Bay floor or drifted into position from the barrier island. The house sits on the site of a much older edifice, the Hankins House. The owners of this house also own approximately 15 acres, including marshland bordering on the largest tide pool — Cormorant Tide Pond. Another section of privately-owned land borders this property to the south. The Township of Dover presently controls the remaining acreage, in addition to a small inholding south of Cormorant Point.

The private/public patchwork of land ownership on Middle Sedge Island may represent a dilemma for the long-term protection of this natural area. This dilemma is more acute in coastal areas where the resource, specifically the undeveloped coastline, is both limited in supply and an important component of the viewshed of Barnegat Bay. Private landowners have played a vital role in the preservation and management of open space in the Bay. The expansion of a private retreat by an individual or group, however, may not always be in the best interest of the resource. Introduction of tools such as conservation easements, deed restrictions, and/or cooperative management agreements between private owners and public land managers would yield long-term environmental benefits.

Mike's Island (with Bill's and Wilde's Islands)

Dover Township

7.8 Acres

Mike's Island lies slightly more than .1 mile to the west of Ortley Beach, forming, along with its neighbors (Stooling Point and Harbor Islands), the western flank of the Inward Thoroughfare, a narrow dredged channel maintained by the State of New Jersey. A narrow triangular sedge island, Bill's Island is interposed between Mike's Island and the barrier island. One additional minuscule sedge islet, Wilde's Island, apparently was separated from Mike's Island's southeastern flank or arose from the breakup of the former

large land mass that included Harbor, Mike's, and Stooling Point Islands. Alternatively, the group of islands may be the remnants of a flood tidal delta.

A raised crescent of land, dominated by northern bayberry and giant reed, occupies the shoreline of Mike's Island in a 180° sweep, taking in most of the eastern flank. This area is close to the dredged channel, providing evidence that Mike's Island owes at least part of its present configuration to the deposition of dredge spoil. The fine white sand of the island's beaches and interior is a further indicator that a formerly pure sedge island received fill. A salt marsh characteristic of sedge islands, composed of cordgrass, salt marsh hay grass, and scattered clumps of Marsh-elder, is found on the western shore. The shoreline here, on the island's most exposed quarter, consists of pitted and eroding marsh peat. The island's botanical diversity becomes fully evident as the seasons progress. Low mats of beach heather sport lemon yellow flowers in early summer and the inflorescence of asters and goldenrods coincide with the fall migration of monarch butterflies.

Although it represents an altered landscape, Mike's Island does provide a varied habitat and is a part of the island chain that serves as an important corridor for wildlife between the northern and southern reaches of the Bay. The well-developed beach and sand bar at the southern end of Mike's Island are popular resting sites for gulls and terns. Formerly an active site for least tern reproduction, Mike's Island has lost its appeal to these birds as its vegetation has matured (Joanna Burger, personal communication).

Mordecai Island

Beach Haven Borough

67 Acres

Mordecai Island is located less than .1 mile west of Beach Haven Borough on Long Beach Island, from which it is separated by a navigable channel. The site is just south of an existing municipally-owned sanctuary, known as the Beach Haven Wild Bird Refuge.

Mordecai Island is unique among the Bay Islands reviewed in this report in a number of characteristics, including size, natural state, shoreline surface area, and proximity to densely populated residential areas. The island may be a fragment of the barrier island to its north, east, and south. Mordecai Island itself is repeating the process of fragmentation and island genesis, as the embayments along its western shore continue to enlarge and cut through into the interior. Relocation of a channel by the U.S. Army Corps of Engineers some thirty years ago and bulkheading along the opposing shore of Beach Haven Borough have increased the strength of currents and accelerated the natural erosion process. The wakes of large casino-bound boats, that regularly pass by the island's western shore and accelerate into the main channel, cause further erosion. A 1989 aerial photograph points to the formation of a new islet along the northwestern shore. Field observations in the fall of 1994 confirm that the "birthing" of a new islet (at the northern end of Mordecai) is complete.

Mordecai Island beautifully illustrates the ability of natural areas to persist and function despite widespread human alteration of the adjacent landscape. Mordecai evokes the metaphor that all natural areas, whether terrestrial or marine, will ultimately be “islanded” by population growth and the primary and secondary effects of urbanization. Over 60 percent of the land surface supports native salt marsh, with extensive areas of giant reed, a cosmopolitan plant that thrives at slightly higher elevations. Stands of Marsh-elder intermingle with lower marsh vegetation. Certain areas that are raised several feet — a hint of dredge spoils — are colonized by giant reed, bayberry, winged sumac, and token eastern red cedar.

The meandering shoreline, embayments, sand spits, and flats provide a diversity of habitat for foraging and resting birds. In May, June, and July, Mordecai has been known to host nesting common terns and laughing gulls. When the sandy beaches are fairly high and there is sufficient eel grass wrack to be used as nest platforms, upwards of 20 pairs of black skimmers nest here as well (Joanna Burger, personal communication). Mordecai Island is also frequented by a boldly marked and unusual shorebird — the American oystercatcher (Willie deCamp, Jr., personal communication).

Mordecai Island appears to have maintained its ecological integrity despite nearby pressure from resort and residential development. The island was donated by a club member to the Little Egg Harbor Yacht Club, which was originally organized, in 1917, as a gun club. The open space of Mordecai was guaranteed through a deed restriction (John Cranmer, personal communication). Surveillance by the yacht club is facilitated by the short distance across the channel from the clubhouse to the island and by the presence of yacht club members. A few posted signs reading “No Hunting” indicate that other activities, if respectful of the island, such as hiking and birding, are allowed. The island is being successfully managed and maintained and does not appear to be embattled as a result of its location.

Northwest Point Island

Dover Township

17.7 Acres (Privately-owned)

31.2 Acres (Public: all of Marsh-Elder Island and part of N.W. Point Island)

In an aerial view, mimicking a great whale on its terminal dive, Northwest Point Island and its companion, Marsh-Elder Island, form the flukes which flare respectively to the northwest and to the east. Marsh-Elder Thoroughfare appears as a widening tidal incursion that is calving Marsh-Elder from the larger sedge island. All of the islands in this group probably represent a flood tidal delta — the work of a former inlet to the east that was either filled in or that migrated along the barrier island to another position. Northwest Point Island lies .1 mile south of Middle Sedge Island and .2 mile west of Chadwick Beach, on the heavily-populated barrier island.

Northwest Point Island represents a continuation of the expansive marshes of its neighbor, Middle Sedge Island, toward the Bay’s interior. Northwest Point harbors low salt marsh, with saltwater cord grass in full

evidence. Phragmites makes its formidable presence known, forming thick stands to the waterline and shouldering out its competition, chiefly the cord grasses or Spartinas. The fragile peat substrate of the marshes continues to be sculpted and eroded by storm and flood tides.

Despite evident uniformity in vegetation, the island offers ample retreat and respite for avian species on long-range migrations along the Atlantic Flyway, or on short forays from the Bay and mainland. The numerous small, sandy beaches sloping off onto the marsh peat and mud flats are likely to lure shorebirds such as sandpipers, known affectionately by birders as “peeps” (a general name reflecting the birds’ vocalizations as well as the difficulty of identifying the numerous species). Tidal pools, ranging from 0.5 to 1.5 acres, greatly augment the island’s potential as a refuge. With high tides, crustaceans and small fishes have access to the island’s interior and are prime food for avian predators such as herons and egrets.

Quiet and serene in the early winter, Northwest Point Island and Marsh-Elder give little hint of the avian activity they support during the warmer months. Northwest Point Island belongs to a group known as the Lavallette Islands (along with Marsh-Elder, Middle Sedge, and Little Sedge Islands) that have long been relied upon by common terns as a nesting ground. The tern colonies on the four islands once held as many as 500 pairs of birds. Unfortunately, the proliferation of gulls over the last ten years has driven common and least terns from their nesting islands; the last pair of common terns were seen nesting on Northwest Point Island in 1993. Nonetheless, Northwest Point Island’s contiguous neighbor, Marsh-Elder, boasts one of the Bay’s best breeding colonies of shorebirds, including great egrets, snowy egrets, glossy ibis, and black crowned night herons — birds which take advantage of Phragmites, shrubs, or small trees in their nest construction (Joanna Burger, personal communication).

Northwest Point Island currently presents a patchwork quilt of private and public-ownership. At the time of this writing, Marsh-Elder Island and the contiguous middle section of Northwest Point Island are owned by Dover Twp. As is the case for many Bay Islands, sound land conservation can be carried out by public or private owners. A greater consensus is needed regarding the islands’ long-term resource management and protection, particularly if multiple owners are involved.

Parkers Island

Little Egg Harbor Township

2.1 Acres

Characterized by its small size and relative isolation, Parkers Island nevertheless provides an embodiment of the Bay sedge island condition. It is located midway between the Hither Island group of sedges and the Forsythe Refuge on the mainland (at the southern edge of Little Egg Harbor). The inclusion of this island of only 2.1 acres indicates a recognition of the role that each and every component of the Bay ecosystem plays. To ignore these small islands because of diminutive size would be a mistake, since they add to the complexity and fragility of the Bay ecosystem as a whole. To migrating waterfowl and colonial birds on the Atlantic Flyway, each parcel of land in the Bay has potential significance as a resting and feeding area to

prepare for the long haul. That potential significance has been recognized by hunters over the centuries. Parkers Island is a roughly circular “landmass,” suspended between aquatic and fully terrestrial worlds. Incorporated in death in the spongy peat that supports the marsh or arrayed, living and wind tossed, above the peat, the *Spartina* grasses of both past and present make up the bulk of this island. A sparkling glint evident among the grasses calls attention to a solitary tidal pool — the sedge’s blue eye, reflecting the overarching sky and, in season, the great migrations.

As is certain for members of the Hither Island complex to the east, Parkers Island provides nesting habitat for terns or gulls in the spring and summer months. Out-of-season visitors would never guess at the level of nesting activity which occurs on the sedges. The avian instinct for appropriate nesting habitat has been finely-tuned over the eons. Birds use marsh islands that are high enough to escape being flooded by summer tides but low enough to be swept clean of any predators by the winter high tides (Joanna Burger, personal communication).

Pettit Island

Stafford Township

2.6 Acres

Pettit Island is situated .5 mile above Cedar Bonnet Island at the Manahawkin Bay Bridge and .5 mile west of Surf City Borough on Long Beach Island. Although this island lives up to its name due to limited size and diversity of vegetation, it does have biological importance. The low sedge island is vegetated primarily by salt marsh cord grass and by small clumps of marsh-elder. The two small ponds at its northern end enhance the island’s attraction for waterfowl. A circular trail and duck blinds point to a primary human activity here — duck hunting. Pettit Island appears to be operated as a private hunting preserve. In contrast to many of the sedge islands in the Bay, sod embankments have been dug to provide foundations for duck blinds, thereby making the shoreline even more vulnerable to erosion.

Pettit Island belies its name in regard to nesting seabird populations. Having up to 1,500 breeding pairs in late May and June, Pettit boasts one of the most highly successful common tern colonies in the Bay. Young terns fledge by mid-July. From April to November, Pettit also accommodates a colony of black skimmers, ranging from 2 to 30 pairs, depending upon the year. Several pairs of herring gulls nest on the island each summer and efforts have been made by ornithologists to keep the gulls off, as the gulls are capable of rapidly taking over the tern and skimmer nesting territory (Joanna Burger, personal communication).

The size of the island makes it unlikely that any building will occur here. However, significant wildlife management challenges exist that may require regular and thorough stewardship.

Sandy Island

Barnegat Township

66.4 Acres

Guarding one of the narrowest portions of Barnegat Bay, Sandy Island is only .25 mile from a major mainland section of the Forsythe Refuge, east of Barnegat and .5 mile west of Harvey Cedars Borough on Long Beach Island. Sandy Island is one of the largest private islands under single ownership, serving as the site of a hunting lodge and hunting preserve. The sedge island shows significant modifications facilitating the activities of a gunning club. In late October 1994, the single story wooden lodge was undergoing repairs prior to the opening of the duck hunting season. Two separate channels have been dredged to provide boat and barge access to the lodge. The largest channel, with dredge spoil banks supporting high marsh vegetation, proceeds from the eastern shore into the island's interior. This channel is a feature on all maps and charts. A narrower channel cuts in to the lodge from the northwest, allowing passage of small boats and providing an alternative route in the event of wind conditions unfavorable for an easterly approach. Sandy Island presents the picture of a classic but massive sedge island. Remnants of the island's lowland tail curve to the north, yielding to the erosive power of the elements. *Spartina* marshes make up the bulk of the land mass, pocketed by no less than 26 ponds or tide pools of varying sizes. The ponds are usually interlinked, either by natural tidal meanders or by the ever present mosquito ditching. A number of the ponds appear to be senescent, having been filled in with sediment and subsequently colonized by marsh grass. The water impoundments, natural and otherwise, make for a highly attractive setting for waterfowl and for hunters. The artificial berms provide substrate for giant reed, Marsh-elder, groundsel tree, and northern bayberry.

Diverse nongame bird species were encountered during a brief circumnavigation of Sandy Island. A great egret and a great blue heron took to wing from the marsh rim. A male black-bellied plover lingered on a small sedge pinnacle, the base of the island's northern tail. A belted kingfisher made its presence known with a territorial screech as it darted out over the Bay from its perch on a Marsh-elder. Sandy Island has an active herring gull colony in the spring and summer months, with a small number of greater black-backed gulls also in attendance. Additionally, Sandy Island has had nesting common terns, but these birds have been discouraged by an increasing gull population (Joanna Burger, personal communication).

The nearness of the large landmass of the Forsythe Refuge, in which hunting is currently prohibited, poses intriguing questions. Is the gunning activity occurring at the expense of the Refuge, preying on birds which are forced up the narrow bottleneck of the Bay? Alternatively, does the co-existence of longstanding hunting practice and of the preservation of natural areas represent a genuine resource conflict?

Sedge Island

Ocean Township

21.9 Acres

Sedge Island forms a capstone of the Sedge Islands Wildlife Management Area northwest of the Barnegat Inlet off Island Beach State Park. The site is unusual in combining a pristine natural environment, seasonal human habitation in the form of a lodge and two attendant buildings, and a distinctive historic record. Sedge Island was recently acquired by the Trust for Public Land through the generosity of the Morrison family and conveyed to the State of New Jersey for public use and historic preservation and as an educational and environmental field station. The site will be used for Division of Fish, Game and Wildlife (DEP) authorized wildlife education.

Sedge Island has long been in private ownership and has an intriguing past. The property has served as a family retreat and hunting and fishing camp since the late 1800s. The Great Sedge Gunning and Fishing Club, founded in 1919, boasted numerous members and visitors. Among the luminaries of the sporting world to visit the island, probably on duck hunting trips, were Lou Gehrig and Babe Ruth. The Sedge House, the island's main lodge, built in 1919, served as headquarters for the Coast Guard Auxiliary Squadron and was assigned to provide local surveillance of German naval operations during World War II (Miller, 1994).

Sedge Island presents a varied landscape, with Phragmites and Spartina marsh and well-developed uplands containing eastern red cedar, groundsel tree, northern bayberry, and assorted deciduous shrubs and small trees. The bright scarlet of Virginia creeper proclaims the autumnal season, particularly when set against the deep green of the cedars. Drawing migratory birds to its fruits by colorful leaves, virginia creeper is demonstrating a phenomenon known as "foliar flagging." Extensive clam flats, the rights to which are leased-out, are associated with Sedge and its neighbors.

Sedge is part of a larger island group, a flood tide delta, of ornithological significance. The island group has harbored nesting common terns — a situation which changes from year to year, depending on the presence of peregrine falcons. The falcons were reintroduced on neighboring Great Sedge in 1975 by the DEP Division of Fish, Game and Wildlife. The smaller islands of the group have also been used as nesting areas by black skimmers.

Looming up on the southern shore, Sedge Island's buildings could be mistaken for a small island village. Weatherbeaten but well kept, they blend quite effectively with their surroundings. The gray shingled lodge, Sedge House, is spacious and offers a screened-in porch on the water, a small dock, and bulkheading. In the heyday of its operations, from the 1920s until the mid-1970s, Sedge House was used as a dining hall, a dormitory with space for 18, and club house for members and guests. The middle building is an old barn, which has been home to a cow or two, even in recent times. The most easterly of the buildings is actually a barge which has been converted into a caretaker's residence.

Sedge Island and its buildings have played and will continue to play an important role in the life of the Barnegat Bay. Currently under state ownership, Sedge will provide an ideal setting for research, natural history programs, and Bay-oriented education. A new chapter in the history of Sedge Island, as recently documented by Pauline Miller of the Ocean County Cultural & Heritage Commission in her fine monograph, *The Great Sedges* (1994), will soon begin.

Shelter Island

Long Beach Township /

Beach Haven Borough

21.3 Acres

Positioned in the middle reaches of Little Egg Harbor (the southern extension of Barnegat Bay), the privately-owned Shelter Island lies 1.3 miles west of North Haven Beach on Long Beach Island and 1.4 miles southeast of the Forsythe Refuge on Little Egg Harbor's western shore, near Tuckerton. Pettit and Lower Little Islands lie to the southeast and the Marsh-Elder Islands lie to the northwest (all Century Plan sites).

Shelter Island is characterized by numerous tide pools which flood twice daily, and marsh ponds which receive influxes of salt water primarily during storm events and unusually high spring tides. It is, in essence, a sedge island composed largely of salt marsh grasses with a backbone of high marsh. Marsh-elder, a bushy shrub with serrated light green leaves and spires of greenish-white flowers, is the overlord of the high marsh zone.

The relatively simplified ecosystem of a sedge island, however, has its surprises. The succulent stalks of glasswort, whose autumnal shades of salmon pink and carmine intergrade into persistent summer greens, appear beneath an otherwise uniform light ochre mat of salt marsh hay grass. A rustling sound in a marsh-elder clump reveals a song sparrow, a frequenter of marshes, foraging for insects.

Mounds of dead eel grass, one of the few flowering plants to thrive in a marine environment, mark the highest incursions of spring tides, which deposited broken blades of eel grass well inland. One of the most important primary producers of the Bay (turning solar energy into carbohydrate, which is then available to other organisms), eel grass is often associated with the Bay's shoreline and sedge islands and is generally found at depths of 1 meter or less. Despite a massive die back of eel grass that occurred in the 1930s and 1940s due to a microbial wasting disease, eel grass has made a come back in the Bay and is generally found from the two Marsh-Elder Islands north. In fact, eel grass beds are as dense or denser than those of the Chesapeake Bay, where the species is also making a recovery. North of Cattus Island, eel grass is increasingly replaced by widgeon grass (Ken Able, personal communication). Eel grass is also important in that it provides habitat and nursery for marine invertebrates and fish and serves as food for many waterbirds, including brant, Canada geese, black ducks, mallards, and American goldeneye. Black

skimmers have a special use for dead eel grass that has been deposited by the tides. The mats are used to form a platform on which the nest can be constructed, affording a measure of safety from spring and storm tides. In addition to black skimmers, laughing gulls and common terns have also used Shelter Island as a nesting site (Joanna Burger, personal communication).

As with many of the sedge islands of Barnegat Bay, human presence on and use of Shelter Island is strongly seasonal. Duck blinds point to the island's primary use as a duck hunter's station during the autumn.

Sloop Sedge and Islet

Barnegat Township

14.3 Acres

Sloop Sedge and its attendant islet are located at a strategic mid-Bay position: .5 mile east of Whalebone Point on the mainland expanse of the Forsythe Refuge at Barnegat Township; .7 mile west of Loveladies Harbor on Long Beach Island; and 1.6 miles southwest of the state-protected Sedge Islands north of the Barnegat Inlet.

This island is aptly named. It appears from overhead and from the water (with a stretch of the imagination) as a sailing vessel, close-hauled against a freshening northwesterly breeze. The diminutive sedge could represent its dinghy in tow. Sloop Sedge is exposed to the elements from all compass directions.

All of the Bay islands have an important function as way stations or stepping stones for migrating waterfowl and shorebirds. Because of its relative isolation, its mid-Bay position, and the loss of suitable habitat on Long Beach Island to the west, Sloop Sedge is particularly suited for the role of stepping stone. Duck hunters have taken advantage of this strategic position. The foundations for blinds are visible at several points on the shoreline. A white rectangular structure, which appeared at a distance to be a building, perhaps a hunters' lodge, actually turned out to be a State of New Jersey barge, possibly indicating research in progress.

In terms of landscape and vegetation, Sloop Sedge and islet represent a distillation of the Bay islands. *Spartina* marsh forms the island periphery and the major interface between water and land. The golden brown marsh grasses also form a good portion of the interior. Marsh-elder predominates as the high marsh shrub, and is accompanied by bayberry and groundsel tree. Reflecting an apparent genetic difference, some clumps of marsh-elder shrubs had shed their leaves by late October, in preparation for the winter months ahead, whereas other clumps still retained their summer foliage. Sloop Sedge also boasts an interior pond, which greatly enhances its appeal for ducks and geese. The pond configuration is very regular, however, suggesting possible enlargement or deepening of a natural pool with the specific purpose of enticing waterfowl to the island. With a tidal pool of its own, the islet is a miniature version of Sloop Sedge.

Regarding the loss of common tern and black skimmer breeding colonies, Sloop Sedge mirrors the pattern encountered on numerous bird-nesting islands along the Atlantic coast. Herring gulls, whose range has spread since the 1940s aided by proliferating garbage dumps, have taken over Sloop Sedge as a spring-summer breeding territory (Joanna Burger, personal communication). The more aggressive greater black-backed gulls invariably join the herring gulls and command the best nesting sites on the island. Included in the black-back's omnivorous diet are the eggs and chicks of other species (and of its own species, if neighbors' eggs or chicks are unguarded!) The more fragile, fish-eating terns are both easily discouraged and displaced from their mating sites by aggressive gull species.

In full cooperation with the private owners, a gull eradication program could be carried out through the U.S. Fish and Wildlife Service. Gull nesting can be prevented through active measures that either remove gulls from the island or discourage gulls from nesting. In the absence of gulls, terns will be quick to re-establish their colonies.

Stooling Point Island

Dover Township

17.7 Acres

Stooling Point Island is the northernmost island in a chain of islands immediately north of the Thomas A. Mathis (Route 37) Bridge. Stooling Point Island is separated from the Ortley Beach area of Dover Township by the Inward Thoroughfare, a navigable channel which is less than .1 mile in width. The island is .2 mile north of its nearest neighbor, Mike's Island.

The chain of islands, of which Stooling Point is a part, is not immediately close to refuges and its preservation is important in linking a baywide system of natural areas. The fragmentation of remaining undeveloped land and the loss of corridors, passageways along which plants and animals can move, are among the grave consequences of development predicted to accompany an increasing population along the New Jersey coast. Islands, in essence, must serve as a natural corridor for the considerable stretches along the eastern edge of the Bay where Island Beach State Park does not have a presence.

Stooling Point Island presents a surprisingly varied vegetational profile. A rim of sand followed by a ribbon of salt marsh cordgrass defines the shoreward margin of the island. Giant reed characteristically positions itself inland of and often intermingling with the cordgrass. Glasswort or samphire, a succulent marked by a resplendent scarlet color in the fall, is a native marsh inhabitant that can be found here, along with bur reed. It is the well-developed hammock growth, however, that distinguishes Stooling Point from the classic sedge island. In fact, the uplands here may be a result of deposition of dredge spoils from prior activities along Inward Thoroughfare. At an elevation of one to two feet above the marsh, the hammock is composed of groundsel tree, northern bayberry, red maple, staghorn sumac, eastern red cedar, black cherry, and sassafras. Poison ivy is a frequently-encountered component of the hammock, its white berries and orange-red foliage contributing to the autumn scene. In certain areas, the bayberry bushes are very concentrated

and present a dark green wall against the white sand. The majority of plant species present in this hammock are important components of the diet of migrating birds, such as the cedar waxwing, myrtle warbler, and American robin.

During our brief stay in the vicinity of the island, bird life was very evident: great blue herons, great egrets, and snowy egrets searching for prey at the water's edge; mute swans congregating in rafts offshore; and Canada geese winging south in large numbers. As a potential site for nesting seabirds, Stooling Point's landscape would benefit from the creation of an interior, cleared area. Terns, for example, need a bare sand substrate for their nests and insurance, due to the slightly higher elevation, that flood tides will not carry nest and eggs away. It can be argued, therefore, that active management of this site could definitely increase its productivity for certain avian species.

West Sedge

Little Egg Harbor Township

27.5 Acres

The westernmost of a triad of privately owned sedge islands, West Sedge is situated 2.1 miles west of Beach Haven Borough on Long Beach Island. West Sedge is 3.3 miles east of the mainland component of the Forsythe Refuge at Tuckerton. It is, however, on the northern fringe of the Hither Island group, 3/4 of which is under state protection.

At 27.5 acres, West Sedge is the largest of three northern outliers of the Hither Island group. With its embayments and peninsulas, it offers a greater degree of variation in shoreline and a higher diversity of habitat than its two companions, East Sedge and Middle Sedge. The island consists predominantly of low salt marsh, with the northern section containing the best-developed high marsh, as the shrubs, Marsh-elder, and groundsel tree grade into bayberry clumps towards the interior.

In essence, the island group, a small archipelago to which West Sedge belongs, serves as a natural bridge between the Forsythe Refuge to the west, the Great Bay Wildlife Management Area to the southwest, and the Holgate Unit of the Forsythe Refuge to the south. The Hither Island group spans Little Egg Harbor near its widest point. In an ever-shrinking natural environment, these sedge islands provide a haven and an alternative habitat for terrestrial and aquatic organisms. The island group serves as a critical corridor for avian migrants and its associated shallows serve as a feeding area for fish and marine invertebrates. The Hither Island Group is well-known in the Bay for its colonial nesting gulls and terns and nesting herons, egrets, and ibises. West Sedge shares fully in this living heritage.

Each link in the Hither Island chain deserves protection for the long term. Once it is built upon or altered from the natural condition, an island link is less effectively available to wildlife. Dredging and filling, the

construction of a house, a dock, or a pier, the intrusion of boats and barges, the introduction of pets, and frequent excursions onto an island are all potential ways in which an increased human presence can impact a previously wild area. The detrimental effects of these activities can be difficult to reverse.

Woods Island

Harvey Cedars Borough

1.8 Acres

Located .1 mile west of Long Beach Island in Harvey Cedars Borough, Woods Island demonstrates the significant pressures, both natural and human, at work on Barnegat Bay's islands and coastline. The formerly-bulkheaded shores of Woods Island are retreating from the onslaught of rising sea level, storm and flood tides, and prevailing winds. Isolated pilings extending some 150 feet west of the island indicate an earlier shoreline. The eastern shore of this small island is intact, with bulkheading in place and a sand spit in the process of formation. Certainly aiding the erosion process are the wakes of passing boats and jet skis.

As an outlier of protected islands (Harvey Sedges, Carvel Island, and Marsh Elder Island) and of a major mainland component of the Forsythe Refuge, Woods Island presents a fragment of nature in surprising proximity to the intensively-developed western shoreline of Harvey Cedars Borough. Nature has a determined, if somewhat tenuous, hold on Woods Island. True to its name, the island is largely wooded, with bayberry and red cedar predominating. On the western shore, shrubs have been killed and uprooted by the concerted action of wind and waves. Where sandy substrate for growth remains adequate, *Phragmites* has established a strong foothold along the northeastern shore.

The significance of this island lies not in its biological diversity but in the challenge it presents for long-term stewardship of Bay islands in general. Change in configuration and size over time are the rule for sedge and sand islands of a shallow bay. Sand and soil are continually being added, removed, and reworked. The process of removal, however, is being aided by a rising sea level. Woods Island seems to be accelerating its approach to the condition of Bear Island, north of East Sedge (Little Egg Harbor Township), the surface of which is entirely below water at high tide. Efforts to prevent the loss of Woods Island to erosion have been unsuccessful at this point. As an alternative to erection of new bulkheads, the reestablishment of a salt marsh perimeter could serve to trap sediment and buffer wave action. Another alternative, of course, would be to let nature take its course.

“As I look back it seems that all my life I have been in close touch with marshes — and always have I taken them for granted...Summers during my boyhood I lived on the Barnegat, which is to say, I lived half in the marsh and half in the sea.”

Edward Weeks

Barnegat Bay Beach Inland Area

Ocean Township

950 Acres (Estimated)

As outlined by the U.S. Fish and Wildlife Service in its 1994 environmental assessment, the Barnegat Bay Beach Inland Area consists of three subareas located on both sides of Route 9, north of the town of Barnegat. An opportunity still exists to consolidate these tracts.

Subarea A

Bounded approximately by Bay Shore Avenue to the north and Cedar Street to the south, Subarea A is adjacent to existing Forsythe Refuge holdings east of Ridgeway Street. Bisecting the tract is Bay View Boulevard, which provides a fine visual sampling of a well-developed but fairly young forest of 30-40 years in age. The landscape is dominated by pitch pine, with an admixture of white oak, black cherry, red maple, gray birch, American holly, and low gallberry or inkberry holly. Pokeberry, staghorn sumac, and coastal pepperbush can be found on the woodland edge. A slight decrease in elevation or increase in soil moisture brings Atlantic white cedar to the fore. A fine maple/gum swamp forest is evident in the interior. Trails that run along the crest of old berms can be found, marking the existence of former cranberry bogs. Catbrier and brambles, both major components of the wetland understory, are present throughout the three subareas, as they are throughout the Barnegat Bay watershed. Evergreen against the brown leaves of the forest floor, these hardy plants are armed with sharp thorns that discourage ready passage through the woodland and serve as a warning to browsing herbivores.

Subarea B

In Subarea B, the pinelands and the lowland deciduous forest are present in condensed, almost miniature, form. The smallest of the three Barnegat Bay Beach Inland Area sites, Subarea B (30 acres) occupies a roughly rectangular area north of Seminole Avenue, south of Pancoast Road, and east of Route 9. By entering a thick screen of pines, one is able to quickly and amazingly extract oneself from the dizzying onrush of the Route 9 corridor and enter a quieter world. Pine Barrens upland forms the perimeter of this tract. Fine white sand, cinnamon-colored broom sedge, the pale browns of winter grasses, and the green of pitch pine serve as a backdrop against which some scarlet oaks blaze with a color of leaves that persist through the fall and winter months. Beyond the pines, a deciduous lowland forest opens up, characterized chiefly by a red maple canopy with sweetbay magnolia, brambles, and catbrier in the understory. Subarea B

illustrates a theme encountered in many of the smaller Century Plan sites — namely, that retention of ecological integrity, habitat value, and beauty are possible, even on a reduced scale. As witnessed during studies of remnant rainforest patches in Central and South America, smaller sites can be highly instructive regarding the long-term viability and stewardship of resource areas of varying sizes.

Response to Stresses by a Woodland of the Bay Watershed

Three stresses of different origins and magnitudes are operative in the woodland of Subarea C. Numerous scarlet oaks of varying ages in this tract bear swollen growths, peppered by minute holes, on stems and branches. Many of these appear to girdle twigs and kill them. The cause of the growth is a parasitic wasp that lays her eggs in an oak branch. The tree responds to the injury by producing a tumor-like gall, in this case the potato oak gall, which houses and feeds the developing wasp larvae. When the larvae have matured, they break through the gall, leaving behind the numerous exit holes. Because gall formation is initiated by physical and chemical disturbance of plant tissue and results in rapid cell division and a tumor-like growth (characteristic for the host plant and the parasite), the study of plant galls is of considerable relevance to the study of animal and human cancers. Once attuned to the presence of this particular gall and its location on an oak, one begins to notice how prevalent the galls are.

Stress, due to a parasite of an entirely different nature, is evident in specimens of pitch pine within Subarea C. Infrequently, pitch pines display a phenomenon seen in other conifers — a massive and localized increase in the number of branchlets, twigs, and foliage, resulting in a witch's broom. In red, white, and black spruce, the culprit is likely to be a dwarf mistletoe; a minuscule and peculiar plant, 1-2 inches in height. The mistletoe lacks pigments required for photosynthesis and so carries out a parasitic life by sinking a root-like structure into the host tree's sugar transport system. Infection by mistletoe triggers the conifer's response of forming a witch's broom. The foliage of the broom often dies prematurely.

Physical stress, in the form of mechanical injury, is an additional challenge which confronts trees of the Pine Barrens and to which they must adapt. While pitch pine is known for its resistance to fire, it is equally known for reliance on periodic fires to remove competing vegetation and to promote germination of pines. As demonstrated within Subarea C, pitch pine presents an admirable response to another physical stress — a blow-down, usually caused by high winds. One particular pine had its trunk partly broken as a result of either a windfall or the felling of a larger neighbor. Refusing to take "no" for an answer, the prostrate trunk has curved upward toward the light and now supports an actively growing pitch pine. This tree demonstrates an additional adaptation to fire and other stresses — the production of epicormic sprouts, sprays of needles that occur directly on the trunk without branches or twigs. This ability allows the tree to "hedge its bets," producing extra photosynthetic tissue to meet demands caused by the initial stress.

Subarea C

At an estimated 620 acres, Subarea C is the largest of the three sections of the Barnegat Bay Beach Inland Area. The tract greets the eastern boundary of Subareas A and B across Route 9 and provides topographic relief for a mature, well-developed pine/oak woodland.

Although landscapes within the Barnegat Bay watershed may, at the outset, appear similar, closer and more patient scrutiny can reveal subtle differences and even surprises. A former presidential assertion that, “Once you’ve seen one redwood, you’ve seen them all,” is belied by a quizzical and open approach to nature.

In overview, this portion of the Barnegat Bay Beach Inland Area, which may not appear to have outstanding characteristics beyond its gently rolling topography, has secrets to reveal and riddles to propose for those with patience and an inquisitive mind.

Beaver Dam Creek/North Branch

Brick Township

51 Acres

Approximately 51 acres of Phragmites marsh and mature upland pine/oak forest define the western bank of the north branch of Beaver Dam Creek south of Route 88. Dividing Brick Township to the west from Point Pleasant Borough to the east, this tidal tributary flows into the Metedeconk River, which, in turn, empties into Barnegat Bay. Undeveloped, natural shoreline is an increasing rarity, particularly in the northern sections of the Bay. The north branch of Beaver Dam Creek is currently under residential development pressure and that pressure can only be expected to increase.

In brooding dark greens of pine set against the ochre of giant reed, the woodland conveys its extent and evokes a setting such as early European settlers might have encountered. The full northward sweep of the western bank confirms this impression. The natural scene has been long and fully appreciated by canoeists, motorists, and residents of Point Pleasant, a borough with little publicly accessible open space. The marshes and uplands of the west bank widen, as the creek flows southward, to include marsh islets, invaginations of the creek, and even several abandoned bulkheaded lagoons, evidence of unsuccessful development attempts in the past.

The combination of woods, marsh, and tidal creek makes for significant wildlife habitat, even though the creek is under stress. The beavers, for whom the creek was named, were trapped out long ago, but a few muskrats still persist. Among the birds sighted by local residents are mallards, canvasbacks, widgeon, buffleheads, wood ducks, loons, greater yellowlegs, snowy egrets, great egrets, great blue herons, and osprey. Although populations are not as high as in the past, marine life, including perch, snappers, bluefish, blue crabs, shrimp, and killifish, makes full use of the creek.

Assaults upon the integrity of the Beaver Dam Creek ecosystem have been of varying origin. The mud banks that grade upward into the Phragmites frequently bear the stumps of Atlantic white cedars killed by the abnormally high salinity of the creek. This high salinity is the result of the incursion of water diverted through the Point Pleasant Canal (which was constructed along part of the route of the creek in the 1930s), from the Metedeconk River to the north. This feat of human engineering has significantly altered and impoverished the ecosystem of the northern Bay.

Following the lead of the aborted lagoon dredging on the western bank, a recent and disquieting change is the subdivision and clearing of an area of the upland for four housing lots. The process had been initiated during the summer of 1994, complete with two rights-of-way to the creek, a road, and a cul de sac. Flagging on adjacent tracts indicates that this may be but the first wedge of development.

A new large residential complex across Jordan Road typifies the pressures being brought to bear on open space in this area. That development has not already encroached on the extreme northern end of the woodland, adjacent to Route 88, is a reflection of the limited width available for lots. That situation changes as one proceeds further south along the creek and as the marsh/upland wedge broadens.

For Brick Township and for Point Pleasant Borough across the water, the western bank of Beaver Dam Creek North would significantly benefit the surrounding communities if set aside as open space. Conservation would be carried out both for the wildlife value the site affords and for the quality of human life enhanced. Infrastructure, in the form of bulkheaded lagoons, exists at the southern end of the site and could be utilized for increased public access, particularly for non-motorized boats — kayaks and canoes. The site is contiguous, across Route 88, with a 5-acre Ocean County Park along the creek. A bridge could connect the two protected sites and allow for the creation of a greenway in this increasingly congested northern region of the Bay. Monitoring and stewardship assistance could be provided by Point Pleasant residents, for whom the wooded shoreline is a valued viewshed.

Beaver Dam Creek /South Branch

Brick Township

230 Acres

To the extent that they are not built-up, each of the approximately

Timber Harvesting in the Watershed

As is characteristic of forested lands within the Barnegat Bay watershed, the south branch of Beaver Dam Creek displays evidence of recent and historic timber harvesting. In fact, it is highly unlikely that any woodland or woodland patch within the watershed has escaped cutting during the period between the first colonial settlement and the present day. For many woodlands, multiple cuttings have occurred. Until replaced by coal at the time of the Civil War, wood was the primary fuel for firing industrial furnaces, as well as heating homes. While pitch pine was cut for lumber, massive harvests of pines also were carried out for the production of charcoal. Cutting of cedar for lumber and of pine and oak for lumber and pulpwood continues to this day (Foreman, 1979). Clearcutting also occurs as one of the first stages in site preparation for development.

one dozen streams that flow to the Bay through Brick Township has the potential to serve as a natural corridor — as an oasis and as a travelway for living organisms. Similar to its sister creek to the northeast, the South Branch of Beaver Dam Creek provides an important and diverse habitat for flora and fauna.

Although the South Branch travels almost four miles from its headwaters to the Bay, the 1.5-mile section between Route 88 and the Jordan Road bridge constitutes the study area. As evidenced by stumps revealed at low tide, portions of a once extensive Atlantic white cedar stand have died as the result of an increase in the salinity of the creek waters. This increase in salinity is due in large part to canal construction that brought water from the Manasquan River south to the Metedeconk River.

The relative youth of the woodlands on the banks of the South Branch, estimated to be 30 to 40 years of age, is readily apparent along the sandy tracks that lead into the interior of the site. Depending on the cutting cycle, site history, and degree of abandonment, a site such as the South Branch of Beaver Dam Creek ironically may have a wilder aspect now than it did in earlier centuries. An area that had previously lost all or part of its forest cover may now be reforested.

The extensive marshes and vegetated marsh islands at the site render it a very attractive habitat for a wide assortment of avifauna: shorebirds, waterfowl, and upland birds. In early March, male red-winged blackbirds are already hard at work in the Southern Branch, establishing territories for the females who will arrive at a later date. Mature breeding males have staked themselves out in the Phragmites marsh, at points of highest visibility, and are displaying their vermilion epaulets, underlined in bright yellow, by raising their wings at the same instant that they vocalize. Set against the dull green of a cedar, a crimson northern cardinal also proclaims his presence through visual and auditory channels. A minute golden-crowned kinglet is invisible high in a cedar, its high pitched, wiry call drifting down.

Cedar Bridge Branch

Brick Township

180 Acres (Estimated)

This Brick Township site extends eastward approximately 1.25 miles along the north side of State Route 528 (Cedar Bridge Avenue-Mantoloking Road) from the confluence of the Cedar Bridge Branch with the Metedeconk River at Cedarwood Park to the Garden State Parkway. The northern boundary is Route 549 (Chambers Bridge Road) and the residential development of Birchwood Park. Suburbanization of this site has severely reduced the natural resource area to the uplands west of Route 70 and to the corridor of wetlands associated with the Cedar Bridge Branch. The site has fairly flat topography with a difference in elevation of about 20 feet. The transition area between the upland and wetland areas often occurs along steep slopes 5-15 feet high.

The uplands support a pitch pine to pine-oak forest, a section of which has been severely impacted by prior use and invasive species such as switchgrass, common reed, tree-of-heaven, and sassafras. An Atlantic

white cedar swamp extends one-third of the distance from the Garden State Parkway, with the remainder covered by a sedge swamp. Hidden from the road by the surrounding woodland, the sedge swamp appears to be the most interesting resource here. A bed of Sphagnum moss with an abundance of cranberry lays beneath the more obvious sedges and shrubs, and scattered throughout the sedge landscape are small individuals of red maple, pitch pine, and Atlantic white cedar. Poison ivy in shrub form is interspersed amongst the sedges, as are fetterbush, highbush blueberry, and bayberry. The stream channel is bordered by smooth alder and swamp rose. Both swamps contain potential habitat for endangered, threatened, and rare vegetative species, with the state endangered Pine Barrens treefrog known to inhabit lands immediately to the west (Zappalorti and Johnson, 1982).

The wetlands immediately eastward of Route 70 may, in fact, be tidally influenced. A mix of hardwood and Atlantic white cedar swamp with some scrub/shrub aspects is squeezed between the shopping malls. A small but valuable brackish water environment exists to the east of Chambers Bridge Road, where it crosses Cedar Bridge Branch. Development to the east of Chambers Bridge Road includes the bulkheads and boat ramps typical to residential and commercial shoreline developments.

Cedar Creek Point/Lanoka Harbor

Lacey Township

122 Acres

Cedar Creek Point/Lanoka Harbor is an important peninsular foothold for nature on the Bay's western shore. Located on the mainland .3 mile south of Berkeley Island County Park, the site is a central link in a chain of mainland properties that face the Bay and that have been identified by the U.S. Fish and Wildlife Service (1994) for potential inclusion in the Forsythe Refuge. The site complements and protects Berkeley Island Park.

As is typical of many of the wetlands rimming the Bay, Cedar Creek Point/Lanoka Harbor presents a fairly uniform aspect to visitors approaching by water. Phragmites or giant reed dominates and appears to choke out other forms of vegetation. The complexity and diversity of the marshland become apparent as one penetrates inland or gains a vantage point from adjacent roads. The dynamic interplay between plant species specializing in the marsh habitat is shown at the demarcation between saltwater cord grass, salt hay cord grass (often demonstrating its cowlick pattern), groundsel tree, and a wall of Phragmites.

A distinguishing facet of Cedar Point Creek/Lanoka Harbor marshlands is the prevalence of small wooded hammocks, scattered throughout the low marsh. Such natural islets in a large salt marsh perform a function similar to that of a hedgerow in a farmer's field. The hammocks, which often contain eastern red cedar, pitch pine, black cherry, and oak, provide ecotones, or zones where two or more different habitats meet. Such locations characteristically enhance availability of food, localized differences in climate (microclimate), and species diversity.

Reflecting the quality of the habitat, bird species diversity is very high in the Cedar Creek Point area. Five species deserve special mention because of their rare or endangered status: American bittern, great blue heron, osprey, northern harrier, and bald eagle (Herpetological Associates, field observations, 1990).

The three westerly approaches to Cedar Creek Point — Meadowlark Drive, Clairemore Avenue and Hickory Drive — have favored the eastward spread of residential housing onto the peninsula. This process has fragmented the woodland, which has pine-oak upland and red maple/Atlantic white cedar swamp components. Particularly evident in aerial photography, the remnant patches of woodland are prominent as one proceeds along any of the easterly roads toward the point.

In addition to the marshes, pools, and waterways of Cedar Creek Point, the westward extension of the peninsula should be protected as land buffer. The peninsula is in the process of being islanded by development, although the proximity of Murray Grove/Stouts Creek to the south and Berkeley Island County Park and Maple Creek to the north hold promise of future green links. Oyster Sedge, a 2.2-acre salt-marsh island frequented by gulls and terns, lies just east of the shore of Cedar Creek Point. It would be opportune to include the island in long-range plans for the protection and stewardship of the mainland tract. From the salt marsh flats of Cedar Creek Point past the low silhouette of Oyster Sedge, one can see on the eastern horizon the great sweep of Island Beach State Park. With a small leap of the imagination, it is possible to be transported to an earlier century on the Bay from this viewpoint.

Cedar Creek South

Berkeley and Lacey Townships

200 Acres (Estimated)

Cedar Creek South is bounded by the Garden State Parkway to the west and by Route 9 to the east; the Creek's main stem forms the municipal boundary separating Berkeley and Lacey Townships. The site is tightly contained by current and proposed development.

The Berkeley Township portion of the site consists of publicly-owned land that forms a narrow greenway extending from Double Trouble State Forest (Department of Environmental Protection) to Route 9. The integrity of that greenway has been partially degraded by the construction of public amenities, including an

Rejuvenating the Human Spirit

Their many other attributes aside, it must be remembered that the Bay's remaining wild areas are places in which to rejuvenate the human spirit. One particular scene, encountered during the field research for this report, poignantly carried this message. On a seasonably brisk day in late November, a mother and daughter had set up two beach chairs on Cedar Creek Point's southern beach and were immersing themselves in the early winter landscape. In repose, they faced the glittering surface of the Bay, the giant reed forming a golden backdrop behind them in the westerling sun. Their labrador retriever playfully patrolled the beach ahead. The two figures and a dog could well have been in an Edward Hopper painting of the Outer Cape. The ladies had come from another shore community to this favorite spot, rediscovering the natural world, and finding in the site an oasis amid the expanse of built-over land.

active recreational area, golf course, and tennis courts. The Lacey Township portion of the site is larger and considerably less developed. The undeveloped upland areas, however, show evidence of recent survey activity, suggesting that development is being evaluated.

Relative to the site, an appreciable area (approximately 150 acres) of undeveloped upland habitat occurs on the site's southwestern quarter. The upland contains areas of pitch pine and pine-oak forests; black huckleberry, bear oak, mountain laurel, and bracken fern are quite common throughout, but are especially dense where the tree cover breaks open. Turkey-beard, partridge-berry, and inkberry are found along the upland and wetland transitional slopes.

Some impressive stands of Atlantic white cedar occur along much of the stream corridor, but may also be found in pockets removed from the creek main stem. Red maple and black gum variously dominate the hardwood and scrub/shrub wetlands, while sweetbay magnolia and black willow lend additional character. Mountain laurel, fetterbush, highbush blueberry, cranberry, inkberry, and Sphagnum moss can be found in most wetland areas here. Emergent wetlands, especially those occurring in the vicinity of the tennis courts off Route 9, are characterized by bayonet rush and Atlantic manna grass.

Some shallow depressions with potential as vernal ponds occur within the wetland and wetland transition areas. Vernal ponds, freshwater bodies of seasonal duration, offer potential breeding habitat for amphibians such as the state endangered Pine Barrens treefrog.

Cedar Run Creek/East of Parkway

Stafford Township

1,150 Acres

This irregularly shaped Stafford Township site extends to the northwest along Cedar Run Creek from the Forsythe Refuge to the Garden State Parkway, a distance of nearly 2.5 miles. The site is approximately one mile deep at its widest, and that breadth is frequently approached along its length. The area of interest here approximates five percent of the township's land area. Of particular interest are the three aquatic regimes present within this reach of Cedar Run Creek (non-tidal freshwater west of Route 9 and tidal freshwater and brackish water to the east).

In some places, development along Oak Avenue and Route 9 extends deep into the site. Recent surveying and wetland boundary marking activity is obvious and residential development is in progress. That, combined with posted offerings of lots for sale, suggest the Cedar Run-Mayetta area is experiencing a surge in residential growth. The site would make an excellent greenway and wildlife corridor, connecting the very rural setting of Cedar Run Creek west of the Garden State Parkway with the Forsythe Refuge along Barnegat Bay.

The site's topography is fairly flat. In fact, there is barely 60 feet of elevational change along the one mile east-west axis. The wooded uplands vary from pine-oak to oak-pine forests. American holly, mountain laurel, bear oak (or scrub oak) and black huckleberry are common in the shrub layer. As a practical matter, there is very little upland habitat of consequence to the east of Route 9 and much of that to the west of the highway to the north of Cedar Run Creek is significantly decreased by development. The greatest extent of upland habitat is to the south of the creek, but it, too, is being subjected to development.

An impressive Atlantic white cedar swamp continues along Cedar Run Creek, an extension of the cedar swamp to the west of the Garden State Parkway, and enters the abandoned cranberry bog along the west side of Route 9. The bog is comparably impressive, and is now mostly a sedge swamp supporting a variety of sedges, rushes, grasses, shrubs, and occasional trees. A casual glance reveals Canada rush, soft rush, bayonet rush, wool-grass, bull sedge, leatherleaf, fetterbush, highbush blueberry, Sphagnum moss, and, of course, cranberry. The area is prime habitat for endangered, threatened, and rare plant species. The small tributaries to the creek support hardwood swamps dominated by red maple and black gum. These small watercourses have potential for vernal ponding in their intermittent reaches, thereby providing breeding habitat for the state endangered Pine Barrens treefrog.

Cedar Run Creek/Northwest Extension

Stafford Township

1,350 Acres (Estimated)

This Stafford Township site extends approximately 2.5 miles to the northwest along the Cedar Run Creek watercourse from the Garden State Parkway. The site is about 0.75 miles wide at its deepest point and contains about five percent of the township's land area. Paved roads are absent, but access can be gained from Micaja's Road along the southerly boundary and by Stocum's Road and an unnamed cart path along the northerly boundary. A number of well-defined trails lead off from the dirt roads and permit easy passage from upland areas into, and through, the wetlands.

The topograph includes small, rolling hills in the southern half of the site, while the northern half is relatively flat with gentle slopes. The transition area from upland to wetland habitat generally occurs along moderate slopes to the south side of Cedar Run Creek. The site's elevational difference is about 90 feet.

Wetlands associated with the watercourse of Cedar Run Creek include Atlantic white cedar, red maple, and black gum dominated swamps. Tree species encountered in these swamps include pitch pine and sweetbay magnolia. Shrubs common to these swamps include fetterbush, highbush blueberry, cranberry, inkberry, swamp azalea, dangleberry, sweet pepperbush, bayberry, and leatherleaf. Areas that are not heavily shaded by trees have a carpet of Sphagnum moss peppered with cranberry, runs of leatherleaf, and a mixture of sedges, rushes, and shrubs. The Atlantic white cedar and sedge/shrub swamps contain excellent potential habitat for endangered, threatened, and rare plant species.

Vernal pond situations are found in the headwater area of Cedar Run Creek and in both Stocum's Branch and Long Branch. The vernal pond in the headwater of Cedar Run Creek is adjacent to Micaja's Road and has been seriously degraded by heavy use of off-road recreational vehicles. These vernal ponds offer potential breeding habitat for the state endangered Pine Barrens treefrog.

The uplands are variously wooded with pitch pine, pine-oak, and oak-pine forest. Bear oak, black huckleberry, and bracken fern are common in the woodland understory. Somewhat open areas contain little bluestem, and turkey-beard may often be found with sheep laurel at elevations above the wetlands. Potential habitat for the state endangered timber rattlesnake and the state threatened pine snake is provided by the extensive undeveloped upland setting of this site, coupled with good quality wetlands and an Atlantic white cedar swamp.

Church Road Property

Dover Township

265 Acres (Estimated)

Situated between the western flank of the Ocean County Community College and the Garden State Parkway, the Church Road Property is part of a complex of open space that includes the college campus (280 ac.) and the Silver Bay Westward Extensions (480 ac.). The three sites are islanded by residences and roadways. While not connected to other conserved lands, the Church Road Property lies within the same drainage basin as Tilton Point and Cattus Island County Park.

A condensed wilderness, the Church Road Property has high topographic relief, with contours ranging from 35 to 75 feet, and provides a corresponding diversity of habitat. Views at different seasons from the 99-foot oak/pine knoll, centrally located within the northernmost tract, give a feeling for an elevational gradient that is pronounced and quite unusual for a pineland site. Remnant bogs, many of which were once used for cranberry culture, occupy the lower elevations. Old berms provide the hiker with access to the interior of central bogs. A derelict building bears testimony to former agricultural operations which nature has readily reclaimed.

Both bog and freshwater swamp habitats are found in the Church Road Property. Among plants found in bogs or on bog margins at the Church Road Property are leatherleaf, swamp azalea, royal fern, cinnamon fern, Virginia chain fern, sensitive fern, spike rush, sundew (3 species), northern bugleweed, arrow arum, slender burreed, and pipewort (Truhan Consulting Engineers, Inc. 1988). The preponderance of ferns brings to mind the primordial swamps of the Pennsylvanian period, an ancient time when ferns ruled the wetlands habitat, before the rise to prominence of seed-bearing plants.

The upland woods of the Church Road Property are diverse and species-rich. The woodlands range from the pure pitch pine stand near the Community College to a strictly deciduous stand of white, scarlet, and pin oak and red maple along the southern edge of the site. Along the numerous trails, including former

berms of the cranberry bogs that penetrate the interior, can be found a profusion of evergreen growth. Atlantic white cedar, mountain laurel, sheep laurel, sweetbay magnolia, teaberry, partridgeberry, and mosses provide the green notes, which are sustained throughout the year but which become more insistent with the onset of spring. The Church Road Property also serves as habitat for the state endangered swamp pink and for the bristly umbrella sedge.

At least 38 breeding bird species have been noted on the site, including red-tailed hawk, chimney swift, solitary vireo, black and white warbler, blue-winged warbler, prairie warbler and rose-breasted grosbeak (Truhan Consulting Engineers, Inc. 1988).

In recognition of its great species diversity, its role in ecosystem function, and its service as indicator of ecosystem health, the terrestrial invertebrate fauna — specifically insects and spiders — have increasingly become the focus of conservation efforts. While the butterfly species encountered in mid-April on the trails of the Church Road Property are widespread in distribution and are not endangered, their sighting is a positive and hopeful sign both of habitat condition and warmer days. The butterflies at this site are especially noticeable when seen against the browns of the forest floor and the greens and grays of the forest border. Along the leafstrewn path, a quick-moving flash of blue indicates that the spring azure butterfly is on the wing. Dusky brown wings with cream yellow borders announce the mourning cloak, at momentary rest in a sunlit patch. The cabbage white, in flight along the edge of the woodland path, is a species that was introduced from Europe and has prospered here.

There is no guarantee for the future serenity and integrity of the Church Road Property. Of all the Century Plan sites, the Church Road Property is certainly one of most threatened by imminent development. There have been several proposals for housing projects on the site, most recently a 740-unit housing development, which has been proposed for the uplands of the northern portion of the site. Interior wetland areas would be protected from building and would have 50-foot buffers, but once the adjacent uplands are built upon, the wetlands may be adversely impacted. Local homeowners have waged a long campaign against the subdivision efforts. Once this fairly large and very beautiful pocket wilderness is lost, it will never return.

The Church Road Property can best be viewed in a larger context of open space. A network of streams and trails links the Church Road Property to the Ocean County Community College campus and the Silver Bay Westward Extensions. Ecologically, the three sites function as one unit, together containing an estimated 1,025 acres. The arc of open space serves as a buffer for the college, provides passive and active recreation for the community, as well as a potential outdoor laboratory. Creative solutions to the protection of this natural area are still possible. A collaborative effort including the State of New Jersey, Ocean County, Dover Township, the Ocean County Community College, local homeowners, nonprofit land conservation

Marshes, Swamps, and Bogs

The distinction between marshes, swamps and bogs is an important one. All are wetlands, and intergradations between the three may exist. Freshwater and salt marshes are dominated by herbaceous or soft-stemmed vegetation (such as blackrush, salt meadow cord grass, and giant reed or Phragmites). Swamps almost always have herbaceous vegetation but are dominated by living, standing trees. Bogs are glacially scoured water-filled depressions with a characteristic Sphagnum mat and vegetation such as cotton grass, pitcher plant, and sheep laurel.

organizations, and a local land trust (yet to be formed), may provide the necessary resources to ensure that the fine woodlands and wetlands of the three contiguous tracts are preserved.

Clamming Creek

Berkeley Township

140 Acres (Estimated)

Located east of Route 9 in the Bayville section of Berkeley Township, the natural area known as Clamming Creek appears to be holding its own, having been identified in 1994 by the U.S. Fish and Wildlife Service for prospective inclusion in the Forsythe Refuge. The southern boundary of the site is marked by residential development along Butler Boulevard and North Bay Drive, where Clamming Creek broadens and flows out to the Bay. The northern boundary of the area is defined by housing at Holly Park. Over half of the site is occupied by salt marsh, which joins a rich upland forest to the west. Two peninsular horns of high-quality marsh jut into the Bay, the southernmost of which has been fragmented by the currents of Clamming Creek and forms what are essentially two small islands.

As is the case for neighboring Century Plan sites (Maple Creek, Sloop Creek, and Good Luck Point), Bayview Avenue (Route 617) cuts across the marshes of Clamming Creek and provides a 360° perspective on the Bay, marshes, and adjacent uplands. As Bayview Avenue partitions the site, it is accompanied by a series of new fire hydrants — harbingers of change. Ironically, the road also provides the viewer with a sense of the fundamental integrity and beauty of the landscape.

Springtime brings Clamming Creek to life. Phragmites and Spartina marshes extend to the base of a pitch pine and oak upland. In May, the vibrant greens of the awakening marsh carry the eye to the foot of this woodland, where a lavender gray line marks the seed heads of Phragmites from the previous growing season. The greens of the marsh grasses are echoed but muted by distance in the colors of unfolding huckleberry, highbush blueberry, maple and oak leaves and in the fresh needles of pitch pine.

Human history and natural history are closely intertwined on Barnegat Bay. The name for the creek and for the site recalls the ancient practice of shellfish harvesting which dates to prehistoric times on the Bay, and which has been carried forward to the present day in the form of an active commercial fishery and aquaculture. Shell heaps, or middens, in the Bay region testify to the bounteous shellfish harvests by Native Americans over many centuries. Given their low caloric value, clams, mussels and oysters were probably used as dietary supplements. Shell middens were once more widespread, “but as the waters of the bays and ocean eroded the lands, they were swept away. Other shell middens were carted away by farmers to ‘sweeten’ (neutralize) their acid soils” (Kraft, 1986). An additional destructive assault on the middens has been made by individuals seeking artifacts within them. Thus have man and nature conspired to remove a vestige of the Native American presence.

Finninger Farm

Lacey Township

500 Acres (Estimated)

This site is a large tract of land fronting on the Barnegat Bay, and is bounded by Route 9 to the west, Forked River to the north, and Oyster Creek to the south. Just west of Route 9 is the Oyster Creek nuclear plant. The eastern end of the Finninger Farm contains a partly wooded area with canals, dredge spoil banks, old foundations, small ponds, and dirt trails. A young Atlantic white cedar swamp is located along the power plant outflow at the northwest corner of the site.

This site is composed largely of uplands consisting of old agricultural fields, along with smaller areas of pine-oak woodlands. It is the old fields which comprise this site's most interesting feature, as they provide habitat for a number of threatened, endangered, or declining birds known collectively as "grassland" species. Although salt marshes are the only natural, self-sustaining grasslands along the Eastern Seaboard, agriculture has helped to create extensive open areas — grain fields, pastureland, and orchards, which provide habitat for such avian species as upland sandpiper, vesper, grasshopper, savannah and Henslow's sparrows, horned lark, bobolink, eastern meadowlark, short-eared owl, northern harrier, and, to a lesser extent, eastern bluebird (a tree cavity nester in open areas). With the decline of agriculture in New Jersey and the Northeast, habitat for these birds has become increasingly scarce. Northern harrier, short-eared owl, vesper sparrow, and Henslow's sparrow are now listed by the state as endangered; while grasshopper sparrow, savannah sparrow, and bobolink are listed as state threatened nesting species. Horned lark and eastern meadowlark have declined precipitously, as has the eastern bluebird (though the latter has rebounded in recent years due largely to the success of nest box programs).

All but one of these birds — Henslow's sparrow — have been seen on the Finninger Farm tract since 1991, either as breeding species or as migrants or over-wintering birds. Grasshopper sparrow, eastern meadowlark, and eastern bluebird have been confirmed to nest on the site, while singing savannah sparrows and bobolinks have been noted on several dates in late spring, which is suggestive of breeding. Vesper sparrow, horned lark, short-eared owl, and northern harrier have been observed here in late fall, winter, and early spring. The farm is also heavily used by migrant and resident passerines; four species of thrushes, six flycatchers, four vireos, and sixteen species of warblers have been seen here in recent years, as well as rare or uncommon birds such as Lapland longspur, red-headed woodpecker, snow bunting, and saw-whet owl. In all, a total of 137 species of migrant, resident, and transient birds have been seen on the site since 1991, a very high total for this area of the state.

Finninger Farm also provides habitat for a variety of other vertebrate species. Diamondback terrapins have been observed in the Oyster Creek and Sand Point waterways and in the canals at the east end, and box turtles have been observed in the fields and wood edges. Snakes such as black racer, kingsnake, northern pine snake (a threatened species), eastern hognose, and northern ringneck are known to frequent the site or its immediate vicinity. Such a diversity indicates that the area supports a good variety and number of prey

species such as meadow vole and white-footed mice, which are hunted by the larger snakes. Other mammals such as white-tailed deer, raccoon, opossum, gray squirrel, red fox, long-tailed weasel, striped skunk, eastern cottontail, and woodchuck are also present and common on site. Diamondback terrapins are often captured in crab pots in the canals that surround the farm. These turtles come out of the water to nest along the upland field edges in June.

If the current owner, Jersey Central Power and Light, intends to hold on to the property, a management plan for maintaining the open grassland habitat should be developed for the site. Low-cost maintenance might involve simply mowing the fields once a year in October or November, which would prevent succession by woody plant species. This technique was adopted by the U.S. Navy at the Lakehurst Naval Air Station, where there are large grassy areas along runways in the parachute jump zone. This management technique has helped increase the number of upland sandpipers, grasshopper sparrows, and horned larks present on the base.

Forked River Annex and Adjacent Uplands

Lacey Township

Forked River Annex: 484 Acres

Adjacent Uplands: 13.5 Acres

The Forked River Annex area provides an example of a marsh creek of high quality with significant benefits for terrestrial and marine life. Identified by the U.S. Fish and Wildlife Service (1994) as a key tract in their proposed expansion of the Forsythe Refuge and by the Ocean County Department of Parks and Recreation as an important recreational area, the Forked River Annex (including the Old Airport Site) is a magnificent 484-acre tract of open space in the East Lacey Road area. The tract encompasses pine-oak uplands, red maple swamps, pools and streams enshrouded by Atlantic white cedar stands, abandoned fields, orchards, and foundations of farmsteads. An impressive expanse of saltwater marshes follows the Bridge Creek to the Bay. The site is bounded to the north by the marshes and uplands of the Forked River State Game Farm (Department of Environmental Protection), which continues the northward sweep to the marshes of Sunrise Beach. The Middle Branch of the Forked River forms the southern boundary.

With over a mile and a half of shoreline, not including marsh creeks and pools, Forked River Annex presents a very dynamic and varied interface between salt marsh, river, and Bay. Marshes occupy approximately fifty percent of the acreage of the site. The combination of tidal pools, marsh creeks, a long and irregular marsh shoreline, mud flats, and shallows have created an area of high productivity.

The marshlands that are most attractive and useful to the numerous fish species migrating into the Bay from the Atlantic have several important characteristics, including presence of creeks and a notable lack of bulkheading, ditching, and diking. Of these characteristics, marsh creeks are the most critical, for they serve as a sheltered area in which juvenile fish can feed and grow. The life cycle of the summer flounder or fluke, for example, is directly tied to marshes. Following initial development in the ocean, the larvae are

planktonic (e.g., very small and drifting in the water). The young fish enter the inlets to become Bay residents from October through April. Eventually, they settle to the bottom and become visible in the marsh creeks at about 50 mm in size. In spring and summer months, the juvenile fish sit at the mouth of the creek and travel inland during flood tides. Analysis of stomach contents before and after entry into the creek reveal that most of the feeding on smaller fish and invertebrate prey is taking place in the creek. A rapid growth of the juveniles takes place, so that by the end of the summer they have added 25 cm (or 10 inches) to their length (Ken Able, personal communication).

The forested uplands, containing pitch pine, Spanish, red, willow, scarlet, black, and white oaks, red maples, American holly, and numerous other species, are botanically rich and characteristic of the Bay region. Bright green carpets of running pine, whose ancestors of 400 million years ago formed a major portion of coal strata, indicate an undisturbed habitat. Proceeding from Jones Road to the foundation of an AT&T communications tower (which was never built), a long Bay trail provides a transect of the forested land as it gradually grades into lowlands and salt marsh. Atlantic white cedar, along with leatherleaf, alders, and coastal pepperbush, mark freshwater lowlands or swamps and watercourses associated with Eno Pond, located in the western portion of the site. Broadleaf swamp areas are characterized by red maple, sour gum, sweet bay, southern arrowwood, and cinnamon and royal ferns (U.S. Fish and Wildlife Service, 1994). Plant species introduced by the hand of man are found thriving near old farmsteads and fields on the site. Such species include Norway spruce, Norway maple, osage orange, domestic apple, and persimmon.

Mirroring the variety and integrity of the Forked River Annex landscape, numerous plant and animal species of concern to conservationists have also been found on the site. Six plant species — New Jersey rush, slender marsh pink, pine barren boneset, fragrant ladies tress, wandlike goldenrod, and marsh rattlesnake master — are all listed as rare in New Jersey. One species, swamp pink, is on the federal list of endangered species and is listed as threatened in New Jersey. Regarding the avifauna of the site, five species — Cooper's hawk, great blue heron, little blue heron, osprey, and savannah sparrow — are on the New Jersey threatened list and one species, the red-shouldered hawk, is listed as endangered in New Jersey. The Forked River Annex also harbors one amphibian species, the Pine Barrens treefrog, on the New Jersey endangered list and three amphibian species, including the four-toed salamander, marbled salamander, and the eastern spadefoot toad, listed as being of special concern in New Jersey.

At the time of this writing, the Trust for Public Land holds an option on a key 85-acre tract. TPL will acquire, subdivide, and convey the tract to two separate land management agencies. The easternmost portion (55 acres) will be conveyed to the U.S. Fish and Wildlife Service as an addition to the Barnegat Unit of the Forsythe Refuge. The remaining 30 acres will be transferred to the Ocean County Department of Parks and Recreation for use as a passive recreation facility geared toward picnicking, hiking, and nature study.

At the northwestern boundary of the Annex, two upland parcels (13.4 acres in total) link the Annex with the game farm and have important buffer and habitat functions. The parcels are under immediate development threat and are deserving of protection.

Forked River Beach

Lacey Township

9.6 Acres

An unusual conservation and restoration opportunity presents itself at Forked River Beach. The 9.6-acre site of largely open and maintained grass fields, stretches from the southern flank of the mouth of Forked River to a quarter mile from the eastern extension of the Finninger Farm tract and provides approximately .7 mile of Bay frontage. The property formerly contained a beach club with pool that reached its peak activity in the 1960s. The proprietor of the club also constructed the homes which line the southern boundary of the property along Beach Blvd., many of which are occupied on a year-round basis. In the mid 1970s, the entire Forked River Beach property was acquired by Lacey Township, which continues to serve as owner-manager.

A major challenge facing Forked River Beach is not unlike that which confronts the majority of Century Plan island sites, namely continued erosion of the shoreline. Loss of soil under the relentless onslaught of waves and rising sea level has pushed back the shoreline from between 10 and 45 feet landward of its 1954 position. Nearly 100 feet have been stripped from the eastern peninsula, defining the mouth of the Forked River, during the same time.

According to Township officials, development does not loom in the immediate future of Forked River Beach. Steady erosion, however, continues to whittle away at the site's potential to serve as a park or natural buffer for adjacent residences along Beach Boulevard. The officials cite an apparent need in Lacey Township for a natural park to meet the demands of passive recreation activities such as hiking and birdwatching. In contrast, active recreational areas are well-represented in Lacey and include Clune Park, William Hebrew Recreation Area, and Richard L. Gille Township Park.

Lacey Township is working to develop a long-term management plan for its Forked River Beach property. There are three major alternatives. The first option preserves the Forked River Beach site in its current state, acknowledging that there will be less and less acreage to maintain as each year goes by. A second option calls for erosion counter-measures. Stabilization of the land can be artificial (employing such devices as wooden bulwarks, cement blocks, or rip-rapped shoreline) or natural (re-establishing a salt marsh buffer). With sufficient investment, natural stabilization could lead to the establishment of a very fine shoreline park, which would involve restoration of natural Bayshore habitat — a combination of salt marsh, upland, and trails. A third alternative would be sale to abutting landowners with conservation and management restrictions sufficient to protect the tract's long-term value as open space.

Good Luck Point

Berkeley Township

520 Acres (Estimated)

The Good Luck Point site is a relatively large, privately owned area located in Berkeley Township east of Route 9 and fronting on the Barnegat Bay. The northern portion of this site is bounded by the mouth of the Toms River. Extensive housing development exists along the site's southern and western reaches, while a broad expanse of wetland and upland transitional areas characterize the Bayside portions of Good Luck Point. The site is presently owned by AT&T.

The bulk of this tract is composed of a tidal salt marsh containing growths of several species of cordgrass, marsh-elder, groundsel tree, bayberry, Phragmites (also known as giant reed), saltworts, and other typical salt marsh species. Although it has been ditched and contains numerous metal towers, poles, and other structures used for signal transmission, the marsh is largely intact and healthy. Diamondback terrapins are common at high tides in the tidal guts and ditches, and birds such as clapper rail, marsh wren, the state threatened American bittern, American black duck, willet, osprey, Forster's tern, and two "salt sparrows" — sharp-tailed and seaside — are known to nest here. The federally endangered peregrine falcon (which nests nearby) has frequently been observed hunting and resting here, and an immature bald eagle was present during the winters of 1993 and 1994. Good Luck Point is an important migration and wintering area for shorebirds and waterfowl; 13 species of ducks, geese and swans have been counted at the site, along with 14 species of shorebirds, including Hudsonian godwit, a rare migrant. To the west of the salt marsh is a largely forested area containing a mix of habitats including oak-pine uplands, a small area of Atlantic white cedar swamp, two ponds, red maple/sour gum wetlands, and transitional upland/wetland zones dominated by sweet gum, inkberry, and American holly. Open areas containing old sand and gravel pits and numerous sand roads and trails are also present. Several rare, threatened, or endangered plant species occur here, including crane-fly orchids and southern twayblade (another orchid), as well as sickle-leaved golden aster, a globally rare species which is also on the Pinelands list of protected plants. Mud bank paspalum, another globally rare species, also can be found.

Ornithological studies of this area of the Good Luck Point tract have shown that it provides critical habitat for migrant neotropical birds such as flycatchers, orioles, vireos, warblers, and thrushes during their long journeys to the north and south. The intact forested areas serve as a resting and feeding "island" in an otherwise heavily developed area which is not favorable feeding or resting habitat. Migrant neotropical birds, many of which winter in tropical and subtropical areas south of the U.S., have greatly declined in recent years, due in part to rainforest destruction. Some recent studies, however, suggest that habitat destruction and fragmentation in the north has contributed to this decline; it remains vitally important to preserve local habitat such as Good Luck Point.

The wetlands on the site — salt marsh and some palustrine freshwater swamp — are protected under current CAFRA and other state regulations, as is a variable band of upland buffer area. There is no

evidence that a wetland delineation has been conducted here, though it is assumed that minimum buffers of 150 feet would be required, since endangered species such as peregrine falcon and protected plant species are known to occur in the area. Upland portions of Good Luck Point which lie beyond buffer boundaries are unprotected and at risk to development. These uplands, consisting of open wooded areas, trails, old sand and gravel pits and areas of mixed pine and oak uplands are heavily used by area residents for recreation.

Although the wetland portions of the site are protected under current regulations, the uplands are not, and are threatened by development pressures; building restrictions in wetlands have greatly intensified construction in unprotected uplands in recent years. An effort should be made to secure — through public or private action — as much of the upland portion of Good Luck Point as possible, as this would provide critical habitat for threatened, endangered, and rare species as well as common species, all the while meeting the broader societal needs of improved water quality and open space.

Holgate Marshes

Long Beach Township

18 Acres (Southern Marsh)

Located one mile north of the Holgate Unit of the Forsythe Refuge on Long Beach Island, a series of salt marshes persists in a densely populated and built-over area. Formerly a continuous band of marshland, two distinct natural areas flank a marina and run in an easterly direction against several residences and Long Beach Boulevard. While fronting the relatively calm waters of Little Egg Harbor, the marshes are less than 100 yards west of the breakers of the Atlantic Ocean. Aerial photography confirms the extent to which these marsh fragments are islanded by home construction on Long Beach Island and highlights their vulnerable position.

The most southerly marsh is the focus of this report because it is under the most immediate development pressure.

The actual salt marsh, which occupies the southern portion of the site, historically occupied the entire area. Encroachments due to infilling have occurred as a result of dredging and construction activities accompanying marina and residential development. The marsh shows a classic gradation with rising elevation from west to east of white sand beach on the Bay front, tidal marsh with salt marsh hay grass and cord grass with tidal meanders and high marsh with groundsel tree, marsh-elder, and northern bayberry. The presence of several native wildflower species associated with near-marine environments — such as seaside goldenrod of the beach and sea lavender of the low marsh — point to the persistent vitality of the site. The upland portion, the northern half, represents a filled former marsh. This upland has been colonized by high marsh shrubs, giant reed, and broom sedge.

Drawn by a green oasis set in the rising tide of development, wildlife make abundant use of the marsh through the seasons. The shrubs of the high marsh and upland are teeming with autumnal migrants, chiefly warblers and sparrows. The marsh pools and flats are the frequent haunts of herons and egrets. Large numbers of swallows on migration feed on insects above the marsh and rafts of wintering ducks gather immediately offshore. Numerous amphibians (most likely Fowler's toads) have been reported on the site by area residents.

The Holgate marshes provide ample habitat for terrestrial and marine invertebrates. Dragonflies (so-called mosquito hawks) take advantage of the last warm days of fall to hover in search of prey. Bumblebee and syrphid flies pollinate the seaside goldenrods. Horseshoe crabs make use of the beaches in their ancient spring mating rituals. Their exoskeletons remain through the fall and winter months where the high tide has left them.

The southern Holgate Marsh has weathered real and proposed human alterations of its landscape. Prior to the passage of federal tidal wetlands laws in the early-1970s, the entire site was scheduled to be filled-in, with fill extending out hundreds of feet into the Bay (Sandy Gingras, personal communication). The original subdivision plat is expressed in the current tax map, which indicates some 210 small building lots and four paper streets. A new subdivision plan that contemplates considerably less density is currently before the public, generating considerable controversy among preservation and development advocates.

The southern marsh and the peninsular marsh of Holgate should be conserved in their entirety as areas for passive recreation and the preservation and enjoyment of nature.

Kettle Creek/Green Branch

Brick and Lakewood Townships

400 Acres (Estimated)

Traversed by the Garden State Parkway and bounded by the large residential areas (Leisure Village East, Leisure Village West, and Cedarwood Park), the Kettle Creek/Green Branch site is nevertheless cause for optimism. For here, nature perseveres — if left to her own devices.

The Garden State Parkway, under which Kettle Creek flows toward its rendezvous with Green Branch and eventually with Barnegat Bay, has probably been the single greatest factor in creating easy access to the New Jersey shore region. The Parkway has forever altered the face of the natural and agricultural landscape. The roadway carries on with the business of moving traffic with scant notice of, or attention to, the quiet creeks and streams below. Close to the shadows of concrete pillars and below the onrush of traffic, the myriad transactions of life proceed. Fresh water algae photosynthesize, sending bubbles of oxygen to the surface, and protozoans, both carnivores and herbivores, search for equally microscopic food.

The anchor post fences of Leisure Village East parallel the Green Branch for part of its journey

northeastward. The branch proceeds from several lakes, including Lake Waddill, in or near the retirement community, toward a junction with Kettle Creek, 1.2 miles away. From the boundary of the development, the branch appears to provide furtive glimpses of itself before it slides off into thick woodland. Passing under Shorrock Road, Kettle Creek displays its sand/gravel bed, amber colored and slowly, steadily moving waters, and the characteristic meandering pattern caused by the varying speed and erosiveness of water in the stream flow.

Lowland forests, such as those of Kettle Creek/Green Branch, provide a distinctive and rich habitat which greatly augments the variety of life encountered in the Barnegat Bay watershed.

“Lowland forests are characterized by water levels close enough to the surface, usually less than two feet, to exert a year-round influence upon the vegetation. Within the pines, three major types of lowland forests are recognized: pitch pine lowlands, cedar swamps, and hardwood swamps” (Boyd, 1991). The first two types are dominated by a single species — pitch pine and Atlantic white cedar respectively. In addition to a high water table, the hardwood swamp vegetation along the banks of Kettle Creek also reflects seasonal and temporary inundations as the branch oversteps its bounds. The hardwood swamp, or flood plain forest, contains, among other species: red maple, sour gum, gray birch, pitch pine (usually in lower numbers in this habitat than in pitch pine lowlands or upland barrens), clammy or swamp azalea, sweetbay magnolia, black huckleberry, highbush blueberry, fetter bush, coastal pepperbush and brambles. A variety of red maple known as trident maple (a reference to its small three-lobed leaves) is frequently encountered at this and other sites within the watershed.

Within the Kettle Creek site, west of Shorrock Road, a residential construction site of several hundred acres has made inroads but appears on the retreat, thus creating an experiment in pitch pine regeneration. Judging by the age of the many pine saplings that carpet the landscape, the large development site was abandoned seven to ten years ago. Roadbeds, curbing, fire hydrants, and storm sewers speak of a major building effort that failed. Given an appropriate seed bed and seed source, as well as the ability to sprout from fire-charred trunks, pitch pine is a formidable recolonizer. Pines take part in the overall pattern of succession which usually begins with colonization of a site by such species as broom sedge, true sedges, and lowbush blueberries. Over time, if fire is excluded from a site, pitch pines are expected to become less prevalent members, as deciduous species such as oak take hold.

Kettle Creek North

Brick Township

210 Acres (Estimated)

When taken from the point of view of a marsh hawk or northern harrier, gliding silently above the grasses and rushes in search of rodent prey, the marsh landscape of Barnegat Bay becomes increasingly fragmented, as the bird of prey moves in a northerly direction. Wide swaths of ochre and brown of coastal marshes in winter are invaded by silver, grey, and white geometric forms — the repetitive and apparently

self-generating pattern of housing developments. Along the Bay's western shoreline, the trend toward more widespread disruption of the natural landscape parallels the increasing population density of the northeastern portion of Ocean County. The loss of tidal marshes has been documented. "From 1953 to 1973, Ocean County lost about 10,929 acres of tidal marsh representing almost 30% of the tidal marsh acreage in Ocean County. Much of this loss occurred in the Barnegat Bay watershed" (Rogers, Golden, & Halpern, Inc., 1990). The pressure on wetlands is expected to be greatest in the most densely populated townships, such as Brick. Even if the marshes themselves have a good measure of protection through the New Jersey Coastal Wetlands Act of 1970 and through CAFRA (Coastal Area Facility Review Act), enacted by the New Jersey Legislature in 1973 and amended in 1994, they are subject to habitat disturbance of numerous kinds, as the adjacent uplands are lost. The habitat disturbance can come in the form of pollution (point source and non-point source), erosion, run-off of water no longer absorbed by an upland forest, dumping of household and construction debris, increased human presence in the marsh or marsh periphery, and the introduction of non-native flora and fauna, including pets.

Kettle Creek's salt marshes are emblematic of the northern Bay's tidal wetlands under duress. The marshes here still form a magnificent expanse at the entry of Fedder's Creek, a tidal stream southeast of the main channel of Kettle Creek. Occupying about 25% of the land area of the Kettle Creek North site, the marshes form a wide plain cut by channels and meanders and continue to evoke the grandeur of their past. Guarded by a sentinel on the bank, a small group of Canada geese navigate Fedder Creek on a morning in mid-March. At the gradual approach of a human, they take to wing in unison, giving their resonant honking. Mallards and a solitary male canvasback probe the mouth of the creek, from which the ice has departed.

Dramatic contrasts of the landscape characterize Kettle Creek North, symptoms of the incursions of "civilization" into the natural realm. Paralleling Fedder Creek for a short distance is a wide sand track, a continuation of Starboard Road, which gives access to the marsh and to an area of white sand, which has been stripped of its vegetation — a playground for dirt bikes and ATV's. Car parts and even an entire boat can be found in the interior, where sand tracks have provided access. Proceeding north of this location, the pitch pines mark their thin corridors as well as their widest bands with a living banner of soft olive green. A wide cleared area, as seen north of Kettle Creek's passage under Hooper Avenue, may be the result of mining of topsoil, sand, and gravel. Such mining activity, provides raw materials for road construction and for the glass industry and creates patches of wasteland. Some 15,000 acres of the Pinelands National Reserve, which is 934,000 acres in size, are affected by this mining process (Boyd, 1991). A 180° turn at the point where Fedder Creek crosses Hooper Avenue brings into view two very different landscapes: to the west, woods line the waterway and venerable oaks cast their long reflections in the creek; to the east, a fully bulwarked channel proceeds by the large marina at Sailors' Quay. Unoccupied in late winter, the many slips of the marina betoken heavy boating use of the creek in the spring, summer, and fall.

Tax maps of the Kettle Creek North site reveal a historic, aggressive and ecologically uninformed method of partitioning the landscape. In the area south of Hooper Avenue, narrow, linear strips of private land proceed from the shoreline into the upland interior. This approach is reminiscent of early surveys of Maine

islands, according to which individual landowners could buy a narrow plot with shorefront on opposing sides of the island. Clearly geology, landform, and ecosystem function have not been taken into account by this approach.

The southern shoreline of Kettle Creek North is fully visible from the peninsula at Mallard Point, a Century Plan Site. Protection of both sites would help to save a diminishing resource — the wild shoreline of northern Barnegat Bay.

Kettle Creek Peninsula (Chamberlain Point)

Brick Township

160 Acres (Estimated)

Bracketed by developments to the north, east, and west, Kettle Creek Peninsula and Chamberlain Point, its narrow leading edge, jut out into the widest reaches of Kettle Creek. Although currently used for dumping and frequented by All Terrain Vehicles (ATVs), the peninsula has an unexpected beauty and integrity. Even in the depth of winter, in late February, the color of the vegetation resonates. Low pitch pines, their needles a light acidic green, are islanded in an ochre sea of grasses and sedges and the grassland is interrupted in places by bright patches of sand.

At the time of the site visit, Harry Irons, whose family has been in residence in the area for several hundred years (one ancestor having been executed by the British for “insurrection” during the Revolution) was intently studying the tracks and signs of wildlife in the sand. Preparing to run his dogs on raccoons, he was looking for tracks but, in the process, uncovered a wealth of evidence of other mammalian residents and visitors. Quickly differentiating red fox from gray fox tracks, Harry’s gaze took in the shortgaited line of skunk tracks, and then turned to the footprints of a muskrat with the characteristic tail drag, a central waving line. The dogs would be unleashed in sport that night and a raccoon would be treed but would not be harmed. Observed Harry, “It gets harder and harder to find new ‘coons, if you do away with the treed ones. And I don’t think I want to travel very far to find new ones.”

The site serves as a fine example of natural succession on former farmland. Kettle Creek Peninsula was part of an extensive saltwater farm, formerly known as the Brower Estate (Harry Irons, personal communication). Earlier this century, fields with cattle descended to the water. Thick growth now occupies the site of the former farmstead, whose foundations can be located only with perseverance. The sand and grass expanses mark the location of fields into which pitch pine and various old field invaders, such as black cherry and eastern red cedar, are making advances. Two large marsh pools significantly add to habitat diversity and are in active use by ducks, including black ducks and mallards, and wading birds, including snowy and great egrets and great blue herons. The gradual, almost imperceptible decline in elevation, as one proceeds toward the shore, ushers in high marsh vegetation, such as marsh-elder and groundsel tree, before the lower marsh with Phragmites and Spartina is reached. On the shoreline, views to

the east and west demonstrate, in the middle distance, the great development pressure that shorefront land continues to experience.

Site misuse, particularly the dumping of household and construction debris, continues. Not far from some of the most appealing images of the Barnegat Bay marshes, the spiralling pattern of salt meadow cord grass at the retreat of high tide and the islets and undulations of the shoreline, are found rubber tires, chunks of asphalt and concrete, and a rusting baby stroller. A dilemma of wild but accessible places is their vulnerability. Kettle Creek Peninsula deserves to be defended from both neglect and development. In the context of the remaining open space on the Bay, the site is unquestionably a natural gem.

Liberty Harbor

Ocean Township

145 Acres (Estimated)

Of the remaining large open lands on the Bay's western shore, the Liberty Harbor site and the Lighthouse Camp/Bowker site are most closely situated to the mainland portion of the Barnegat Management Unit of the Forsythe Refuge. Within the overall configuration of the Bay, the site also lies in close proximity to vast protected areas on the eastern shore of the Bay, principally Barnegat Inlet and the complex of sedge islands off of Island Beach State Park. Together with the Lighthouse Camp site, Liberty Harbor forms an important link between state- and federal protected lands.

Shoreline views of Liberty Harbor from adjacent areas reveal a large, modern residence built on the shore at the end of Wescott Avenue. This building dominates the viewscape.

The woodland of Liberty Harbor is luxuriant, containing assorted oaks and maples, mature black cherry (some specimens attaining an estimated age of 50 - 60 years), sweet gum, American beech, American holly, eastern red cedar (ancient specimens are very prominent along the roadway), with young cherry and American holly, staghorn sumac and sweet bay magnolia among the species of the understory. On a hazy day, in the light of a westerling sun, the understory of American hollies, on either side of a trail, forms a shimmering and pale green tunnel. In places, strikingly old and magnificent trees soar above their neighbors, revealing by their open branching pattern that they germinated not in the dense forest but in areas that were originally more open, old fields and clearings. Such dominating, widely branched trees are known to foresters as "wolf trees," because they "wolf" the sunlight from a stand of younger trees below, whose growth the foresters hope to promote.

Freshwater wetlands are well-developed at Liberty Harbor, bracketing a woodland trail, interfingering with Phragmites stands that ultimately lead to the Bay shoreline, and forming broad seeps through tussock sedge, swamp red maple, and black gum. The interconnectedness of the Bay watershed, from upland runoff, through broadleaf swamp, through Phragmites, and through saltmarshes to the Bay shore, is illustrated in condensed fashion at the Liberty Harbor site.

As can be expected, given the diversity of vegetation and habitat, birdlife is very active at Liberty Harbor. In early February, foraging American robins are in abundance, in addition to northern cardinals, black-capped chickadees, and cedar waxwings. Nine-tenths of the cedar waxwing diet consists of fleshy fruits, and the eastern red cedar is a primary provider, with American holly serving as a secondary source of fruits (Martin, et al., 1951). Amongst the hollies and cedars of Liberty Harbor, thin, wiry calls and agitated movement within the evergreen foliage point to a flock of cedar waxwings at work, fueling up against the winter's assault.

The biological richness of Liberty Harbor and its integral position as one of the "stepping stones" of open space along the Bay's western shore argue strongly for its preservation.

Lighthouse Camp and Bowker Property

Ocean Township

191 Acres (Estimated)

The contiguous properties Lighthouse Camp (c. 95 acres) and Bowker property (c. 96 acres) are situated on the Barnegat Bay shoreline in Waretown, north of the Forsythe Refuge at Double Creek and south of the proposed Forsythe expansion area at Barnegat Beach and Liberty Harbor. Residential developments bracket the Lighthouse/Bowker site, separating it from existing and proposed Forsythe areas. North of the Lighthouse Camp is a deepwater marina that has undergone expansion over the years at the expense of the wetlands.

The Lighthouse/Bowker site contains a great diversity of floral and faunal habitat including salt marsh, freshwater marsh, streams, and ponds, mature deciduous upland forest, abandoned old fields in various stages of succession, and a small white pine plantation. Wetlands comprise approximately 50% of the overall site.

As a consequence of habitat diversity, the high frequency of edges (zones of contact between adjacent habitats), and the large areas of wetland, the biological productivity of the Lighthouse/Bowker site is predictably high. A canal (constructed some 30 years ago to allow rowboat and canoe access to the Lighthouse Camp), in addition to various old mosquito ditches, may enhance tidal exchange. The marsh complex on the site is known to be a spawning area for striped bass and bluefish. Numerous marine invertebrate species are found including blue crabs, spider crabs, and fiddler crabs. Inland, the site provides habitat for Pine Barrens treefrogs (listed as endangered in New Jersey), pine snakes (listed as threatened in New Jersey), black snakes, black racers, ring-necked snakes, and garter snakes. Bird species are prevalent, both species that visit and those that breed on the site, including great blue heron, Canada goose, and Dutch mute swan (introduced). Nesting species expected at the perimeter of abandoned fields include catbird, common yellowthroat, and yellow warbler. The flora on the site is also rich and diverse, with wild flowers of the old fields and marsh edges being particularly notable.

The Lighthouse/Bowker site was certainly in use in prehistoric times by Native Americans as areas for foraging, fishing, hunting, and encampment. The properties were utilized during the nineteenth century (and probably earlier) as salt water farms, the low country being ideally suited to the production of salt hay for livestock forage. No buildings remain on the Bowker site and the previously farmed land is reverting to a wild state. Lighthouse Inc. has operated a summer camp for the visually impaired since the mid-1960s with an increasing emphasis on serving the needs of multi-handicapped persons. The Lighthouse Camp complex, which occupies filled land that was formerly largely marsh, contains a total of 28 buildings, including garages, outbuildings, and 18 cabins. The oldest of the buildings, the recreation hall, dates to 1927. The presence of so many buildings presents a challenge to the conservation of this land.

These two contiguous properties should be considered as one, reflecting their shared ecology and history. The Lighthouse/Bowker site probably best lends itself to management practice that balances protection of the natural resource with limited public access. The Lighthouse property, with its waterfront, dock, pier, and walkways, already has a built-in infrastructure for passive recreation.

Manahawkin Baptist Church Tract

Stafford Township

200 Acres

A saltwater marsh, freshwater wetland, and woodland corridor, the Manahawkin Baptist Church Tract serves both as natural habitat and as a land buffer between the Manahawkin Wildlife Management Area (DEP) and the burgeoning communities of Beach Haven West and Bay Side. “Manahawkin” might be an Indian designation for “good land” or “good land for corn” (Zinkin, 1976). The site is also named for the first church built in Ocean County (dating to 1758), located on Route 9, and its modern replacement, located near the junction of Stafford Avenue. The site encompasses the Manahawkin Creek as it flows southeasterly into the Bay, north of the Manahawkin Bay Bridge. It is an area of subtle and dramatic contrasts, characteristics of a buffer zone.

Epitomizing the buffer concept at the Manahawkin Church site, a wild and bramble-entangled woodland lies in direct contact with commercial and residential activities north of Bay Avenue and south of Hilliard Boulevard. The woodland backs up against a shopping mall, the Manahawkin Plaza. As is frequently the case, the point of contact between a wet natural area and asphalt paving or disturbed land is marked by the invasive opportunist, giant

Buffering Lands

Although originally drawn from chemistry, the concept of buffers has great utility in land management. Just as the buffering of a solution, such as blood, keeps the acidity of that solution within a tolerable range, so a land buffer limits the impacts of man’s presence on a natural area. The current philosophy underlying the design of biological reserves is to surround the core area, in which the primary focus is protection of the natural resource, with a buffer zone. A buffer zone physically distances the habitat of the flora and fauna of the reserve from the influences of man. Such influences include traffic, noise, pollution, dumping of debris, clearing of land for agriculture or building, introduction of domestic animals, and introduction of alien and invasive plants and animals. The buffer can also be used to safeguard the viewscape of the core area, while permitting traditional activities such as hunting and fishing on the periphery.

reed, or Phragmites. Yet, within yards of the buildings, a species-rich woodland perseveres. White oak, red oak, sassafras, sweetgum, black gum, white ash, pitch pine, shortleaf pine and red maple form a lush and hospitable canopy. Mountain laurel, highbush blueberry, huckleberry, American holly, and arrowwood populate the understory. There is evidence, primarily in the form of cut stumps and the relative youth of the stand, that the area has been cut over, undoubtedly on several occasions in the past.

Carrying November's leaves and distilling the sky blue to a deep ultramarine, Manahawkin Creek quietly edges its way from the upland forest, through broadleaf swamp, and finally through saltmarsh to the Bay. Its slow eastward pull is detectable in the movement of the uniformly brown oak and maple leaves at the water's surface. Part of the hydrological system, partially ditched waterways in the marshes north of Route 72, serve to link marsh pools and provide habitat for waterfowl.

Although fragmented to an extent by roadways, the Manahawkin Baptist Church woodland and marshes maintain their ecological function and their beauty.

Maple Creek

Berkeley Township

270 Acres

Its marshes sweeping to the bay, Maple Creek has a pivotal geographic location. The southern peninsula of Maple Creek is less than .1 mile west of Berkeley Island County Park. With a characteristically strong emphasis on public access and recreation, Berkeley Island County Park has recently expanded westward, south of Brennan Concourse toward Maple Creek. Maple Creek is located between the two major state parks (Department of Environmental Protection) of the Bay region. It is only .5 mile northeast of Double Trouble State Park at the mouth of Cedar Creek. Maple Creek lies to the west, across the Bay, from Island Beach State Park, whose distant dunes evoke a more primitive and open New Jersey coastline. Moreover, Maple Creek is at the center of a chain of undeveloped lands on the western shore of the Bay, stretching from Tilton Point in Dover Township to the Lighthouse Camp/Bowker Property in Ocean Township that have been identified by the U.S. Fish and Wildlife Service (1994) for potential inclusion in the Forsythe Refuge.

While development has made inroads, nearly islanding the site to its west, south, and northeast (east of Bayview Avenue and north of the creek itself), Maple Creek manages to maintain its vitality and its efficacy as a natural area. On a brisk day in late November, ring-billed gulls gather on an exposed mudflat, a great blue heron quietly lifts aloft above the ebbing stream, and a female northern harrier glides and tilts only feet above the marsh, which conceals her rodent prey. While Maple Creek's marshes appear to have survived incursions on their perimeter — ditching, draining, and filling — there are signs that the uplands at Maple Creek are threatened. Fire hydrants have been recently installed at regular intervals along Bayview Ave. A pine-oak woodland bordering Bayview Avenue north of the creek bears placards announcing that portions are "For Sale."

From a real estate, land management, or public policy perspective, each of the Barnegat Bay Century Plan sites along the Bay's western shore can be viewed as a discreet entity. For wildlife, however, the natural world which supports them is a continuum; the boundaries recognized by humans have little or no relevance. The bald eagle, on the Federal list of endangered species, has been documented at two Century Plan sites, Murray Grove/Stouts Creek and Cedar Creek Point/Lanoka Harbor. The American bittern, listed as threatened in New Jersey, has been sighted at additional Century Plan sites, including Good Luck Point, Cedar Creek Point/Lanoka Harbor, and the Sloop Creek Road Area (Herpetological Associates, field observations, 1990). With allowances for habitat preference and tolerance of built environments, avian species are utilizing sites whose ecology mirrors that of Maple Creek. As available habitat in the Bay region continues to diminish, the importance of Maple Creek in meeting the needs of numerous bird species will undoubtedly increase. In addition to having important biological functions, Maple Creek, in its undeveloped state, greatly enhances the quality of life of Bayville.

Metedeconk River/Forge Pond

Brick Township

230 Acres

This Brick Township site extends approximately 2.5 miles to the southeast along the Metedeconk River corridor from the Garden State Parkway to Breton Woods. The southwestern boundary passes along Route 549 (Chambers Bridge Road) and excludes the developed areas of Laurelton Acres, Bricktown, and Cedar Bridge Manor. The northeastern boundary begins at Route 88 and skirts around the nearby development to Fairview Avenue. Residences, commercial enterprises, and public facilities hide much of this site from the casual traveler. A glimpse, however, to either side of Route 70 in the vicinity of the Metedeconk River Bridge reveals a floristically diverse vista.

Upland and wetland areas here are generally flat, but the transition area between them occurs across moderate to steep slopes in the southeastern half, and on gentler slopes elsewhere. The aquatic regime includes both fresh water (tidal and non-tidal) and salt water components. The freshwater area occurs just upstream of Route 70 within Forge Pond, and remains tidal to about 200 yards above the confluence of the North and South Branches.

The site can be accessed by foot from the parking lot behind the municipal offices along Chambers Bridge Road and from the public recreation area (a soccer field) off Route 88. A small public park affording an excellent view of Forge Pond is found mid-span off the westbound lane of Route 70 and a small but decent boat ramp and parking entrance is found less than 100 yards to the west. The shallowness of Forge Pond and the Metedeconk River west of Route 70 restrict most boating to canoe enthusiasts.

Wetlands and open water cover the majority of the site, as most upland tracts have been developed. Giant reed dominates the wetlands to the east of Route 70 as a virtual monoculture. The freshwater wetlands to

the west of Route 70 are more aesthetically appealing owing to their diverse and robust character. A recent survey by Herpetological Associates found six distinct wetland communities (coastal plain Atlantic white cedar swamp, freshwater marsh complex, graminoid marsh, stream-side shrub marsh, pine barrens hardwood swamp, and pitch pine lowland forest). Eight state endangered, threatened, or rare species were observed during that survey. These included great blue heron, great egret, osprey, Forster's tern, least tern, Elliott's goldenrod, purple bladderwort, and a moss. Potential habitat was also observed for barred owl, red-headed woodpecker, Pine Barrens treefrog, livid sedge, pine barren boneset, Swamp pink, New Jersey rush, crested yellow orchid, and curly grass fern.

Forge Pond has been dammed at least twice since the late 1700s. Remnants of the old dams are still in place within meters to the west of Route 70, as are some of the old cart paths associated with Atlantic white cedar lumbering. Between 1808 and 1840 the forge — owned by Banajah Butcher and Barzilla Burr — produced the pipework used in the water mains of lower Manhattan. The Metedeconk River presently flows freely through the pond, but the Brick Township Municipal Utilities Authority (BTMUA) would like to reimpose the dam to secure a potable water supply. The local water table/aquifer has been compromised by salt water intrusion, while the deep aquifer supply has been overdrawn. The proposed impoundment will have an impact on nearby wetlands, which are threatened by the ongoing processes of salt water intrusion and sea-level rise. Historically, the Metedeconk River has been a freshwater environment emptying into Barnegat Bay. Salt water presently intrudes well into Forge Pond, and has been increasing in frequency of occurrence and concentration during the last few decades. The impacts of sea-level rise (rising 0.15 inches per year) are less immediate, but nonetheless real. The combination of these processes will likely result in the loss of most on-site wetlands by the year 2100.

In the interest of protecting their water supply, BTMUA may be in a position to acquire private property within the watershed, especially those properties most immediate to their riverside pumphouse. Small areas just upstream and contiguous with the site are already under county ownership and offer some protection of the water supply and downstream habitats.

Middle Branch/Forked River

Lacey Township

1,000 Acres (Estimated)

The Middle Branch of the Forked River is a boggy, lowland area rich in plant and animal species. Though the site has not been thoroughly surveyed for endangered and threatened species, a preliminary analysis indicates a diversity that belies the site's neighboring land uses, which include the Garden State Parkway, the Oyster Creek Nuclear Power Plant, Route 9, and residential and commercial development. The Middle Branch east of Route 9 is built up.

Wetlands present consist of extensive areas of Atlantic white cedar swamp along stream corridors, as well as lesser amounts of open canopy and pitch pine lowland. Many of the plants which occur in these open,

savannah-like areas are unusual given the site's proximity to the coast, and are more typical of the central Pine Barrens to the west. Bog-loving species such as cottongrass, Sphagnum moss species (golden crest), the orchids (grass pink, rose pogonia, and dragon's mouth (a rare species)), Carolina clubmoss, and carnivorous species such as pitcher plant, bladderworts, and sundews can be found in these areas. Two plants which occur at Middle Branch are endemic to New Jersey, and both are listed by the state as endangered. A medium-sized population of Knieskern's beaked rush, also a federal threatened species, can be found at one of the savannah-like areas, as can bog asphodel, a very showy member of the lily family that is a candidate species for federal listing.

A sweep of the site's pitch pine lowlands turns up sheep laurel, inkberry, beaked rushes, and other sedges, turkey beard (one of the loveliest of all the Pine Barrens' flowers), and clubmosses. The pitch pine lowlands present on the Middle Branch site are scattered throughout, and often occur as transition zones between the wetter cedar swamps and the dry uplands; a number of globally rare plant species such as pine barrens smoke grass, pine barrens reed grass, and pale beaked rush occur in them. Also present is curly grass fern, one of the rarest and smallest of all North American ferns. A fertile frond of curly grass can be as small as an inch, and its grass-like corkscrew leaves even smaller, which can make the plant difficult to detect in its lowland, often boggy habitats.

Upland habitats present on Middle Branch consist of closed canopy pine-oak forests with a dense huckleberry shrub layer, sparsely vegetated areas of bare sand, and dry, sandy areas of filled wetlands; the latter two are heavily disturbed in places by ATV traffic and have been fragmented by recent construction activity.

Animal life present on this parcel consists of common, widespread species such as painted turtle, green frog, black racer, pine warbler, towhee, song sparrow, cottontail rabbit, red fox, and white-tailed deer. A family of river otter has also been seen here on several occasions. Though actually rather common in unpolluted waterways throughout most of New Jersey, otters are rarely seen, and an encounter with them is always a memorable event. There is suitable habitat on Middle Branch for such state-listed species as pine barrens tree frog and northern pine snake, but it is not known whether they occur here.

The bulk of the Middle Branch site, which is largely wetlands, enjoys general protection under state land use regulations owing to the presence of numerous threatened and endangered species. Constituent uplands and transition "edge," however, do not enjoy the same threshold of protection. While development is apt to degrade the high quality of the Middle Branch wetlands, maximum buffers should be applied to any conversion of raw land. From site visits, it appears that the uplands most vulnerable to development are located near the southern boundary, where there has been recent construction and heavy ATV damage.

As a next step, it is recommended that this significant botanical site be thoroughly surveyed for threatened and endangered plant species; the only known site visits have been conducted during the winter. Roughly

twenty listed plant species are known to occur with Knieskern's beaked rush and bog asphodel, but most species are identifiable only during the growing season. Clearly, a more thorough inventory of this area of Middle Branch is needed.

Murray Grove/Stouts Creek

Lacey Township

1,300 Acres (Including 210 Acres at Murray Grove, 135 Acres at Oak Park Homes)

The Murray Grove/Stouts Creek tract presents a magnificent natural landscape, evocative of the New Jersey coastal woodlands and marshes that blanketed the western shore of Barnegat Bay in colonial and precolonial eras. Murray Grove/Stouts Creek also harbors significant human history. It was the founding site of the first Unitarian Universalist Church in America. In September of 1770, Rev. John Murray, an English Universalist minister, arrived on the shores literally by accident — the grounding of his brig on a sand bar to the north. He found an insistent resident named Thomas Potter, a church built by Potter, and a community very much in need of a minister. Murray was cajoled into preaching and his providential appearance, according to one theory, gave rise to the naming of the site “Good Luck.” In addition, “Good Luck Point,” located in Berkeley Township (a Century Plan site), received the same name as the location where Murray ran aground. The Potter Meeting House, rebuilt from original timbers in 1842, is situated adjacent to Murray Grove. The Unitarian presence persists to this day. The Murray Grove Association operates a retreat and conference center for the Unitarian Universalist Church near the northwestern edge of the property.

Regardless of the season, Murray Grove/Stouts Creek is impressive for its beauty, the relative pristine quality of its landscape, and the botanical diversity it contains. The west/east trail leading from the conference center to the Bay allows a sampling of the gradual transition from rich, primarily deciduous woods of the uplands to high marsh and salt marsh, following a gradient from 15 feet above sea level to sea level at the Bay shore.

The upland forest at this site is one of the most species-diverse areas encountered in this study. Showing some evidence of previous wood harvests, the forest contains mature white and red oaks (some in excess of 60 years in age), spanish oak, scrub oak, willow oak, chestnut oak, black oak, pitch pine, shortleaf pine, white pine, sassafras, black cherry, red maple, Norway maple, and sugar maple. Sweetgum, blackgum, sassafras, and red maple have a greater presence in the lower, wetter areas preceding the marsh. Understory species include inkberry holly, American holly, northern arrowwood, highbush blueberry, and huckleberry.

Numerous abandoned old fields, now populated by broom sedge, eastern red cedar, gray birch, and black cherry, point to early land-clearing and farming efforts at Murray Grove. The fields are gradually and inevitably reverting to forest; the fields can still be kept open through mowing. Eastern red cedar, for instance, is a noted colonizer of old fields. The age and size of one particular specimen hint that there have been several episodes of land clearing followed by succession through scrub growth to forest.

Freshwater and saltwater habitats abound at Murray Grove/Stouts Creek. Further adding to the diversity of the woodland are twenty freshwater vernal pools, which are usually dry by mid- to late summer. These pools offer good breeding habitat for salamanders, frogs, and toads.

The marshes of Murray Grove/Stouts Creek contain a complex network of natural waterways, pools, and embayments, as well as the mosquito ditching. In addition to the north and south branches of Stouts Creek, there are waterways such as Hancy's Pond, Stumpy Pond Creek, Potter's Creek, Bony (or Bone Dry) Creek, and Wire Creek Pond that reflect local legend and history. The marshes and attendant mud flats provide prime habitat for foraging waterfowl and shorebirds. As is typical of all marshes on the western shore of the Bay, however, the mainland connection at Murray Grove allows ready access to predators. Raccoons, foxes, weasels, cats and dogs would make short work of marsh nesters. The only effective refuge, for breeding purposes, of such ground-nesting species as common tern, least tern, black skimmer and laughing gull for example, remain the offshore islands.

The richness and complexity of the marshes here constitute prime habitat for marine organisms, both vertebrate and invertebrate. Black sea bass, for example, spawn offshore in the Atlantic. The young fish are planktonic, minute in size, and drifting with the current. Only 13 mm. in size, they settle to the bottom on the inner shelf of the Atlantic coast in estuaries and in bays. Their food supply is greatly enhanced by the contribution of the marshes — in the form of detritus, invertebrates, and smaller fish (Ken Able, personal communication).

In light of its pristine state and biological significance, Murray Grove/Stouts Creek has been recognized as being a prime component in the proposed expansion of the Forsythe Refuge. The site fully meets the state criteria for endangered or threatened wildlife species habitats. A 1991 survey by Herpetological Associates confirmed that New Jersey and federal-listed birds — including peregrine falcon, bald eagle, northern harrier, osprey, red-shouldered hawk, American bittern, and grasshopper sparrow — have utilized the site for foraging or roosting.

The protection of Murray Grove/Stouts Creek has recently been achieved through purchase by the Trust for Public Land (TPL) and conveyance to the U.S. Fish and Wildlife Service. In November, 1994, TPL transferred the 208-acre Murray Grove tract and the adjacent 133-acre Oak Park Homes to the Forsythe Refuge, thereby creating a new management area in the central area of the Barnegat Bay and serving to reinforce the “green link” among undeveloped lands at the Forked River Game Farm, Forked River and Sunrise Beach to the south, and Cedar Creek Point/Lanoka Harbor and Maple Creek to the north.

Oyster Creek/Sands Point Harbor

Ocean Township (Waretown)

140 Acres (Estimated)

An aerial photograph of Barnegat Bay's remaining open space can create a false impression that a stasis has been reached — that a balance has been struck between developed and undeveloped lands. Repeated visits, however, confirm that perception and reality are two different matters. Of the sites identified by the U.S. Fish and Wildlife Service (1994) for potential inclusion into the Forsythe Refuge, Oyster Creek/Sands Point Harbor perhaps best demonstrates the perils of ongoing site fragmentation, a widespread problem in the Bay region, and underlines the need for prompt protective measures.

Formerly part of a large saltwater farm, the site has two components, divided by the east-west strike of Bay Parkway, a residential collector street. The northern section is the Sands Point Harbor peninsula. Consisting largely of salt marsh with patches of deciduous upland, Sands Point Harbor fronts the Bay and curves inland to form the southern portion of the mouth of Oyster Creek. On the opposing bank of the creek is Finninger Farm, also a Century Plan site. A recently constructed residence, with bulwarking and a long dock, sits on filled former marsh just north of the terminus of Bay Parkway. The southern section of the site appears to be more pristine, with beachfront, marshes, and a fine mixed deciduous upland forest.

Upon reaching the Bay, however, the street provides an informal but important waterfront public access for nearby residents, bicyclists, and strollers. This area may be improved and protected as a “pocket park” by installing benches and support facilities, including the stabilization and restoration of the street-end, which presently collapses into the Bay.

The upland forest of nearby Oyster Creek is notable for its botanical diversity in contrast to the marshes, which have been ditched and have received dredge spoil in areas. The prevalence of *Phragmites* over *Spartina* grasses indicates the degree to which the wetlands have suffered alteration due to human activities. South of the Bay Parkway and east of Spruce Street, where the Privateer Cove subdivision commences, a rich pine/oak/maple woodland dominates the landscape. The variety of oak species encountered is high, including white, Spanish, willow, scarlet, black, blackjack, and scrub oaks. American holly, black huckleberry, and high bush blueberry are frequently found in the understory. The Oyster Creek landscape is enriched by old abandoned fields undergoing gradual reversion to shrub and forest. Ground cover at the Oyster Creek woodland and woodland fringe consists of species such as grass-leaved goldenrod, fragrant goldenrod, prickly pear cactus, golden false heather, calico aster, stiff aster, white paniced aster, beard grass, switch grass, and bracken fern (U.S. Fish and Wildlife Service, 1994).

Plants of critical concern from the standpoint of conservation biology are present on the Oyster Creek site and include bog asphodel and pine barrens bonset (both listed as state endangered and pine barrens protected); pine barrens reed grass (pine barrens protected); and Barratt's sedge (pine barrens protected) (Gordan and Vivian, 1994).

Birds play a vital role in the overall ecology of the Bay marshes and uplands. The following species, listed as threatened in New Jersey, have been found at Oyster Creek: savannah sparrow, grasshopper sparrow, American bittern, little blue heron, great blue heron, and osprey. The list of species of special concern in New Jersey broadens to include many of the above, but also the upland sandpiper, vesper sparrow, bobolink, horned lark, and eastern meadowlark (Herpetological Associates, field observations, 1990). An avian predator listed as state endangered, the northern harrier, or marsh hawk, can often be seen on its silent patrol above the marsh surface. The eastern hognose snake, a reptile of special concern in New Jersey, also frequents the Oyster Creek area.

Given this background of biological diversity, it is disturbing to note that the upland woods of Oyster Creek are now under active residential conversion. On first glance, when viewed to the south from the Bay Parkway, the uplands appear to be intact. The opening wedge of change is a short woods road south and west of Cable Road. The woods road leads to recently cut-over areas — two future home sites. From the clearings, a blue blazed trail continues on into the woods, perhaps pointing the way to further projects. Fragmentation of the woodland may be safely predicted to continue in the absence of immediate preservation measures.

Pancoast Inland Area

Ocean Township

900 Acres (Estimated)

Bounded by Pancoast Road to the south, by development south of Wells Mills Road to the north, and by the Garden State Parkway to the west, the Pancoast Inland Area embodies the upland wooded tracts on both sides of the Parkway that are under increasing pressure from residential expansion. The site is immediately north of the Barnegat Bay Beach Inland Area (a Century Plan site).

On entering the interior of the site along Garrison Road heading south from the residential area of Laurel Wyck Drive, one has the impression of entering a vast forested tract. The fact that the forest consists of a patchwork of trees of differing ages is not inconsistent with the image of the primordial pine/oak forests of the region, which were subject to periodic fires of both natural and human origin. Timber harvesting and limited clearing for agricultural purposes have undoubtedly occurred in the Pancoast Inland Area over the past several centuries, resulting in stands of trees that are mature, over 50-60 years of age, as well as stands that are young, less than 15 years of age.

A pine-oak theme dominates the forest of the Pancoast Inland Area. Within the context of this theme, however, the variety of plant species also becomes apparent. Rock or chestnut oak, which fares well on dry, sandy soils, appears to be one of the most numerous of the oaks. Spanish, red, white, scrub, and blackjack oak, many with dried leaves still attached and rattling in the late November wind, are also interspersed among the pitch pines. Scattered clumps of mountain laurel form an evergreen haze in the understory. Also

present in the understory are low bush blueberry, high bush blueberry, coastal pepperbush, low gallberry holly, and American holly; the latter two shrubs adding their darker green accents to the greys and browns of the forest. Species that colonize disturbed habitat, such as along the edge of trails, include grey birch, sweet fern (a low flowering plant with serrated leaves that resemble fern fronds), and bracken fern (a true fern).

The future of the Pancoast Inland Area as a continuous and integral site appears to be very much in flux. Ownership of the site is fragmented. The Township of Ocean owns six separate parcels. At least 13 private owners hold the remainder. Jeep and ATV trails, deer hunting stands, and trailside dumping indicate intermittent use, while flagged survey lines point to property lines and potential subdivisions. Building activity between the abandoned railroad right-of-way and Route 9 is evident in the southeastern portion of the tract, as it is along the northern boundary of the Pancoast Inland Area.

Fire and Pineland Forests

From colonial times even to the present day, absentee ownership, uncertain property titles and boundaries, and the marginal agricultural value of the pine barrens encouraged burning. The varied motives for the burning include the production of charcoal, harvesting of cordwood, enhancement of the blueberry crop, and arson. Accidental fires were sparked by the iron industry and by the railroads, as both made inroads into the Barrens (Forman, 1979).

The ability of pitch pine to recover quickly from widespread habitat disturbance, particularly fire, is well documented. The characteristic vegetation of the New Jersey Pine Barrens is actually maintained by frequent, low intensity fires that help to eliminate or discourage competition and prepare the seed bed for the pines. A variety of the pitch pine, found in fire-prone areas, has serotinous or “glued” cones that open only in response to fire. The great fire that burned 20,000 acres in Manchester Township in April 1995 serves as a reminder of fire as the determinant, the prime mover, of pinelands ecology.

In addition to fire, numerous factors have been and continue to be at work in determining the make-up of pineland forests. “Cutting, especially clear-cutting, also has exerted great effects on the present day composition of the forests; many areas in the Barrens have been clear-cut four or five times since 1600. Land clearing and abandonment, and the natural succession of plants that differ in size and in seedbed requirements and in their tolerance to shade also play an important role. Deer browsing, beaver-caused flooding, and human activities, such as road paving and abandonment, removal of sand or gravel, and planting of native and non-native species, have important but less widespread effects” (Foreman, 1979).

Reedy Creek Additions

Brick Township

2 Parcels Totalling an Estimated 85 Acres

The Reedy Creek area of Brick Township has been the site of significant conservation efforts and achievements that have served as a catalyst for a comprehensive approach to preservation of the Barnegat Bay watershed. Coastal and upland open space, located between Route 528 (near its crossing of the Bay at Old Bridge) and Havens Cove, is designated as Reedy Creek, in reference to the tidal stream which flows to the southeast through the lower third of this large area. Conservation efforts at Reedy Creek were initiated by the Ocean County Izaak Walton League and have been advanced by the Trust for Public Land's Barnegat Bay supporters. The early 1990s witnessed an expansion of the Forsythe Refuge to include a new unit at Reedy Creek, potentially a 2,400-acre area eligible for federal purchase. Over 770 acres are now part of the Reedy Creek Unit of the Forsythe Refuge much of which was protected through the work of the Trust for Public Land. Two unprotected sites, totalling 85 acres, have been selected as priority Reedy Creek Additions.

The two priority sites are named for the owner and for the project: the Trenton Diocese woodland and the Havenswood/Maple Avenue Associates tract. Both sites are contiguous to protected lands and will consolidate or bridge Fish and Wildlife Service holdings. The Reedy Creek area in its entirety thus resembles an open space jigsaw puzzle for which the various pieces are being assembled.

The priority sites can best be understood in the context of the broader protected area. A relatively open forest with deciduous canopy (chiefly of maple and oak amidst scattered pitch pine) characterizes the area north of Havens Cove Road and under Fish and Wildlife jurisdiction. The high quality and variety of the woodland is striking. The canopy contains red maple, pitch pine, sweetgum, sour gum, scarlet oak, chestnut oak, and white oak, while the shrub layer harbors American holly, inkberry holly, northern bayberry, sweetbay magnolia, black cherry, highbush blueberry, and black huckleberry. The groundcover, in part, is made up of sheep laurel, blackberry, partridgeberry, low bush blueberry, and teaberry. Tree clubmoss, a lycopodium belonging to an ancient lineage of non-flowering vascular plants dating back over 300 million years, forms persistent green patches on the woodland floor. These diminutive plants suggest a well established and undisturbed forest habitat. Club mosses seem to embody or possess a "wilderness spirit," as attempts to transplant and cultivate them outside of native woodlands are largely unsuccessful.

In addition to serving as a continuation of the protected Reedy Creek woodland, the 35-acre Trenton Diocese site, which is technically outside of the Refuge boundary, harbors an abandoned farmstead dating to the early nineteenth century. Vegetation masks the foundation of a building that was once part of the underground railroad, through which slaves made their escape from the South during the Civil War.

The integrity and breadth of the natural landscape provide the underpinning for faunal species diversity at Reedy Creek. In early April, with cold nights and frost a lingering possibility, spring's invertebrate

emissaries are in full evidence throughout Reedy Creek. Erratic flight and delicate lavender wings against the browns and grays of the woodland announce the presence of spring azure, a small and active butterfly with wide distribution throughout the United States. Both the mourning cloak and the red admiral butterflies can be seen resting in sun spots on the forest floor. A deep yellow-orange color marks the orange sulphur as it frequents forest openings and old fields in search of blossoms. Increasingly, invertebrate species are being used as indicators of environmental quality. Preserves are even being established with invertebrate species as the central focus. Such a recognition stems from the finding that much of the biological diversity of the animal kingdom resides in the arthropods, including insects and spiders.

A high level of avian diversity has been documented at Reedy Creek, specifically at the Havenswood site. During the course of five and a half hours in May 1992, biologists recorded some 690 sightings, comprising 76 bird species. Many of the birds were migrants. The researchers noted the very unusual sighting of five species of woodland thrush (veery, gray-cheeked thrush, Swainson's thrush, hermit thrush, and wood thrush) in one location during a short period of time (Herpetological Associates, field observations, 1992). High bird species diversity can be seen as a direct reflection of habitat quality.

Riverside Woods

Brick Township

6 Acres

Riverside Woods occupies a shallow cove on the southern shore of the Metedeconk River. The site provides yet another example of nature islanded by changes in land use. On its western flank lies land altered by sand and gravel fill; a shoreline area that could benefit from restoration. On the east lies a densely developed residential shorefront area.

Riverside Woods is a gem that combines an old and well-established woodland with marshes and riverfront. There are numerous specimen trees of an impressive age, in some cases estimated to be as old as 65 - 80 years. The woods are composed of scarlet oak, Spanish oak, white oak, chestnut oak, black oak, black cherry, sassafras, and red maple. American holly, sweetbay magnolia, mountain laurel, and northern bayberry occupy the understory. Prickly brambles and Japanese honeysuckle often cover the lower vegetation. An interesting adaptation allows photosynthesis by brambles, such as blackberry and greenbrier, in winter (whenever temperatures rise above freezing). A light green haze set against the browns and greys of the winter woods indicates that the stems of brambles are capable of producing sugars in the absence of leaves. This makes them all the more desirable as food for browsing animals, such as white-tailed deer. To counter this particular vulnerability, the green stems are heavily endowed with thorns (Ted Stiles, personal communication).

The marshes of Riverside Woods consist of a combination of Phragmites and Spartina and take the form of peninsulas, fingers, and islets. Completely enclosed marsh pools, rejuvenated by the Metedeconk River

during storm and spring tides, are also found. Predictably, waterfowl are quick to make use of such habitat. Visible during an early March visit were mallards, common mergansers, canvasback, and buffleheads.

The site is receiving a very noticeable degree of local care and stewardship. Short sections of boardwalk, a shore path, a viewing platform with wooden chairs, the absence of litter, carefully pruned trees, support for a sizeable overhanging trunk of a black cherry, and a carved and painted mallard sign in the marsh all speak of a level of care that is quite extraordinary. Riverside Woods appears to be open for local and distant visitors to explore as a small shoreline preserve and makes for an ideal mini-park/preserve. This is in contrast to the neglect and misuse that are the more frequently encountered modes of interaction with open space that is “out of sight and out of mind.”

Roberts Avenue Marsh

Berkeley Township

7.07 Acres

The Roberts Avenue Marsh is a fragment of the wetlands that was once extensive in prehistoric and colonial times and that rimmed the shoreline of Island Beach, a barrier island that defines the eastern limit of Barnegat Bay. Bounded by houses along Roberts Avenue to the south and along Bay View Avenue to the east, the marshland and pond represent a pocket wilderness. An aerial view confirms the isolation of the marsh in a sea of houses and its proximity to the green and protected sweep of Island Beach State Park.

In its restricted area, Roberts Avenue Marsh consists of a microcosm of the Bay’s salt marsh habitat. The site contains a tidally nourished pool and channel occupying 1/3 of the site area, a sand beach fronting the Bay, areas of beach grass and salt marsh grasses, a low dune area containing such salt marsh shrub species as bayberry and marsh-elder, and patches of relatively open but re-vegetating ground near the residential developments. Roberts Avenue Marsh is frequented by the expected denizens and visitors of salt marshes in this region — various species of herons, egrets, sandpipers, ducks, gulls, and terns. As a miniature, fully functioning oasis for plants and wildlife less than

a quarter of a mile from one of the major coastal refuges in New Jersey, Roberts Avenue Marsh provides cause for optimism regarding the longevity and future of shoreline open space.

Roberts Avenue Marsh is privately owned. Incursions onto the original marsh by development have occurred along Roberts and Bay View Avenues. The presence of Phragmites growing in contact with the western edge of the Bay View Avenue housing indicate that the marsh has been filled prior to construction in 1989. The future status of the property is uncertain, as three subdivisions have been drawn up by the present owner. Much of the site is salt marsh, rimmed on the landward side by fill, and it probably could not legally be built on.

Because of its small size, the marsh could probably be best administered as a park of Berkeley Township. A committee of local residents from the immediate neighborhood — people with the greatest interest and

stake in the project — could be entrusted with monitoring and stewardship. The current lack of litter and evidence of dumping are encouraging, indicating that this surveillance may already informally be in effect.

The area is too small and fragile to allow much public access. The chief human use would be passive recreation in the form of birding and other natural history activities. A small observation platform near the junction of Roberts and Bay View Avenues (currently an empty rectangular space) may be appropriate. Instructional signs, as at the Bay end of Roberts Avenue, would be useful in introducing the site and in setting forth rules of visitation. The rows of houses which effectively wall off the marsh, utilizing it as a backyard viewscape, ironically serve to buffer it from the wider public at this time. Currently, the waters immediately offshore are used for the mooring and anchoring of sailboats.

Silver Bay Westward Extensions

Dover Township

480 Acres

Embracing abandoned farm fields in succession, red maple/black gum swamps, Atlantic white cedar swamps, pine barrens, mixed oak/pine woodlands, magnificent stream corridors and tidal marshes, Silver Bay Westward Extensions holds great promise for the conservation of a wide array of habitat for Bay flora and fauna. With frontage on Silver Bay, the site flanks the eastern and northern boundaries of the Ocean County Community College (much of which is currently undeveloped). The site proceeds to the west to a junction with the Garden State Parkway boundary and with a landfill. The proposed Silver Bay Westward Extension ties in to the south with the Church Road Property, an impressive and diverse woodland and a Century Plan site. Taken together, these two sites form a 745 acre crescent around the community college campus, better buffering it from residential developments to the east, north, and west.

At numerous points on the periphery of the Silver Bay Westward Extensions, the cul-de-sacs of suburbia confront a wilderness area. At Chapel Court (off of Old Church Road) on the northern edge of the site, a “for sale” sign marks clearing and potential subdivision of a mature pine/oak woodland, typical of the Pine Barrens. At the eastern end of the same Chapel Court, a young, purely deciduous woodland is encountered. Youngsters playing basketball where Vaughn Avenue reaches a dead end at the southeastern edge of the site might take note of a primordial vista — a stream coursing through a meadow toward a distant pitch pine/red maple swamp. A dead end sign marks another wilderness line near the junction of Acorn and Vaughn avenues, where red maple, in spring flower, holds full sway. Representing its western edge, finger-like projections of the site carry narrow corridors of hardwood swamp west of the Garden State Parkway. These vistas at the cul-de-sacs are eloquent reminders of the beauty of a former wilderness and of the mounting pressures that remaining natural areas face. In many cases, public access is prohibited or discouraged. Rising beyond the asphalt, walls of woodland appear inviting but vulnerable.

Streams of varying dimensions carry water through the Silver Bay Westward Extensions, forming a network that eventually leads to Silver Bay and Barnegat Bay. The bog seep in its carpet of Sphagnum moss and carnivorous plants; the rivulet that flows through a freshwater marsh; the narrow and shaded stream that passes under the Garden State Parkway; the brook with islets of pine and cedar; the branch that proceeds majestically, sun gilt, to the Bay; and the salt water tidal creek are all facets of this water system. At one point, a branch intersects a jeep/ATV trail, which gouges its way through the landscape. The integrity of individual components invariably is linked to the integrity and viability of the Bay.

While not contiguous with existing preserves, other than the open space of the Ocean County Community College, the Silver Bay Western Extensions and the Church Road Property, are fully deserving of protective measures. The sites have significant potential as parkland and could support a system of hiking trails that would serve to link them with trails on college property. Perhaps the college could be enlisted to help with long-term stewardship of the property. If conservation wins the field, the area available for biological research, education, and passive recreation would increase.

Sloop Creek Road Area

Berkeley Township

300 Acres (Estimated)

At an estimated 300 acres, the Sloop Creek Road Area presents a complex and magnificent expanse of marshland on the verge of the Bay. The marshes are nourished by three streams — Potter Creek, the largest stream, to the south, Little Sloop Creek, with a westerly branch crossing Bayview Avenue south of Sloop Creek Road, and Sloop Creek which takes a northwesterly route through the tract, west of Allen Road.

In view of the remaining open space, the Sloop Creek Road Area boundaries could be expanded beyond those outlined by the U.S. Fish and Wildlife Service in their 1994 Plan for the Barnegat Unit of the Forsythe Refuge. In recognition of Sloop Creek's habitat value, its southern limit could incorporate Potter Creek westward toward the wooded uplands that buffer Route 9. The southern limit of the coastal portion would consist of the mouth of Potter Creek, while the northern limit would follow Allen Road, which is defined by residential development.

The full and exhilarating sweep of marshland distinguishes the Sloop Creek Road Area from its neighboring western shore tracts to the south, including Clamming Creek and Maple Creek. From many vantage points, the eye can be tricked into perceiving that there is almost no end to the ochre plain of marsh grasses, cut through occasionally by the brilliant blue of tidal stream and marsh pool. While Phragmites and the Spartinas are the primary members of the site's marsh flora, other salt marsh specialists are prospering, such as glasswort, perennial salt marsh aster, and sea pink. The Fish and Wildlife Service identified a filled area of former marsh, probably north of Sloop Creek Road, with its own distinctive plant life, including eastern red cedar, switch grass, beard grass, wild flax, and Canada goldenrod, in addition to the everpresent Phragmites. The upland forest at Sloop Creek can be described as pine-oak or oak-pine, depending upon

the predominance of pitch pine in a given subarea. The oak species include white, willow, Spanish, scarlet, and black. American holly and mountain laurel provide an evergreen note to the understory.

The avian fauna of the Sloop Creek Road Area is a rich one and benefits from the expansive and contiguous habitat. A recent survey identified 82 species of birds on the site, about half of which were thought to breed on or near the site (Herpetological Associates, field observations, 1991). Included are the red-shouldered hawk, northern harrier, and peregrine falcon — three birds of prey listed as endangered in New Jersey. The peregrine is also on the federal list of endangered species. Additionally, Cooper's hawk and osprey, listed in New Jersey as threatened, make use of Sloop Creek's marshes and waters. Great blue heron, American bittern, and savannah sparrow — listed as threatened in New Jersey — were encountered by biologists. A survey also located two amphibian species of special concern in New Jersey — the marbled salamander and four-toed salamander (Herpetological Associates, field observations, 1990).

The Sloop Creek Road Area, with its abundance of tidal creeks and man-made ditches, provides productive habitat for both marine invertebrate and vertebrate life. Above other attributes, the presence of creeks and riparian "edge" increases the habitat value of an estuarine ecosystem. The tide-driven exchange of nutrients that occurs between the Bay and its fringing marshes is greatly facilitated by the three channels of the Sloop Creek Road area, which reach far inland with the life-sustaining tide. Killifish, of which the *Mumichog* is an example, spend their entire life cycle of two or three years in this type of aquatic system, utilizing warmer marsh pools in the winter and the larger marsh creeks at other seasons. Spawning of this species occurs intertidally; the larvae hatch out on falling tides on the marsh surface and make their way into the pools and creeks, where they will grow to full size (Ken Able, personal communication).

Sloop Creek Western Extension

Berkeley Township

200 Acres (Estimated)

Carrying the sweep of open space that characterizes the Sloop Creek Road Area west of Route 9, the Sloop Creek Western Extension is a sizable tract of upland forest under duress. Main access points to the interior of the site from Hickory Road to the north lead to a network of dirt roads used by trucks and ATVs. There is much evidence that the groundwork is being laid for major development of this site. Widely cleared roads, concrete piping, and storm sewers are very visible. In addition to the Ocean County Utilities Authority's Central Water Pollution Control Facility, the site is adjacent to industrial activity to the west, in the form of sand and gravel mining, rock pulverizing, and concrete production.

In contrast to the disturbance described above, the Sloop Creek Western Extension contains a fine woodland, composed of stands of trees of varying ages and species composition. Depending upon the particular location within the site, the woodland may be dominated by pitch pine or by a combination of red, Spanish, and white oaks or may be characterized by an even blending of pine and oak.

Part of the Sloop Creek drainage, a pond and stream near the center of the site, are rimmed by rushes and grasses and, set slightly further back, by the olive green wall of Atlantic white cedar. The serenity of this location belies the level of human activity evident elsewhere on the site. Cut stumps and the fairly youthful appearance of the cedar stand, however, indicate that this area has been cut over, perhaps on several occasions, in the past. Even a relatively young cedar swamp will attract birds as foragers and nesters, particularly if it has an accompanying shrub layer consisting of high bush blueberry, black huckleberry, coastal pepperbush, and fetterbush. Birds that breed in cedar swamp areas include eastern wood pewee, catbird, wood thrush, yellow-throated vireo, yellowthroat, redstart, parula warbler, yellow warbler, and song sparrow (Leck, 1979). These insectivores are encountered in the warmer months.

A borrow pit or sand excavation site, an extremely altered and artificial habitat, can be useful to wildlife. Borrow pits at Sloop Creek Western Extension may be utilized by breeding populations of Pine Barrens treefrogs and other amphibians.

Given an accelerating pace of home building, the longevity of the Sloop Creek Western Extension is very much in question.

Sunrise Beach

Lacey Township

40.2 Acres

Its fine wetlands sweeping northeastward and then incurving to form a peninsula, Sunrise Beach contains a northerly extension of the marshes of the Forked River Game Farm and the Forked River Annex (a Century Plan site). The total shorefrontage of these three areas, excluding streams and tidal creeks, extends over 2.5 miles. Continuity of marshland is critical to its habitat value, and, in light of nearby development pressure, is an essential factor in this central area of the Bay.

The interface between residential development and coastal wetlands is starkly evident at Sunrise Beach. A formidable bulwark separates the marshes and distant Barnegat Bay from filled former wetlands to the west, which are being prepared for housing construction. As a reminder of the original nature of the substrate, small clumps of Phragmites persist next to new fire hydrants, storm sewers, and concrete curbing.

An Avian Benefit of the Pine/Oak Woodland

In contrast to a stand of pure pitch pine, a mixed pine oak stand can be predicted to have a larger and more diverse insect population. Oaks as a group have long been associated with a large array of leaf feeding and gall-making insects. Predictably, insect eating birds, such as the red-eyed vireo and pine and prairie warblers, favor nesting in mixed pine/oak woodlands, where food for the hatchlings abounds. Additionally, avian species, such as the black-and-white warbler and the ovenbird (a secretive warbler of the forest floor) utilize leaf litter in nest construction and so can be expected in areas of mixed deciduous and coniferous vegetation (Leck, 1979).

The Sunrise Beach marsh presents a varied landscape. The marsh perimeter, directly facing the Bay or contiguous with existing development, is dominated by Phragmites. This opportunistic member of the grass family with a worldwide distribution spreads by rhizomes and forms solid stands, often to the exclusion of other species. Phragmites prospers in direct response to wetland alteration or disturbance; activities such as dredging, diking, and filling help to increase the plant's range and dominance.

The marsh interior, however, gives a far better idea of the appearance of native salt marshes of the Atlantic seaboard. Such salt marshes had prevailed for the innumerable centuries prior to European arrival but began to give way to man's great appetite for land. Saltwater cordgrass and salt meadow cordgrass occupy large areas of the Sunrise Beach marsh, their golden ochre hue of fall and early winter offset by the persistent soft olive green of the shrubs, groundsel tree, and marsh-elder.

Wildlife is fully responsive to the quality and diversity of habitat. The marsh with its channels (natural and man-made), the peninsula with its protected cove, and the hammock of upland trees and shrubs provide needed cover and forage for birdlife. In mid-November, even a momentary visit to the northern inlet of Sunrise Beach yielded both mallards and buffleheads. The channels and embayments in the marsh afford nurseries for juvenile fish, such as summer flounder and black sea bass, and habitat for full-time marsh residents, such as killifish (Ken Able, personal communication).

Long-term protection for the Sunrise Beach marsh should arise from its wetland status. But there appears to be an ambiguity of status pointing toward continued development in the area. Red survey (or wetland delineation) flags are visible on the peninsula and bulkheading begins near a cul-de-sac on filled land near the inlet. Even in the absence of building pressure, the cessation of shoreline alteration is an unlikely prospect, as boating traffic and neighborhood activity will be on the rise in the years ahead. The marsh's prospect for continuing viability lies in its full integration with wetlands tracts to the south — an integration that would encompass ownership, restoration, and management.

Tilton Point

Dover Township

530 Acres

Tilton Point has the potential to bridge already-protected public lands while providing diverse, high quality habitat and four miles of contiguous Barnegat Bay shoreline. Certainly the most persuasive arguments can be made, among all Century Plan sites, for the conservation of Tilton Point as a natural area. The tract shares a shoreline with the 530-acre Cattus Island County Park to the north, which itself is contiguous to state-owned lands at Calf Creek. Shelter Cove Township Park is located along Tilton Point's southern boundary.

The large expanse of open space at Tilton Point has survived to the present day free of the fragmentation that characterizes much of the northern region of the Bay. Records dating from the 1600s indicate that the land had been under single ownership for much of its history.

As revealed by archeology, the Indian presence at the Cattus Island-Tilton Point area provides a vital context for educational and interpretive use. Drawing on the fine resources of the Cooper Environmental Center at Cattus Island County Park, an innovative approach to the study of natural history and prehistory of Tilton Point/Cattus Island has great potential.

Use of the area by early white settlers was multifold. In addition to farming, fishing, and hunting, Tilton Point was utilized in salt production. Apparently, the site functioned as an interim saltworks during the Revolutionary War, providing General Washington's army with saltpeter (a component of gunpowder) and packing salt for kegs of meat and fish, and for use in field kitchens. With the British blockade preventing salt from reaching the colonies during the Revolution, local sources, such as the salt works here and in the vicinity of Shelter Cove, became very important. In fact, the salt works at Shelter Cove was destroyed by redcoats during a raid (Germaine Georgieff, personal communication).

Together with Cattus Island, Tilton Point encompasses a wide array of habitats: salt marsh, pine oak forest, Atlantic white cedar swamp, freshwater bogs, maple gum swamps and old fields in succession. The natural landscape of the two sites forms a broad and relatively pristine continuum, of vital importance to wildlife. In contrast to the heavily trafficked boating areas and swimming beaches nearby, the light green marshes of midsummer at Tilton Point form a tranquil oasis. Heat waves rise from the marsh, to form a mirage that partly obscures and partly magnifies the distant wooded uplands. The white form of a snowy egret silently takes to the air, indicating by its point of departure the marsh pool or tidal creek where it has been feeding. Its companion, a glossy ibis with an exotic curved bill, remains behind. A school of killifish works its way into the creek. A bluecrab, on the move in her sideways fashion, searches for detritus in the shallows. Lining the tops of marshelder branches, dragonflies, numerous beyond counting, orient themselves to face into the breeze from the Bay. They are known as mosquito hawks, since they dart aloft to intercept their prey in flight and then return to their post. A red-tailed hawk soars overhead, her presence betrayed by the high-pitched shrieking call. The myriad activities of the inhabitants of the Tilton Point ecosystem are carried forward on a July afternoon, as they have since time immemorial.

The upland pine/oak woodland of Tilton Point is mature and of high quality, having some of the tallest and oldest specimens of pitch pine encountered during this study. The taller specimens on this site may attain a height between 50 and 60 feet, although heights greater than 70 feet are possible (Harshberger, 1916).

The benefits of protection of Tilton Point and its potential merger with Cattus Island County Park are multifold. The coexistence of three adjacent parks, even if under different jurisdictions, would lead to a more effective management of conflicting uses. In the context of the three parks, the full spectrum of recreational activities would be possible, ranging from active recreation (swimming, tennis, and baseball) at

Shelter Cove Park to passive recreation (hiking, nature study, birdwatching) at Cattus Island. Large portions of contiguous Tilton Point and Cattus Island could be set aside as wilderness, with pedestrian access facilitated by a system of trails and boardwalks. Finally, protection of Tilton Point would ensure that valuable wetland and upland habitat would be safeguarded against future encroachment by adjacent residential areas and that the educational mission of the Cooper Environmental Center at Cattus Island would be advanced.

Native American Land Ethic and Land Use

One must be reminded that the delineation of boundaries, with lines on a map, surveyor's stakes or stone walls, represents a mindset alien to this continent over the many centuries prior to the appearance of European settlers. To Native Americans, such as the Lenape who hunted, fished, and foraged on Tilton Point's shores, the earth had been created, "For all people and all creatures . . . Mother Earth could not be appropriated by any individual or despoiled for the sake of personal profit. Land, like sun, air, and water, was an essential ingredient of life; without it, corn could not grow, and animals could not graze. Land was to be used and enjoyed but it could not be owned by anyone" (Kraft, 1986).

Rather than land ownership, land stewardship — an old concept in current favor among land management professionals — was the norm. Ancient Indian encampments, usually marked by shell middens, are known at Tilton Point and Cattus Island. Coastal sites favored by Indians often had an upland component near or on the Bay, a location which minimized a salt marsh traverse, provided greater breezes, and helped to avoid the scourge of mosquitoes and green-headed or American horse flies (Germaine Georgieff, personal communication).

Waterford

Stafford Township

328 Acres

As a pocket natural area of 328 acres northwest of Manahawkin, Waterford underscores the resilience of nature as well as the special contribution of the cedar bog/swamp to the hydrology of a region. Although hemmed in by major roads and commercial and residential developments, Waterford retains the soft olivaceous green and cool inner sanctuary of an Atlantic white cedar swamp and bog. With a probable origin in the late nineteenth century, cranberry cultivation at Waterford persisted until c. 1959, when large operations put many of the smaller growers out of business (John Spodafora, personal communication). Nature has been gaining ground since the site's abandonment. The foundations of four to five buildings — residences for workers, barns, and storage sheds — are cloaked by vegetation. The cedars had been harvested from Waterford over the years, both to exploit their timber and to clear the natural depressions or bogs for cranberry cultivation. Old stumps remain but the cedar stands have regrouped, reformed, and asserted their former dominion. Old berms that defined individual cranberry bogs remain as trails, giving a

slight elevation and perspective over the prospect of cedars. Where open water prevails, the cedar spires are reflected in umber tones, punctuated in spring by the lemon yellow and green of unfolding pond lilies. Waterford harbors species of special biological significance — the New Jersey endangered Pine Barrens treefrog and the federally threatened, New Jersey endangered swamp pink (a member of the Lily Family with a roseate spike of flowers).

Bogs, whether in a natural state or modified by man for agricultural purposes, play a critical role in water retention and flood control. The Eight Mile Branch and the Four Mile Branch quietly flow through Waterford in their passage toward Manahawkin Lake to the southeast. The streams break into a series of bogs which act, in essence, as both a sponge and a floodgate. Taking in large quantities of water while releasing only a limited amount, the bogs serve to dampen the effects of peak flow during a flood event. Water thus ultimately reaches the Bay at a steady and slower rate than it would in the absence of its retention by bogs and swamps. Further, the vegetation associated with the bog removes potential pollutants, such as compounds containing phosphorous and nitrogen, from the stream, as water is taken up by the plants.

Waterford demonstrates well the challenges and complexities of open space protection and management in a region of high population growth. The Garden State Parkway, in a blur of speeding vehicles, defines the site's western boundary while Route 72 delineates its southern limit. Along Route 72, in particular, the line of contact is abrupt, as the asphalt parking lots of a bank, gas stations, and other commercial enterprises meet a narrow grassland strip and the wall of woodland beyond. Since its construction in the 1950s, the Parkway has produced a major division or discontinuity between coastal natural areas to the east and the pinelands to the west. The Parkway's overpasses, however, allow for connections between the waterways, along with a restricted portion of waterway banks, on both sides of the highway. (An overpass, such as that of the Eight Mile Branch, serves as a limited conduit for organisms, a bridge over or through an otherwise impermeable barrier.) Through its waterways, Waterford can be seen as being in direct contact with large natural areas to the west, including the Oxly tract (a Century Plan site). Eventual linkage between Waterford with the major holdings of the Forsythe Wildlife Refuge to the east is not inconceivable. Such a connection will be aided by the preservation of the Manahawkin Baptist Church Tract (also a Century Plan site) to the east of Waterford. For it is in corridors and connections between islanded refuges that one hope of conservation lies.

Waterford has recently received due recognition and protection. Having been acquired by the Trust for Public Land, the tract was transferred in December 1994 to the U. S. Fish and Wildlife Service to become part of the Barnegat Division of the Forsythe National Wildlife Refuge. Management priorities will most probably include prevention of ATV and motorbike access and education of the public about responsible use of Waterford's trails.

The Great Impounder / Beavers and Wetlands

A natural hydrological engineer, impounder of streams, and creator of wetland areas has left and continues to leave his imprint at Waterford. The beaver's presence is very much in evidence in the waterways at the southeastern end of the site. A beaver dam is in the process of construction and trees lining the banks have been felled and floated into place. The beaver's ability to dramatically alter his environment to meet his needs finds a parallel in human activities. "When a stream is broken by a series of beaver dams, it spreads over its banks and becomes a necklace of ponds and marshes. The swift water slows enough to support plants and attract insects. In turn, these insects attract aquatic organisms and their predators. The lodge, dams, and canals that beavers construct create new travel lanes or nests for many creatures" (Benyus, 1989). The benefits of a raised water level for beavers are water transport for their food and construction material and protection from predators. Beaver activity will certainly alter and may enhance the water retention of a given stream. Extirpated from southern New Jersey by 1820 as a result of overtrapping, the beaver has been making a comeback in the region. since the mid 1930s.

Pinelands

“I listen to the wind swishing through the pitch pines and seething or rustling in the oaks, while blue jays bounce cockily overhead, conversing in brassy, insinuating tones. I sense thousands of years between their voices, hanging millennias. Time opens out again, as the trees hold up their pinwheels of needles and their lacy twigs in the carousel of the wind.”

John Hay, *The Undiscovered Country*

Berkeley Triangle

Berkeley Township

7,500 acres

Bordered to the north and east by the Silver Ridge, Holiday Heights, and Holiday City housing developments, this Pinelands area demonstrates the resiliency of plant and animal species in the midst of extensive urbanization. The name for this site is derived from its triangular shape, formed by man-made boundaries — principally the old Pennsylvania railroad bed to the north, Route 530 to the southeast, and Township Line Road to the southwest. For the purpose of this description, other important areas of plant and wildlife habitat to the north necessitated the northward expansion of the traditional Triangle to include all undeveloped land up to Wrangle Brook.

Once home to the forgotten town of Crossley, the Berkeley Triangle now provides only subtle clues of any prior human settlement. The “town” was composed of several houses, maintenance buildings, work sheds, and a superintendent’s office, which supported the sole operation of the United Clay Mining Company. Beginning early in this century, mining continued for nearly fifty years at the Crossley Clay Pits. Aside from lumber cutting for the mills on the Toms River and charcoal-making in the forest, clay mining was one of the few industries which existed here (Elizabeth Morgan, personal communication). The raw clay excavated from the ground was valuable for the production of water pipes and tiles, and was exported via the Pennsylvania Railroad. Mining eventually ceased once the good quality clay had been exhausted, and ultimately clay was replaced as a commodity by a more versatile material, iron. When the mine closed in the 1950s, the town of Crossley faded into obscurity; the buildings are no longer in evidence and the mining scars left in the forest along Oxhead Branch have reverted to more natural conditions. The old Pennsylvania Railroad bed can also still be seen, but very few of the railroad ties remain. Instead, an endless row of steel powerline towers dominates the landscape of the railroad right-of-way, which is now owned and managed by the Jersey Central Power and Light Company.

The Berkeley Triangle provides a diversity of habitats and is home to several New Jersey endangered, threatened, and rare plants and animals. Hikes along the many sand roads traversing this site reveal such New Jersey-listed plants as sickle-leaved golden aster, Pickering’s morning-glory, Pine Barrens reedgrass, and the largest population of Pine Barrens smoke grass found in Ocean County (Ted Gordon and Rick Radis, personal communication). Dominant understory plant species include blueberry, huckleberry, sweet pepperbush, inkberry, scrub oak, blackjack oak, and sassafras; dominant canopy trees include pitch pine,

red maple, black gum, and Atlantic white cedar. Wrangle Brook, Davenport Branch, and Oxhead Branch provide important corridors for Atlantic white cedar swamp.

Observant individuals have the opportunity to see two of New Jersey's protected snake species. The corn snake, also known as the red rat snake, is a beautiful serpent blotched with shades of red on a gray or orange background. It is a highly secretive animal, blending perfectly into the reds and browns of fallen oak leaves and pine needles. The current status of the corn snake in New Jersey is listed as endangered by the New Jersey Department of Environmental Protection (DEP). Corn snakes reach the northern limit of their range in southern New Jersey and are only found in Ocean, Burlington, and Cumberland Counties. The northern pine snake, currently listed as a threatened species, is a large, robust black and white snake reaching up to six and one-half feet in length. It, too, is at the northern limit of its range and is known only in the Pine Barrens in southern New Jersey. This species finds excellent habitat within the Berkeley Triangle, as determined through long-term scientific research conducted by Herpetological Associates at this site. The presence of these species is important to the local food chain, as they serve as top predators.

Frog and toad species found within the Berkeley Triangle include the state endangered Pine Barrens treefrog, which can often be heard calling from breeding ponds on warm, humid spring nights (late April through early July). The great blue heron, wood duck, mallard, blue-winged teal, and the common goldeneye are five bird species observed in the Triangle. Also confirmed on-site are breeding pairs of red-tailed hawks, American kestrels, great horned owls, bobwhites, whip-poor-wills, and common nighthawks. Potential habitat exists for two State threatened birds, the red-headed woodpecker and the barred owl, although no individuals have yet been observed in the immediate area.

In general, the Berkeley Triangle provides excellent habitat for a number of other common animals, well noted by early scientists. The northern fence lizard, one of the three lizard species found in New Jersey, are particularly abundant along the JCP&L right-of-way. Males of this species, with their metallic blue flanks, can often be seen darting around log piles in pursuit of females or rival males during the spring and summer. Research on the courtship of this small lizard was conducted during the early 1930s by the late G. Kingsley Noble of the American Museum of Natural History. Noble used a donated United Clay Mining Corporation's house as his base of operations and his research was conducted in the forests surrounding the town of Crossley.

Two portions of the Berkeley Triangle are presently protected by the DEP and the New Jersey Audubon Society. The Crossley Sanctuary is a 378-acre tract of land roughly surrounding the clay pits at the end of Crossley Road, and extending northward to the old cranberry bogs on Wrangle Brook. About 115 acres of the Crossley Preserve was conveyed to the state by the developer as a mitigation requirement. The area is currently managed by the New Jersey Natural Lands Trust.

A second area east of Davenport Branch, the Hovnanian/Audubon Sanctuary, is a 465-acre tract of land north of Dover Road. This area was conveyed to the New Jersey Audubon Society by Hovnanian Industries

as part of a mitigation agreement. It, too, is managed by the Natural Lands Trust. All other portions of the Berkeley Triangle are under private ownership and could be developed if approved by the New Jersey Pinelands Commission and the DEP CAFRA program.

Despite the pressures placed upon the Berkeley Triangle by the expanding Silver Ridge, Holiday City, and Holiday Heights housing developments, a relatively pristine stream system and adjoining uplands continue to favor a wide plant and wildlife species diversity. The historical and biological significance of this area provide a unique reminder of the conditions which once existed throughout the New Jersey Pine Barrens. The long-term preservation of this area will not only provide future generations with a valuable historical and cultural addition, but will safeguard a beautiful open space for hiking and nature study.

Blacks and Ruckels Branches

Manchester Township

820 Acres (Estimated)

Blacks and Ruckels Branches are the epitome of the Pine Barrens wilderness stream. The two forks travel easterly over four miles from headwaters within the Fort Dix Military Reservation and the Manchester Wildlife Management Area to a union with Lake Horicon, south of Lakehurst. Such streams are difficult to pin down in places, as they broaden into broad seeps or immerse in red maple/black gum swamps. In other locations, their presence is betrayed by the rows of Atlantic white cedars that crowd along their banks. These stream corridors are fundamentally wild places. For the most part, the streams are located within 1/3 to 1/2 mile from paved roads. At certain points, particularly along utility and telephone rights-of-way, however, the branches are accessible to motor bikes and ATVs, which encroach upon and destroy habitat. Blacks and Ruckels Branches are also accessible to the determined cross-country hiker who is armed with a compass, topographic maps, and determination.

As witnessed at Blacks and Ruckles Branches, along with the remoteness of a particular landscape comes a certain vulnerability. Wilderness areas, particularly if large, unmonitored, and held by absentee landowners, are often open to abuse. Arson, vandalism, poaching, dumping of household and construction debris, and abandonment of automobiles are forms of this abuse. One point of entry to Blacks Branch, a telephone right-of-way proceeding to the west of Division Avenue (an unpaved road at the western edge of Lakehurst), has facilitated access and has invited abuse. Portions of the sand track that are closest to Lakehurst are burdened with debris, much of which has been jettisoned in accordance with the philosophy "out of sight, out of mind."

Mythology and folklore can provide useful insights on the interaction of the human psyche and the natural environment. This becomes evident when spring birdsong ceases and an eerie silence pervades the pinelands along the remote stretches of Blacks and Ruckels. The heat of the day still radiates from the white sands, despite a lowering sky. One half expects the Jersey Devil to emerge from the green wall of

pinetrees bordering the trail. An area that is vast and mysterious and potentially dangerous (particularly to the disoriented) has inspired the tales of this mythic creature of the New Jersey Pine Barrens.

Moments of imaginative speculation along Blacks and Ruckels Branches are interrupted, as if a spell had been broken, by the urgent business of spring. From the pineland floor, a rufous-sided towhee erupts in song, an insistent “drink your teeeeee.” Most probably, this male is proclaiming his territory and his availability as a mate. The plaintive call of a mourning dove can also be heard, drifting through the pine boughs. Majestic Atlantic white cedars, guardian spirits of the watercourse, with lichen-covered trunks, soar above Blacks Branch. It is comforting to know that, as in countless centuries past, nature continues to call the tune in this wild place.

Cabin Branch

Manchester Township

200 Acres (Estimated)

In its 1.5-mile journey from Cedar Glen West to its junction with the Ridgeway Branch south of Ridgeway Road (Route 571), Cabin Branch changes its character in a way that typifies many of the Barnegat Bay watershed streams. Named in 1839 for the homestead that stood on its banks (Zinkin, 1976), the Cabin Branch runs the gauntlet from an industrialized headwater zone, at its northern end, to deciduous woodland and Atlantic white cedar swamp at its terminus. In places, it is channelized and well-defined, carving its S-shaped meanders in a slow progression toward Toms River. Occasionally the waterway ducks out of sight into thickets of a shrub swamp. Following periods of rain, the Cabin Branch spreads itself widely on the lowland forest floor. In dry periods, the branch persists as a seep, a thin but wide wedge that appears to lack forward motion. In the driest times, sections of the branch can become linear leaf-strewn depressions of the woodland floor.

The water of Pine Barrens streams has its own distinctive chemistry, determined by the interaction of water with bedrock, soil, and plant material. Brownish-red stream water, known as “cedar water” or “cedar tea,” flows through Cabin Branch and other Barrens watercourses. Contrary to initial impressions, the color does not indicate water pollution, but rather results from the presence of iron and tannins in the water. Tannins are brown plant pigments that underly the yellow, orange, and green photosynthetic pigments of leaves and are responsible for the many shades of brown in late fall and winter foliage. Despite the color and acidity (pH of 5.0), cedar tea is usually quite potable, particularly as one works upward in the watershed toward the stream source (Boyd, 1991).

In addition to physical and chemical characteristics, the Cabin Branch fits the pattern of the Pine Barrens stream in its origins. “It is an interesting and significant point that all Pine Barrens streams arise within the Pine Barrens area, originating as ground water discharge from slowly moving surface waters of the Cohansey aquifer. No streams flow into or through the Pine Barrens from outside the region” (Boyd, 1991).

Land protection in the watershed becomes even more important because it presents an opportunity to safeguard the water quality of an integral system which includes the Barnegat Bay.

Water quality and availability are extremely important in determining the vegetation and animal life in a given area. Several of the factors affecting bog communities, for example, relate directly to water: availability of standing water, acidity, and low nutrient content of water and peat substrate. In upland areas, amphibians and invertebrates that can only survive in wet conditions are relegated to streambeds and cedar and hardwood swamps (Foreman, 1979). The seasonal presence or absence of water in the Cabin Branch and the chemical and physical parameters of that water impact plant and animal communities not only along the length of the branch, but beyond it as well. Changes in the Cabin Branch water column, due to such processes as increased siltation and nonpoint source pollution (which may result from land clearing, housing and road construction, and placement of fertilizer on farm fields) can have effects far downstream in the watershed.

Cabinfield Branch

Lakewood Township

300 Acres (Estimated)

With headwaters in Monmouth County, Cabinfield represents one of the many shorter branches within the Barnegat Bay watershed that runs the gauntlet of development and yet still retains something of its former identity. The Cabinfield Branch flows to the southeast across the Monmouth/Ocean County line through the sizeable town of Lakewood, breaks into more open country north of an extensive Ocean County Park, takes a more southerly course through the Woodlake Golf and Country Club, and, having joined the Schoolhouse Branch, joins the Metedeconk River and channels beneath the Garden State Parkway toward Barnegat Bay.

Seemingly far removed from the wide sweep of the cedar-lined pinelands branch or river, Cabinfield reveals itself on a more intimate scale. Its deciduous sun-dappled corridor contains, among other species, red maple, black gum, black cherry, yellow birch, white ash, burning bush, coastal pepperbush, multiflora rose, and green brier. Some of the branch-side red maples are very wide in girth and have reached an estimated age of over 60 to 70 years.

One member of the flora of the Cabinfield Branch floodplain is renowned for its effective biochemical deterrents. A member of the cashew family, poison ivy contains in its sap the resin urushiol, which can produce painful allergic response in human skin. All parts of the plant except for the pollen contain this chemical. Presumably, urushiol has served as a potent deterrent against mammalian and insect herbivores, although inspection of poison ivy leaves often reveals holes and traces of insect leafmining activity. A Native American remedy for poison ivy exposure was provided by crushing the leaves of jewelweed and applying the plant juices to the affected skin. Jewelweed continues to thrive along the banks of the Cabinfield Branch in close proximity to poison ivy.

Plants and Biochemical Warfare

An ageless battle is fought between plants and the animals, chiefly insects, that would eat them. In the biochemical warfare that spans evolutionary time, a particular plant species may develop chemicals which render its leaves inedible to most herbivorous insects. Plants with the genetic ability to produce the defensive chemical will prosper and pass the ability on to their offspring, while plants lacking the defense may even succumb to the attacks or may be so weakened that they don't produce viable offspring. If an insect species is able to "break the chemical code" and bypass the defense, its members may concentrate their feeding on that particular plant species

and become specialists. In time, the plant species will respond by producing new chemical armaments that will allow its members to escape the feeding pressure. Thus, the process of natural selection favors the organisms, both plant and animal, that are best adapted. And so the duel is carried forward through the ages. The crushing, tasting, and smelling of leaves brings to awareness a wide array of chemical armaments in numerous plant species encountered in the Barnegat Bay watershed, including northern bayberry, eastern red cedar, sassafras, and spicebush. It should be noted, moreover, that many of the defenses are not detectable by humans.

By mid-May, Cabinfield Branch's black cherry trees have been almost totally denuded by the eastern tent caterpillar, a species that has finely honed its tastes and has overcome the plant's chemical defenses. Following each day's foraging, the caterpillars return to the dense webbing of their retreat. The assaulted trees may survive if they are able to put out a second set of leaves in a given season.

The name Cabinfield Branch probably refers to an early cabin of the nineteenth or even eighteenth century — a humble building that once stood in a clearing, bounded by woods and by this secretive branch. Surprisingly, farm fields can still be found adjacent to the branch, near its passage under Brook Road. Here, where a pasture meets the riot of vegetation along Cabinfield, as at many points along the various branches of the watershed, it is possible to slip back in time and to momentarily savor an imagined past.

Cotterals Branch

Lakewood Township

320 Acres (Estimated)

Despite accelerating changes to the surrounding landscape, the branches of the Barnegat Bay watershed have managed, for the most part, to maintain both their principal function and their identity. A branch of the Metedeconk River, Cotterals Branch ties into the river as it emerges from Lake Shenandoah. Much of the immediate drainage area of Cotterals Branch and of the South Branch of the Metedeconk River, which flows into Lake Shenandoah from the west, are protected through public ownership. Both Ocean County, through expansion of the Lake Shenandoah County Park, and Lakewood Township have jurisdiction over

different sections of the open space associated with the river and branch drainage. At certain points, undeveloped, privately held lands serve as buffers and as habitat extensions of the protected land. Residential areas and industrial parks (two to the southeast and one to the west of the branch) appear to be closing in on the remaining open lands.

A recurrent theme in the study of watersheds is the significance of each contributing element (whether rivulet, stream, branch, or river) to the function of the overall system.

Even though protected on paper and in concept, a watercourse and its adjacent lands may be subject to abuse, which can have negative effects on water and environmental quality. Some dumping of household refuse into Cotterals Branch is noticeable in certain locations. A large glass bottle dump, evidently in use over many years, can be found on the site north of Cedar Bridge Avenue. Education and the nurturing of local pride in an area are important components of long-term stewardship of the Bay watershed sites.

Like many of the Bay branches, Cotterals Branch can be viewed as a linear oasis in which natural events transpire; a reflection of former abundance. The spring warmth has coaxed sensitive ferns and cinnamon ferns to unfold from the tight coils of fiddleheads. Both species thrive along the banks of the branch, the buff-colored fertile fronds of the cinnamon fern already in full contrast to the light green vegetative fronds.

The woodland of red maple, Norway maple, white oak, chestnut oak, black cherry, box elder, scattered pitch pine, and Atlantic white cedar (in wet areas associated with the branch) harbors avian migrants and residents that can be detected by their vocalizations when dense foliage screens the birds.

Cotterals Branch provides a window on an ancient migratory lineage — the wood warblers. The oven bird, a dun-colored warbler that has arrived from the neotropics to mate and to construct an oven-shaped nest on the forest floor, gives

his low pitched song (“teach...teach... Teach...TEACH”), rising in intensity. The myrtle warbler, in black and white plumage with bright yellow patches on the crown, rump, and before each wing, gleans insects from the oak leaves with great agility. The common yellowthroat, a yellow-throated warbler with a black face mask, frequents relatively open shrub areas. Its “witch witchery” song, when heard in a forest setting, indicates with certainty that a clearing or opening lies ahead.

The degree of protection that has been achieved thus far along Cotterals Branch could serve as model and inspiration for the conservation efforts of other townships and for Ocean County. However, it should be

A Decline of Neotropical Songsters

Despite evident activity of wood warblers in the woodlands of Cotterals Branch and elsewhere in the Bay watershed, a pronounced decline in warbler numbers has been noticed over the past decade along the eastern seaboard. The decline has a number of possible causes and fortunately may be reversible. The causes include: loss of habitat in the neotropics as rainforests are cut to provide land for agriculture, loss of breeding habitat in the temperate zone due to development pressures on open space, and an increase in the number of cowbirds, a parasitic bird which lays its eggs in warbler nests and thus displaces warbler chicks (Terborgh, 1989).

noted that privately-owned tracts of open space lie along the stream corridor and represent potential points of change in the branch landscape. Private or public action may be needed to save the tracts.

Davenport Branch West

Berkeley and Lacey Township

980 Acres

In a geographic sense, this Lacey Township site could serve as the northwestern cap to DEP's Double Trouble State Park, with which it is contiguous. The site is approximately 2.5 by 1.25 miles and contains portions of two separate watersheds. The mineral landscape is relatively flat, with very gentle slopes being the rule; the elevational difference is 50 feet realized over a distance of one mile.

Mule Road provides reasonable entrance to the site. There are relatively few established cart paths or foot trails. Old Forge Road is perhaps the best for viewing the site. Though access is limited, illegal household trash disposal appears to be freely conducted and, while providing suitable habitat for reptiles and small mammals, the level of dumping off Dover Road is nothing less than grossly offensive.

A pitch pine to pine-oak forest inhabits the uplands with white oak dominating. The upland shrub layer is filled with black huckleberry and bear oak; inkberry and bayberry may also be found. Open areas contain golden heather, broom-sedge, and switchgrass. The wetlands along Davenport Branch harbor an Atlantic white cedar swamp and an inactive, impounded cranberry bog. The Irish Tent Branch gives the appearance of past cranberry production, but it is presently filled by a robust sedge swamp from its headwater area nearly to Dover Road. Small areas of pitch pine lowland are also found in wet swales. Common shrubs in these wetlands include inkberry, sweet pepperbush, fetterbush, highbush blueberry, cranberry, leatherleaf, and swamp azalea. The herb layer contains a variety of sedges, rushes, and non-graminoid herbs including wool-grass, soft rush, bushy beard-grass, and Sphagnum moss.

The Atlantic white cedar swamps are valuable for their year-round amelioration of water quality and, along with the sedge swamp, offer potential habitat for endangered, threatened, or rare plant and animal species. Potential habitat is present for swamp pink, livid sedge, pine barren boneset, New Jersey rush, crested yellow orchid, and curly grass fern. Intermittent streams provide breeding habitat for the state endangered Pine Barrens treefrog.

Deer Head Lake North

Lacey Township

80 Acres (Estimated)

Approximately one-half mile in length, Deer Head Lake feeds water from the North Branch of the Forked River into Lake Barnegat and from there out into the Bay as the Forked River. Deer Head Lake has a

strategic location within the Bay watershed, both as a part of the Forked River drainage system and as a link with the massive Forked River Mountains area (the largest site in the Century Plan).

A major portion of the land on the lakefront is owned by Lacey Township and is managed as parkland. For the southern half of the lake, the emphasis for utilization of the open space is on active recreation. The area is open to Township residents, with beaches, swimming platforms, and beach houses, indicative of a high level of summer activity. Progressing northward up the shores of the lake, a relatively thin deciduous woodland, ranging from 20-60 feet in depth, takes on the role of buffer and partially screens residences and road from the water. Following the shoreline north of Trenton Avenue, the woodland perimeter widens to over 150 feet and intergrades with pine/oak uplands and, at the inlet of the Forked River into Deer Head Lake, merges with a fine Atlantic white cedar swamp. In this area of the lake, active recreation has given way to the quiet contemplation of nature. The surrounding residential areas appear to retreat before this widening wedge of open space, which eventually connects with the Forked River Mountain tract beneath the Garden State Parkway overpass.

The construction of the Garden State Parkway brought one of the most profound changes to the Bay and its watershed, not only by greatly facilitating travel to the Bay area, but by spurring growth and subdivision for residential and commercial purposes. As an artificial barrier, the road hinders movement of organisms. The Parkway has so effectively partitioned the landscape that it has been interpreted as a major boundary, separating an area generally regarded as the pinelands to the west from the coastal areas to the east. The jurisdiction of the New Jersey Pinelands Comprehensive Management Plan, for example, is partially defined by using the Parkway as the eastern boundary. Notably, it is where streams cross under the Parkway that some limited continuity between lands to the east and to the west of this major road exists.

Consolidation of the Atlantic white cedar swamp and the pine/oak woodland that flanks it into one protected entity will provide contiguity with the Forked River Mountains, despite the barrier of the Parkway, and will safeguard the water quality, beauty, and integrity of Deer Head Lake. Lacey Township has gone a long way toward protecting the lake's perimeter, as seen along the southern shore of the lake's headwaters, an area in which a portion of the cedar swamp is located. But there are gaps in Township ownership and jurisdiction, and hence in long-term protection, that should be addressed. Beginning at Deer Head Lake, the system of streams and lakes (many of which are artificially impounded) proceeds to the Bay and runs a great gauntlet of residential development. The development's attendant system of streets and stormwater sewers adds to the problem of surface water run-off. Remaining opportunities to buffer the watershed should be attended to, where possible and practical.

Double Trouble State Park/Out Parcels

Berkeley and Lacey Townships

25 - 400 acres

These seven Lacey Township sites are situated near, or within Double Trouble State Park between Dover Forge in Berkeley Township, and Webbs Mill in Lacey Township. Each parcel is associated with Cedar Creek, or one of its tributaries. Their acquisition would protect the various wetland habitats they connect with, and increase the integrity of the Double Trouble State Park's vast open space. Two of these sites are appreciably suburbanized with single family homes nearby, whereas the others are quite remote and are totally natural.

All of these sites are fairly flat with gentle slopes. The elevational differences are as much as 30 feet, but differences of 10 feet or less are more typical. The upland areas support typical Pine Barrens forest vegetation, such as pitch pine and oak. The shrub layer contains bear oak and black huckleberry, while bracken fern is particularly common in the herb layer. The site to the southeast of Mule Road once held a residential structure, as evidenced by an old cart path driveway and the remnants of a building and trash. A vernal pond, barely visible from the roadside, occurs here in the midst of pitch pine and bear oak. This pond is breeding habitat for the endangered Pine Barrens treefrog.

Two sites occur in the eastern corner of the intersection of Dover and Lacey Roads. Cedar Creek passes through or along each of these. The site closest to Lacey Road is virtually all wetland and is known to harbor a colony of the rare swamp pink plant (a state endangered species) along the banks of the creek. The more remote site is bounded on all sides by the reticulated watercourse and associated wetlands of Middle Branch and Cedar Creek. A small upland area occurs here in the middle of the surrounding cedar swamps. A few old trails extend off the cart path (Rockwell Road) from Lacey Road and permit access to each of these sites. The placement of old culverts, walkways, dams, and berms suggests that blueberry and cranberry farming once occurred here in the past. Much of the wetland is a sedge and shrub swamp, but the Atlantic white cedar swamp along Cedar Creek becomes more apparent in this remote site.

The two suburbanized sites around Bamber Lake to the south side of Lacey Road contain upland areas (vacant building lots) adjacent to wetlands that are valuable as habitat for endangered, threatened, and/or rare species. Swamp pink is also known from the wetlands along Cedar Creek between Bamber Lake and Lacey Road. Also of importance is the Atlantic white cedar swamp along Chamberlain Branch where it enters Bamber Lake. Roadways associated with development in these sites have allowed ready access, exposing the land to additional environmental impact from trash dumping and recreational vehicles. Preservation of the open land in these two sites would serve to buffer the impact of the present residential development.

A population of endangered timber rattlesnakes from the Cedar Bamber Lake area is associated with the wetland cedar swamp corridors of Webbs Mill Branch, Cedar Creek and Chamberlain Branch, and all their

tributary streams. During the winter the rattlesnakes hibernate along the edges of the streams where the moving water prevents them from freezing, but in the late spring, they migrate up to three miles from their dens to surrounding upland forest to hunt for small mammals.

The two sites between Webbs Mill Road and Webbs Mill Branch were at one time intimately involved with the cranberry industry. The easternmost site contains only one residence. All other buildings have been razed and the debris left in place. Much of the debris was burned during the recent forest fire. No Name Road (unpaved) provides ready access to both upland and wetland habitats. The old cranberry bog is now an impressive sedge swamp surrounded by an Atlantic white cedar trees. Pine Barrens treefrog, carpenter frog, Fowler's toad, green frog, bullfrog, and spring peeper all use these old bogs as breeding habitat. Spotted turtles, painted turtles, musk turtles, and snapping turtles occur in the ponds and waterways of the old bogs. Vernal pools surrounded by pitcher plants, turkey beard, sheep laurel, and mountain laurel occur in the intermittent stream that passes through the westernmost site near Webbs Mill Branch. Habitat for pine snakes, coastal-plain milk snakes, eastern kings snakes and timber rattlesnakes occurs in the immediate area.

A recent wildfire in April of 1995 destroyed over 20,000 acres of plant and wildlife habitat in nearby Greenwood Forest Wildlife Management Area. However, most plants and trees in the Pine Barrens are fire-resistant and can withstand burning by sprouting new branches from their trunks or roots.

Forked River Mountains and Vicinity

Lacey and Ocean Townships

21,000 Acres

Elevation is relative, especially in southern New Jersey's Pine Barrens, where the landscape is uniformly flat with an average elevation ranging between 25 and 50 feet above mean sea level. In Lacey Township, where the ridges rise up higher than the surrounding area, lie a set of hills near the Forked River. There are two "mounts" side by side, with the western ridge at an elevation of 184 feet and the eastern ridge attaining 176 feet. While most northern New Jersey residents may laugh at such low elevations, here in the Pine Barrens such heights truly represent "mountains." Combined, these hills are known locally as the "Forked River Mountains" and are the apex of a vast 21,000 acre wilderness that is interrupted only by the abandoned Tuckerton Railroad right-of-way. The railroad operated from 1871 to 1935. The open railroad bed was converted into an electric transmission line by Jersey Central Power and Light Company when the Oyster Creek Nuclear Generating Station was constructed in the late-1960s. The transmission line crosses the rolling pine-oak forests in a northwest to southeast direction, connecting the town of Whiting (to the west) with the towns of Forked River and Waretown near Barnegat Bay. Lacey Road and Chamberlain Branch form the northern border; the Garden State Parkway is the eastern edge; County Route 532 is the southern edge; County Route 539 forms the extreme western edge of this vast area. The Greenwood Forest Wildlife Management Area (DEP) is contiguous to the north and west, and forms a greenbelt corridor that

connects to Double Trouble State Park (DEP), adding to the unbroken value of the landscape. The southern edge joins with Wells Mills County Park (Ocean County).

The Forked River Mountains are a place of pure beauty, mystery, legend, and history. Some local folks claim that, "On warm, quiet nights, if you listen closely, you can hear the eerie howling of the 'Jersey Devil' from the bogs and swamps." But the night sounds that one hears are more likely those of frogs, owls, night-hawks and whip-poor-wills. There are places with names such as "Chicken Bone", "Moon Tree" and "Fire Hill." Sand roads that branch out in all directions once carried wagons filled with forest and farm products such as blueberries, cranberries, pears, fire wood, charcoal, cedar logs for the mill, pine cones for holiday decorations, and Sphagnum moss for florists. Many streams in the area were mined for bog iron, and two ironworks, Dover and Ferrago, were established c.1810. Silica sand was also mined and extracted for the glass blowing trade. As modern technology developed, the various traditional Pine Barrens industries became obsolete and dwindled. Poverty set in and many of the small farmers, craftsmen, and wood cutters moved out of the region. They left behind the wood frame houses, buildings, and sheds that were once so busy with activity. These structures have long ago fallen down, destroyed by forest fires or the work of termites. However, the history and legends of the Forked River Mountains live on, put to music by the late Joe Albert and his folklore band known as the "Pineconers." The pine-oak forest and cedar swamps have reclaimed the land and the area looks much like it did 150 years ago, even though the old habitations, such as Aserpaton, Lacey Station, the Collins Place and the Pierce Place, are now gone but not forgotten. The more recent and destructive extraction of sand and gravel within the forked river mountains began after World War II (Elizabeth Morgan, personal communication).

Beautiful, clear streams such as Factory Branch, the North, Middle, and South Branches of Forked River, Oyster Creek, Cave Cabin Branch, Long Branch, Dennis Branch and Cold Branch flow through the region. Dense cedar swamps line the floodplains of these fast-flowing waterways. Some also have grassy meadows or savannahs associated with the stream floodplains. The creeks and streams are only crossed by an occasional sugar-sand road. Because of the vast, unfragmented nature of the Forked River Mountains, there are miles of pine-oak and pitch pine lowland forests. This pristine landscape provides an array of habitat types for many rare, threatened, and endangered plant and wildlife species. An array of rare wetland plants grow along the stream corridors. These include Pine Barrens bellwort, Barratt's sedge, livid sedge, pale beaked rush, slender nut rush, Knieskern's beaked rush, curly grass fern, dragon mouth orchid, Pine Barrens gentian, turkey beard, and Pine Barrens reedgrass (Ted Gordon, personal communication). Carnivorous plant species, such as pitcher plant, spatulate-leaved and round-leaved sundew, abound in Sphagnum bogs. In late April or early May, the beautiful pink flower of swamp pink, listed as federally threatened and state endangered, can be seen growing from its lance-shaped, green basal leaves on a tall central stalk.

To the north, Chamberlain Branch has a population of endangered timber rattlesnakes. This is the only venomous snake found in the Pine Barrens. Despite the myths and fear surrounding this species, timber rattlesnakes remain shy, secretive and quite rare. These snakes are known to hibernate under the roots of

white cedar trees while sitting in the moving stream water to prevent freezing (Zappalorti and Reinert, 1986). During the summer they migrate up to three miles away from their overwintering site to hunt for small mammals on the forest floor.

The high sandy ridges in the vicinity of the “mounts” provide excellent habitat for the threatened northern pine snake. These are large, robust, black and white serpents that attain lengths of 4.5 to 6.5 feet. During late June or early July, adult gravid female pine snakes migrate to the edges of sand roads, or along the old Tuckerton railroad bed to excavate nest burrows in which they deposit their eggs (Burger and Zappalorti, 1986 and 1991). This is one of the few North American snakes that actually digs its own nest chamber in soft sand. Year after year the female snakes return to their nesting area, probably the same site from which they emerged as hatchlings (Burger and Zappalorti, 1991).

Historically, the endangered corn snake has been known to inhabit the Tuckerton railroad right-of-way, but none have been sighted since the rails and ties were removed in the mid-1930s. The coastal plain milk snake was also very common along the right-of-way, but the removal of the ties and the constant disturbance by ATVs have forced them back into the forest where they remain hidden. The northern fence lizard is also a common reptile in the Forked River Mountains. If one walks along the old Tuckerton railroad bed on a warm spring evening, wherever there is a wetland crossing, the vocal calls of the Pine Barrens treefrog can be heard emanating from their breeding pools (late April through early July). Other kinds of frogs and toads also join the chorus, causing a loud ruckus in the otherwise quiet forest.

Game birds such as wild turkey, ruffed grouse, bobwhite quail, and ring-necked pheasant all occur in the forest. The great blue heron, the wood duck, and mallard are but a few of the many bird species associated with the clear, gently flowing waters of the Factory Branch and the North, Middle, and South Branches of the Forked River. Also confirmed in the forest are two breeding pairs of red-tailed hawks, American kestrels, great horned owls, whip-poor-wills, and common nighthawks. Potential habitat is also present for two state threatened birds, the red-headed woodpecker and the barred owl, although none have been confirmed.

In general, the vast wilderness here provides excellent habitat for a number of other rare and common animals, including the mink, long-tailed weasel, red, gray, and flying squirrels, raccoon, skunk, red and gray foxes, and even the threatened bobcat. White-tailed deer are common throughout the Forked River Mountains, as evidenced by their browse signs in the wetland swamps on young cedar trees and their ever present droppings and footprints across sand roads.

An ongoing disturbance to the region has been the constant degradation by ATVs on all sand roads, trails, and the JCP&L Company’s right-of-way/old railroad bed. Landowners have made an attempt to control this problem with only minimal success. Trash dumping along the edges of all access roads has occurred over the years and remains an unsightly problem. The entire Forked River Mountains area is currently under private ownership. The owners include several corporations and individuals including potential land

developers. Applications for both single family homes and large housing developments are pending before the New Jersey Pinelands Commission. There are three active sand and gravel mining operations within the region that have encroached upon the forest, though some mining sites have been successfully restored or reclaimed to minimize impacts. A group of local citizens have formed a non-profit organization called the Forked River Mountain Coalition in an attempt to safeguard this magnificent site. Through their efforts, both state agencies (DEP Green Acres Program and the Pinelands Commission) and nonprofit organizations (The Nature Conservancy, the New Jersey Conservation Foundation, the Pinelands Preservation Alliance, and the Trust for Public Land) have become involved in conservation planning, advocacy, and, in some instances, direct negotiations with landowners to acquire portions of the 21,000 acre wilderness.

Giffords Mill Branch

Little Egg Harbor Township

230 Acres (Estimated)

Agricultural or cultivated open lands have a beauty and significance of their own and are worthy of protective measures. If these lands also contain a stream or branch that makes its way to Barnegat Bay or Little Egg Harbor, their significance, as a component of the Bay's watershed, is greatly heightened.

Stretching some 2.3 miles westward from its entrance into Lake Pohatcong to its headwaters at the boundary of Bass River State Forest, a freshwater creek known as Giffords Mill Branch contains some 13 separate bogs, or impoundments, along its length. Near its headwaters, a pond serves as a reservoir for water needed to flood the bogs. A blazed trail parallel to and north of the branch holds promise for eventual public access as a hiking trail. Given the imprint of historical agricultural activity on the site, Giffords Mill Branch nevertheless retains great integrity and beauty as a landscape. The clearing that preceded cultivation created an expansive viewscape, which would not be possible in the normally forested lowlands and wetlands of a pinelands tributary.

A pine-oak woodland brackets the branch and its line of bogs. Atlantic white cedar is found along the stream corridor. Its absence in large stands points to the high commercial value of the species, which was rapidly extracted as part of the clearing and preparation of the bogs. It should be noted that pressure continues to be placed on Atlantic white cedar to this day and that its illegal harvest remains a concern for landowners. In addition to pitch pines, which are the primary components of the forest canopy, the uplands flanking the bogs contain numerous deciduous species in lower areas, including inkberry (low gallberry holly), mountain laurel, sheep laurel, northern bayberry, scrub oak, blackjack oak, and brambles in profusion. The dykes, earthen mounds that allowed flooding of the cranberry bogs, support their own flora, such as leatherleaf, serviceberry, common high bush blueberry, black chokeberry, and an occasional eastern red cedar, ever the opportunist.

As typified by cranberry production since the late nineteenth century, human alteration of the natural landscape has occurred on a large scale. The contrast between the natural stream and the cultivated bog is well illustrated by westerly and easterly views of the branch from the same location on Otis Bog Road. While bogs continue to the east, a short stretch of Giffords Mill Branch east of Otis Bog Road maintains the thick vegetation of a broadleaf swamp. To create the cranberry bog, trees and shrubs have been removed, topsoil has been scraped out to a depth of 2 to 4 inches, and the land has been graded. The course of the branch has endured dikes, dams, and sluices in an effort to control the water level required by fruit production. “The supply of water should be sufficient and the plantation so provided with dykes as to allow flooding the area with water to the depth of 46 centimeters (18 inches) to 61 centimeters (2 feet) from November to May, in localities where it is necessary to protect the plant from insects and from late spring frosts” (Harshberger, 1916).

Before development altered the drainage upstream in the mid-1980s, Giffords Mill Branch had a much higher waterlevel. The cranberry bogs here are still producing cranberries, but active cultivation has ceased. Natural engineers are still at work, however, altering the water level to suit their needs, as a beaver lodge and beaver cut trees suggest.

Despite the agricultural activity to the west, the entrance of Giffords Mill Branch into Lake Pohatcong still bears the primordial aspect of an unhindered natural area. One half-expects to see a silhouette of an Indian canoe slip quietly into the shadows. The eastern portion of the lake is more heavily utilized for active recreation, given its proximity to Tuckerton.

Green, Big Wrangle, and Run Branches

Manchester/Berkeley Townships

2,500 Acres (Estimated)

The Green, Big Wrangle, and Run Branch corridors present an extensive and unusual panorama. They span the undeveloped lands that lie between the Whiting Wildlife Management Area to the west and the Crossley Preserve to the east, connecting these conserved lands by an impressive network of streams. Branches flowing through the wildlands of the Berkeley Triangle and Davenport Branch West also make their contributions to this system, which ultimately empties into Toms River and Barnegat Bay. The northern boundary of the site lies along Route 70, while the southern boundary is defined by the residential development of Pine Ridge at Crestwood.

Combined, the Green, Big Wrangle, and Run Branches have a wild and forlorn aspect, reflecting, from different vantage points within the same landscape, the long-term exploitation by humans and the regenerative powers of nature. Access to the eastern section of the site at the end of Township Line Road (along the Manchester/Berkeley Township border) reveals the pinelands in a seemingly changeless panorama. The songs of mourning dove, killdeer, and bobwhite can be heard. The vocalization of the rufous-sided towhee emerges from somewhere in the leaf

litter, screened by pines and low oaks. Township Line Road beckons exploration of the pitch pine dominated terrain.

Entry into the Green, Big Wrangle, and Run tracts from the west, by means of one of the sand roads leading from Route 70, results in an encounter with a very different landscape — one which can be described as a scrubland. The land undulates to the far horizon, dotted by low-growing pitch pine and interrupted by large swaths of cleared and revegetating areas. Distant white ridges mark active mining areas. Here pitch pine can assume a stunted growth form that resembles bonsai. Huckleberry and low bush blueberry put forth their red-tinged bell flowers and draw the attention of bumblebees. Patches of pyxie (a moss-like flowering plant), yellow flowered false heather, and dusky mats of bearberry reinforce the impression, on a small and local scale, of an oriental garden. Even though planted white pine and grasses have succeeded in invading some denuded areas, the scarring of the earth's surface by mining is very much in evidence.

Reproductive Strategies of the Pinelands Flora

Within Green, Big Wrangle, and Run Branches, as within other Pineland tracts, two very different reproductive strategies are demonstrated by vegetation at the close of May. A gymnosperm or “naked seed” plant, pitch pine flaunts its many small pollen-bearing cones, each of which releases a fine yellow dust of pollen when breezes pass across it. Along with other species of pine, spruce, fir, and hemlock, pitch pine is anemophilous. This botanical term, which means “wind loving,” indicates that pollen is transferred from male cone to female cone by the wind, a risky affair at best. To compensate for the many pollen grains which fail to reach their target, pollen is produced in copious quantity. The excess pollen coats other vegetation and forms a mist of yellow powder on streams and vernal pools. Forming scattered green mats on the sand in the vicinity of the pitch pines, a plant known variously as poverty grass, beach heath, or false heather shows an alternative strategy and produces small yellow flowers. Each flower bears a female organ in addition to pollen-bearing anthers and has a subtle, sweet smell. A major strategy of flowering plants which are not anemophilous is the use of an insect vector (such as a bee, fly, or beetle) to transfer pollen from the male organ (anther) of one plant to the female organ (pistil) of another plant. This second approach, which is more recent and more evolutionarily advanced than the approach used by gymnosperms, insures a more direct and far less wasteful transport of pollen. The latter reproductive strategy, found in many angiosperms or “vessel-seeded” plants, has apparently accounted for their great success and widespread distribution. Some angiosperms of the Pine Barrens, such as red maple and scrub and blackjack oaks, however, have small, unscented flowers which are wind-pollinated. These plants do not attract nor do they rely on insects for pollination. Regardless of the reproductive method, most pinelands plants are well adapted to frequent outbreaks of fire and have the ability to tolerate hot, dry conditions.

In addition to the current mining activity, developments have been proposed for sections of the Green, Big Wrangle, and Run Branches. Proposed Phase One would occupy 368 acres between the Green Branch and the abandoned Conrail line in the north incorporating 838 residential units and 12,000 square feet of retail

commercial space. A larger development, encompassing over 4,000 acres, is envisioned by the current landowner.

The pine-oak forest which surrounds the Green, Big Wrangle, and Run Branches sites deserves consideration for its potential as open space and nature reserve. The site harbors potential habitat for the federally-listed threatened swamp pink and Knieskern's beaked rush and is known to harbor the state endangered Pickering's morning glory. The state threatened little blue heron and grasshopper sparrow, as well as the state endangered least tern and pied-billed grebe have been found on the site. Herpetiles that also frequent the site include the state endangered pine barrens treefrog and corn snake, and the state threatened northern pine snake (Terrestrial Environmental Specialists, Inc., 1984). In spring, Pine Barrens treefrogs, Fowlers toads and green frogs can be heard calling from the vernal pools and water-filled ditches. Pine snakes forage in the grasslands and along the pine forest edge for meadow voles and mice. It is evident that this magnificent landscape, which has been greatly altered by sand mining, must not be written off as a waste land.

Irish Branch

Manchester Township

190 Acres (Estimated)

A watercourse of approximately 1.5 miles, the Irish Branch consists of an Atlantic white cedar core buffered by a pine-oak forest upland. This linear natural area extends southward from Lacey Road (Route 614), southwest of its junction with Pinewald-Keswick Road. It then joins the Davenport Branch as the latter descends from its headwaters northwest of Harry Wright Lake and proceeds in a southeasterly direction. In its course, the Irish Branch (with its extension to the Davenport Branch) forms links to several existing and proposed open space management areas: an eight-acre Manchester Township recreational area north of the terminus of Ford Place, the 325-acre township park at Harry Wright Lake, the Davenport Branch West, Whiting Clay Pits and Double Trouble State Park, (one of the two major state parks in the Barnegat Bay region). The headwaters of the Irish Branch appear to be to be a small pool with a fringe of cattails and a fountain (!) just north of the point where the Branch crosses under Lacey Road and enters a residential area.

Two distinctive forest habitats are contained within the Irish Branch system. The first, encountered immediately on following the Davenport Branch eastward as it exits the southeastern end of Harry Wright Lake, is a fine Atlantic white cedar swamp. The second is a dry upland pine/oak woodland.

Flourishing in the lowlands where the tannin brown water seeps and spreads, the Atlantic white cedar is clearly the master and definer of its environment. The dense massing of trunks and the intertwining of roots create a shaded realm that is only occasionally sun-flecked, and almost always cool and damp. Some cut stumps of the cedar can be found, indicating timber harvesting of this favored species. On the fringes of the swamp and on any suitable soil within its boundaries can be found the broadleaved tree species red maple,

sour gum, and sweetbay magnolia. Coastal pepperbush, clammy azalea, leatherleaf, and mountain laurel can be found in the high shrub layer while huckleberry, low bush blueberry, northern bayberry, and sheep laurel can be found in the lower shrub layer. Sphagnum moss lines and fills the hollows between the cedar roots. Wildflowers, such as Indian pipe and starflower, are also seen, along with an occasional pitcher plant, a true denizen of peat bogs.

Pine-oak uplands cradle the Irish Branch. The sequence in naming pine/oak versus oak/pine reflects the relative abundance of coniferous, as opposed to deciduous, tree species. The balance definitely changes, even within the limited confines of this site. The drier uplands at the northern end of the branch can be characterized as an oak-pine woodland, for example, containing chestnut oak, scrub oak, red oak, scarlet oak, black oak, sassafras, and pitch pine in the overstory and black huckleberry, spice bush, and high bush blueberry in the shrub layer.

Irish Branch, itself, can be elusive. In some places it is clearly and fairly narrowly defined. In other places, it overspreads its bounds, permeating the cedar swampland that contains it. In other places and particularly during dry spells, the stream can disappear altogether, leaving an arid channel. The Irish Branch was formerly known as the Irish Tent Branch (1866) because Irishmen who were cutting “wood for coal” lived in tents along the stream. Another variant of the stream’s name is Irish Run (Zinkin, 1976).

While it links areas of open space, Irish Branch is caught between expansions of residential areas to the west (Roosevelt City) and to the north and east (Crestwood Village and South Lakewood Heights). Judging from the frequency of advertising for subdivision and the level of building activity in the vicinity of Irish Branch, the pressure can only be expected to increase. The Township of Manchester has acquired important parcels, totalling 96 acres, which contain a portion of the stream bed along which the Irish Branch and the Davenport Branch join, in addition to adjacent woodlands. Private inholdings exist, and the northern segment of Irish Branch is under multiple ownership. Consolidation of the entire branch, a narrow refuge for flora and fauna, is urged.

Jake’s Branch Corridor

Berkeley Township

1,100 Acres

This parcel forms an irregular triangle with endpoints at Beachwood Borough, the Garden State Parkway, and Double Trouble State Park (DEP). In addition, the Jake’s Branch Corridor enjoys a connection to the New Jersey Audubon Society’s Hovnanian Sanctuary. Thus, the site serves as an important link to existing protected parcels and includes six small tributaries that feed the Toms River. Roughly half of the site consists of wetlands and pitch pine lowlands. The upland sections are dominated by pine-oak forest and are composed mostly of Lakehurst and Lakewood soils.

The northeast section has an active cranberry farm that has been in continuous operation for the past seventy-five years. At harvest time, thousands of floating cranberries form thick mats which give the appearance of a scarlet sea in the early autumn landscape.

Additional historic use includes wood cutting for the mills at Toms River, charcoal making, and firewood gathering. Local residents and sportsmen continue to hunt deer on the site in the fall and early winter with good results.

Plant and wildlife viewing opportunities are varied on this site. The wetlands have large stands of turkey beard, swamp azalea, sweet pepper bush, huckleberry, and highbush blueberry. In late spring, the sweet fragrance of their flowers adds a pungent delight to the air when one walks along the sand roads through the woods. Atlantic white cedar, black gum, and red maple trees line the edge of Jake's Branch for almost its entire length. The JCP&L Company's right-of-way is a great place to see some of the wildlife. Turkey vultures and red tailed hawks often roost on the high-line towers where they have a good vantage point for ground prey or carrion. Flickers, mourning doves, chickadees, and bluebirds are also common along the easement.

The northern pine snake can occasionally be found in the area, where they emerge from the forest to hunt and feed on white-footed mice, meadow voles, pine voles, cottontail rabbits, and red squirrels. The floodplain of Jake's Branch also offers suitable habitat for another Pine Barrens serpent, the eastern kingsnake. These shiny, black, robust snakes have a sharply contrasting yellow or cream colored chain-like dorsal pattern. They average about 3.5 feet, but are known to attain lengths of up to 5.5 feet. The kingsnake is able to capture, overpower, and eat other venomous snakes, owing to their unique ability to withstand the effects of an otherwise lethal bite. Other reptiles found in the area include the eastern box turtle, which often parades across sand roads in the early morning or on rainy days in search of mushrooms, berries, and insects. Northern fence lizards are common along the ecotone (or transition) area where they can be seen basking on pine stumps and logs in the warm sun in order to regulate their body temperature. Black racer snakes also can be seen gliding silently across the sand roads during the heat of the day. Northern water snakes lie across overhanging cedar branches above the stream. Aquatic turtles are present in the open parts of Jake's Branch and in the cranberry bogs, where they find suitable basking habitat. Eastern painted, spotted, red-bellied, musk and snapping turtles are all known from the watershed and can be seen basking or swimming in Jake's Branch. Pine Barrens sunfish, black banded sunfish, mud minnows, and pickerel swim about in the stream as well.

Vernal pools in the pitch pine lowlands and the floodplain of Jake's Branch offer suitable habitat for Pine Barrens treefrog. On warm evenings in May, June, and early July, their "quonking" voices can be heard for some distance from the breeding pools. Other species such as such as spring peepers, southern leopard frogs, Fowler's toads, and green frogs, also join the chorus, adding to the loud clamor of spring's night sounds.

Because most of the Jake's Branch corridor and its tributaries are owned by a private housing construction company, upland portions of this site are subject to development. The existing cranberry farming operation offers no threat to the water quality or wildlife, since it has long been operating in harmony with the delicate Pinelands ecosystem. Clean, unpolluted water is crucial to both the cranberry and blueberry growing industries in the Pine Barrens. Since the Jake's Branch (and its tributary stream floodplain) pass through so many important plant and wildlife habitats, it serves as a "greenbelt corridor" between Double Trouble State Park and the New Jersey Audubon Society's wildlife sanctuary. This parcel of land should be given high priority with respect to future protection efforts.

Keswick Lake Corridor

Manchester Township

200 Acres (Estimated)

Located in Manchester Township, the Keswick Lake and its water source, a tributary of Michael's Run, are bordered to the west by Schoolhouse Road, to the south by Route 530 (Pinewald-Keswick Road), to the east by Township Line Road, and to the north by the Keswick Grove housing development. The eastern portion of the site, following a tributary of Michael's Run, exists immediately to the east of the Keswick Grove housing development. In general, the site follows this tributary of Michael's Run through Keswick Grove to Crestwood Village.

In the midst of a large housing development, the Keswick Lake Corridor provides an island of valuable wetland habitat despite the adjacent, human-imposed pressures. Keswick Lake, surrounded by the Keswick Grove development, undoubtedly provides excellent habitat for a variety of waterfowl and turtles. A small island in the Keswick Lake, connected to the shore by a wooden bridge and supporting a small observation tower, provides a quaint but complimentary setting to the surrounding lake and forest. The wetlands in this area are dominated by Atlantic white cedar, red maple, pitch pine, inkberry, and sheep laurel. Uplands, although generally developed to some extent, are predominantly composed of pine-oak forest.

The western portion of the site, when viewed from the road, consists of a small stream surrounded by red maple, pitch pine, inkberry, mountain laurel, and sweet pepperbush. This stream terminates in a small pond on the west side of Schoolhouse Road. The eastern portion of the site, following a tributary of Michael's Run, provides some of the most pristine wetland and upland habitat along the corridor. Associated wetlands are dominated by Atlantic white cedar and Sphagnum moss, with the floodplain fringes containing mountain laurel and inkberry. Typical understory vegetation in these uplands include sheep laurel, sweet pepperbush, and lowbush blueberry. Numerous white-tailed deer tracks and deer stands indicate good hunting.

The forested area along the old Pennsylvania Central Railroad provides excellent habitat for a number of common and protected animal species. The state threatened great blue heron was observed feeding in several of the lakes and ponds in the area, while the state endangered Pine Barrens treefrog has been

confirmed in the wetlands and vernal ponds along the railroad corridor. The state threatened pine snake and state endangered corn snake have been observed inhabiting the dry, sandy uplands. The hognose snake and the fence lizard further contribute to the faunal diversity here.

Maple Root Branch and Long Brook

Jackson Township

1,400 Acres

Maple Root Branch and Long Brook, both tributaries of the Toms River, are separated by, and roughly follow the path of Bowman Road. Maple Root Branch flows to the north of Bowman Road and eventually crosses it, joining the Toms River. The Long Brook flows to the south of Bowman Road, joining the Toms River just to the south of the juncture of Maple Root Branch. Both streams lie to the west of the junction of Route 527 and 528, with the western tip of the site extending toward Route 571. The eastern end of the site is formed by Lakehurst-Whitesville Road (Route 547). Combined, these two stream corridors consist of red maple/black gum/ white cedar swamps and pitch pine lowlands. Soils are extremely sandy and are mostly Lakehurst, Lakewood, Downer, and Evesborough types.

Formerly an agricultural area, the eastern end of the parcel has yielded to farm fields in various stages of succession. Cranberry farming existed for more than 50 years along the western end of the parcel at Long Brook, and remnants of the old bogs are still evident. Land disturbance for cranberry growing has caused major changes to portions of the floodplain along this brook, but much of it is still in its original state. The upland portions have a few old sand roads that cut through oak-pine forest where wood was once gathered for the mills on Toms River. Hunting and fishing continue to be a popular pastime in the forests along Maple Root Branch and Long Brook, especially in the old farm fields where white-tailed deer, pheasant, woodcock, rabbit, and woodchuck are hunted annually.

These pristine stream corridors, composed primarily of hardwood swamp forest, flow through relatively undisturbed habitat. Plant species observed within the Maple Root Branch corridor include red maple, scarlet and white oaks, gray birch, mountain laurel, pitcher plants, and Sphagnum moss. This gently meandering stream is heavily overgrown with understory shrubs and trees, providing a dense barrier along the stream banks. The upland areas surrounding the Maple Root Branch are dominated by an overstory of white oak, scarlet oak, scrub oak, and, occasionally, pitch pine. On slightly elevated ridges amidst the predominately oak forest lie small islands of pitch pine trees. These pine trees stand as veteran soldiers of an ancient battle for plant succession which occurred on the fringes of the Pine Barrens. Dangleberry, highbush blueberry, sheep laurel, and mountain laurel comprise the majority of the understory vegetation. At their widest separation, the Maple Root Branch and the Long Brook are approximately one mile apart, and, consequently their vegetational communities are similar.

South and east of the juncture of the Long Brook and the Toms River, and bordered to the east by Route 547, lies a tract of land that provides excellent habitat for the northern pine snake, a threatened New Jersey

species (Herpetological Associates, field observations, 1991). This area, once a chicken and fruit tree farm, as well as the site of sand and gravel mining, now contains large areas of early successional fields and oak/pine forest. Existing barren land is associated with past sand and gravel mining activities. Due to persistent use by off-road vehicles, revegetation of these areas is limited; only highly resilient forms such as heaths, Pennsylvania sedge, and pitch pines have been able to gain a foothold on the fallow soil. Early successional areas are sparsely vegetated with peach, cherry, and red cedar trees; herbaceous growth occurs in expansive seas of Pennsylvania sedge, purple love grass, cinquefoil, hawkweed, goldenrod, wild strawberry, blackberry, and spotted knapweed, to name a few. The spring explosion of wildflowers is matched only by the numerous species of butterflies which find ample sources of nectar here. Birds and small mammals are also in abundance, feeding on the various insect, seed, and fruit supplies. These grassy fields are burned annually by a local hunting club to maintain an early plant successional level, providing excellent deer hunting.

Although the eastern portion of this parcel (a 428.4 acre area) is scheduled to be converted into an 18 hole golf course, environmental studies seem to indicate that enough necessary habitat will be saved to provide the long-term survival of the northern pine snake at this site. Because this area is contiguous with the land surrounding the Maple Root Branch and the Long Brook, pine snakes may also occur in the land surrounding these stream corridors. The sand and gravel mines have recently been granted a two-year extraction permit from the Pinelands Commission to expand wet and dry sand mining on their property.

Mill Branch / Tuckerton Creek

Little Egg Harbor Township

280 Acres (Estimated)

On the way to the open reaches of Little Egg Harbor (their ultimate destination), the tannin-stained waters of Mill Branch flow southeastward from headwaters in the Bass River State Forest. The Mill Branch, which becomes Tuckerton Creek in the vicinity of the town, covers a distance of approximately 2.5 miles from the Garden State Parkway to the point where it empties into Lake Pohatcong in the company of Giffords Mill Branch, which enters from the west.

As it flows under Nugentown Road, Mill Branch/Tuckerton Creek presents itself as a slow-moving stream, bracketed by an Atlantic white cedar swamp. Atlantic white cedar thrives in the lowlands characterized by both a high water table and by periodic inundation from the branch as it overflows its banks. The species completely dominates its landscape. Moreover, it even defines the physical parameters of its environment. Due to the density of the stand and to the prevalence of water-absorbing Sphagnum moss, the interior of a cedar swamp is relatively windless, and is cooler and moister than the surrounding upland forest (Harshberger, 1916).

On first impression, an Atlantic white cedar swamp appears to be a monoculture of cedar. Penetration of the stand, however, reveals a greater botanical diversity. Scattered on mounds of soil and cedar roots are

the elements of the cedar swamp understory. The shade-tolerant plants of the understory include sweetbay magnolia, high bush blueberry, sheep laurel, northern bayberry, low gallberry holly, coast pepperbush, and swamp (or red) maple. The substrate of the swamp supports lush evergreen growth even in the depth of winter — several species of Sphagnum, haircap moss, and cushion moss. The trunks of the cedars are flecked with bluish green lichen. Sphagnum, cotton grass, and cranberries underscore a bog-like habitat. It is not always recognized that the ever-moist and ever-green gloom supports a magnificent reptilian species listed as endangered in New Jersey. The timber rattlesnake is fully at home in the tangle of roots of the cedar swamp.

Harvesting of Atlantic white cedar dates to the earliest days of European settlement in this region. Atlantic white cedar has been prized for its great utility in the production of logs for cabin construction, roof shingles, barrels, pilings, and boats. Its resistance to rot is well known. Logs buried in bogs have been raised after immersion for hundreds of years and have been found to be intact, usable, and highly valued as “bog cedar.” The intensity of the harvesting pressure on Atlantic white cedar was recognized in the last century.

“Formerly immense quantities of wood and excellent timber were shipped from the State, but this industry is greatly diminished of late years. The cedar swamps were once mines of wealth to their owners, but are now generally worked out” (Price, 1878).

The presence of a fairly uniform, even-aged cedar stand, as seen along sections of Mill Branch/Tuckerton Creek, indicate past harvesting activities. It should be noted that many open bogs in New Jersey mark places where Atlantic white cedar once flourished (Harshberger, 1916).

Along with Giffords Mill Branch and Otis Bogs to the south and Westecunk Creek to the north, Mill Branch/Tuckerton Creek and the undeveloped land defining its banks serve as a long corridor, with potential to link protected state lands to the north with the Forsythe Refuge. For the branches above, with the possible exception of Westecunk Creek, a complete and direct physical linkage with the Forsythe Refuge appears improbable due to intervening buildings and roads. The maintenance of even an incomplete corridor, however, is preferable to allowing inroads by development. Creative solutions, such as vegetated wildlife overpasses and acquisition of private developed land from willing sellers, can be used to establish linkage in the future.

It can be reasonably predicted that the Mill Branch/Tuckerton Creek corridor will receive increasing development pressure, particularly along its northern boundary, where residential areas are advancing south of North Green Street Road. On the southern boundary, north of Nugentown Road, a subdivision (Tuckertoria Heights) was underway at the time of writing. State-owned parcels along the southern boundary represent a portion of the Bass River State Forest and should serve as an important catalyst for continued acquisition and further protection efforts.

Mill Creek West

Stafford Township

900 Acres (Estimated)

The eastern apex of this somewhat cuneiform Stafford Township site is located at the southwestern corner of the Garden State Parkway and Route 72 intersection. From there, the boundary extends northwest along Route 72 for 2.5 miles before passing westerly to the confluence of Stoney Hollow Branch and Cedar Mill Creek, and then southerly to the intersection of Micaja's and Hay Road. The southwest boundary follows Hay Road to its intersection with Recovery Road. This site contains approximately five percent of the township's land area and is largely undeveloped. The property fits neatly with two large tracts recently acquired by the DEP on behalf of the Stafford Forge Wildlife Management Area (DEP). These include the 3,000-acre "Citibank" property acquired by DEP in 1992 and 2,170 acre "Oxly" tract, conveyed by the Trust for Public Land in April, 1995.

The topographic relief to the north of Manahawkin Mill Creek is gently sloping and fairly flat throughout. There is relatively very little upland between Manahawkin Mill Creek and Hay Road. Excellent access is available from Hay Road (unpaved) and the cart paths that enter from State Route 72. In addition, there are a number of well-established trails permitting a pleasant naturalist's tour through both upland and wetland habitats. Parts of the site are sadly defiled by household trash and debris, but this material can serve as a useful amendment to snake and small mammal habitat.

The wooded uplands support areas of pitch pine and oak-pine forest. White oak and scarlet oak are common to the north side of Mill Creek. The shrub layer is characterized by black huckleberry, mountain laurel, inkberry, and bear oak. The extent of the undeveloped uplands constitutes potential habitat for the state endangered timber rattlesnake and the state threatened pine snake.

The predominant wetland appears to be the Atlantic white cedar swamp along Manahawkin Mill Creek, but red maple-dominated swamps are found along the tributary streams. Sedge/shrub swamps also occur along Manahawkin Mill Creek and in the tributary streams. The shrub layer contains varying amounts of fetterbush, highbush blueberry, swamp azalea, inkberry, sweet pepperbush, and leatherleaf. The herbaceous layer contains a mix of rushes, sedges, and other herbs, the most obvious being bull sedge, tussock sedge, soft rush, bushy broom-sedge, cinnamon fern, Sphagnum moss, and arrow-leaf tearthumb. Potential habitat for endangered, threatened, and rare plant species is afforded by the Atlantic white cedar and sedge swamps. The wetlands along the tributary streams have potential vernal pond breeding habitat for the state endangered Pine Barrens treefrog.

There is ample evidence of survey activity within the last few years, and wetland boundary lines have been flagged as well. Part of the site off of Hay Road consists of the DEP Stafford Forge Wildlife Management Area. A great deal of off-road recreational vehicle activity occurs off of Hay Road about one-half mile west of Recovery Road. Most of this activity is conducted off-site, to the southwest side of Hay Road, but it

appears that the bounds of this activity will increase because of the remote, unprotected access at this location. The impacts of ATVs, if left unabated, do threaten to destroy the good upland habitat.

Old Hurricane Brook

Manchester Township

950 Acres (Estimated)

From its origins within the Pine Barrens at the southeastern edge of the Fort Dix Military Reservation, Old Hurricane Brook flows northeastward seven miles through the Manchester Wildlife Management Area (DEP) before it empties into Lake Horicon, south of Lakehurst. From Lake Horicon, the Brook's contribution becomes part of the Union Branch of Toms River. Conservation of the Hurricane Brook watershed can serve to create links among wilderness areas in the Fort Dix Military Reservation, the Manchester Wildlife Area, the Whiting Wildlife Management Area, and even Lebanon State Forest. Such linkages will prove vital if preserves are not to be totally islanded or isolated by future urbanization.

The origins for the name of the brook and for the lake into which it flows remain obscure. According to legend, the name was given for "the place where the Hurricane wind passes through the swamp." The name may also represent a folk etymology of Horicon, the name of an Indian tribe living in Connecticut in the early 17th century "that may have passed through this area at a later time" (Zinkin, 1976). A day with gray moiling sky and with wind building is perhaps most appropriate for the exploration of the brook and its environs. A periodic weather-eye on the horizon may be needed.

Despite the presentation of individual branches and stream corridors in the Century Plan, it is important to think of each site as a single component of the large and intricate system of water transport known as the Barnegat Bay watershed. Lake Horicon, for example, receives the contributions of Old Hurricane Brook, Forked Brook, Goodwater Branch, Blacks Branch, and Ruckels Branch, among other numerous streams. The combined waters exit from the lake at its eastern end, tumbling over a spillway to form the Union Branch of Toms River. Carried along with the cedar tea water itself, aquatic organisms, nutrients, sediment, and pollutants are shared by contiguous streams of the watershed and ultimately join the salt water of Barnegat Bay. Changes in one component of this vast system, such as the silting in of a portion of a tributary due to upland clearing or fertilizer input from farms and golf courses, can affect downstream watercourses and the Bay itself.

Like all Pine Barrens streams, Old Hurricane Brook has its origins deep within the pinelands, an expression of the underground reservoir known as the Kirkwood-Cohansey Aquifer. Whether a stretch of open water or a meander or seep emerging from a tangle of vegetation, the brook and its tributary streams form an integral part of the landscape. An aquamarine spring sky is reflected in Forked Brook, fringed with pines, Atlantic white cedars, and deciduous shrubs. But the still surface of the brook is also punctuated by cedar stumps, providing a reflection of change and of the dynamic nature of the watercourses. Depending upon the time of year and the amount of precipitation, certain rivulets and seeps may be largely dry, or the

streams may be so choked with plant growth that only occasional glints on water of sky blue or silver gray are offered.

Old Hurricane Brook's position as a far-reaching tributary of Toms River, the stream's linkage to existing protected areas, and its wild beauty all argue for conservation measures.

Otis Bogs / Willis Creek (Tuckers Creek)

Little Egg Harbor Township

200 Acres (Estimated)

As a biological corridor, Otis Bogs/Willis Creek is in a very strategic position. The ancient contact between the pinelands of the west and wetlands of Barnegat Bay and Little Egg Harbor has been severed in all but a few places. Running south of Route 9 (Atlantic Boulevard) to Tuckerton Cove, Willis Creek is one of the southernmost streams feeding into the lower Barnegat Bay at Little Egg Harbor. If the Willis Creek corridor were extended west of Route 9, it could tie in ultimately with the Bass River State Forest and provide a linkage, however imperfect and fragmented at its southern end, with the Forsythe Refuge. The need for a such a corridor becomes more imperative as suburban sprawl leads to forest and wetland fragmentation. Two consequences of land development are the loss of migratory routes and the loss of genetic exchange among organisms, an exchange important in maintaining species viability. As any visit to the Otis Bogs area will affirm, development pressure continues at nearby planned communities, notably Mystic Island and Mystic Shores (to the south and east), combined with smaller-scale subdivision activity in the vicinity of Tuckerton Borough.

At Otis Bogs/Willis Creek, human alteration of the landscape is apparent alongside ample evidence of nature's redemptive ability to overtake and win back the altered landscape. From the clearing and impoundment that preceded cranberry cultivation, the bogs have reverted to a more natural state. Red maple, black gum, and the other inhabitants of hardwood swamps are making inroads into the former bogs. Somewhat like beads on a string, formerly active cranberry bogs are clustered along Willis Creek in the vicinity of Otis Bogs Road. In drier times, the creek bed and the bogs themselves largely dry up, giving only a hint of the volume of water that can overspread the creek banks. At the southeastern end of Willis Creek, ribbons of pine and oak woodland serve to buffer the waterway from direct contact with a residential area. As one progresses northeastward along a trail on the northern side of the creek, nature appears to predominate and the buffering land to expand. Inroads are evident, however, in the form of the Atlantis Golf Course, with a bridge spanning the creek between Center Street and Radio Road, abandoned sand mining areas, and a residence north of Otis Bog Road.

A pocket bog, part of the Willis Creek watershed, has been used by Rutgers University for wetlands research. In contrast to its southeastern end at Atlantis, the northwestern extent of the creek's watershed is fairly pristine, without major encroachments, pipes, or outfalls. The bog is near a new dormitory, which has been built on Great Bay Boulevard, to house students working at the Rutgers University Marine Field

Station at Tuckerton. Protection of the Otis Bogs/Willis Creek watershed thus would have the important benefits of promoting ongoing field research in addition to safeguarding the resident flora and fauna.

Oxly Tract

Stafford Township

2,271 Acres

Located approximately nine miles northwest of the Long Beach Island Causeway (Route 72), the Oxly tract plays an important role in protecting water quality and habitat in the central Barnegat Bay region. A longstanding Pinelands Commission priority acquisition site, Oxly forms an important link to existing public lands, including the vast DEP holdings at Greenwood Forest (to the north) and Stafford Forge Wildlife Management Area (to the south). Oxly contains the headwaters of Mill Creek, an important local waterway whose freshwater and tidal wetlands nearer the Bay have been included in the Manahawkin Wildlife Management Area (DEP), in addition to the Forsythe Refuge. In recognition of its important locational and natural resource values, the Trust for Public Land recently acquired and conveyed Oxly to the DEP as an addition to the Stafford Forge Wildlife Management Area.

The site is located in the western corner of Stafford Township in the vicinity of Warren Grove. The tract is quite irregular in outline, but approximates an equilateral triangle 2.5 miles on each side (see map above).

Oxly contains parts of two separate watersheds. The northwesterly quarter is drained principally by the Dry Branch of the Wading River, while the remainder of the site is drained by the Beef Branch, Stoney Hollow Branch, and Manahawkin Mill Creek itself. These watercourses are associated with extensive, high quality freshwater wetland areas. Topographic relief is characterized by small, gently rolling hills with gradual slopes. The elevational difference is no greater than 90 feet spread over a distance of about 1.5 miles. The transition zone between upland and wetland habitats usually occurs along gentle to very gentle slopes, though the site contains some surprisingly steep grades.

Pine-oak forest dominates the upland zone. In some places, both oaks and pitch pine exhibit shrubby stature and the grade-up to approximate the normative stature of the surrounding forest. It is important to note that the Oxly tract is in close proximity to the rare and enigmatic “pygmy pine” forest just to the south in the Stafford Forge Wildlife Management Area. Oxly’s upland shrub layer contains black huckleberry, scrub oak, mountain laurel, and scattered sheep laurel — all typical pine barrens species. The extensive undisturbed uplands and wetlands within and contiguous to Oxly offer vital habitat for the state endangered timber rattlesnake and state threatened pine snake.

Wetlands here include Atlantic white cedar, sedge, hardwood, and scrub/shrub swamps, as well as pitch pine lowlands. Although all of these wetlands can be found in both drainages, the accessibility of those in the Wading River drainage accentuates their impressiveness. The shallow wet dips in the flat landscape may have potential as vernal pond breeding habitat for the state endangered Pine Barrens treefrog. The

Atlantic white cedar and sedge swamps contain several varieties of carnivorous plants, in addition to potential habitat for endangered, threatened, and rare plant species. Certain endangered and threatened orchids, sedges, and even Sphagnum mosses may be present on the site.

Ridgeway Branch

Jackson and Manchester Townships

800 Acres (Estimated)

A tributary of Toms River, Ridgeway Branch travels approximately 6.3 miles from the boundary of Colliers Mills Wildlife Management Area to Pine Lake, which, in turn, flows into the Union Branch of Toms River. The extensive northwestern portions of Ridgeway Branch, including several of its tributaries, are located within the Wildlife Management Area and are protected. The Ridgeway Branch is an important contributor to the fourth-largest watershed of the Pine Barrens and the largest freshwater creek feeding the Barnegat Bay — Toms River/Cedar Creek. The other major Pine Barren watersheds include the Great Egg Harbor/Tuckahoe River (which drains west of Ocean City), the Rancocas Creek (which flows into the Delaware River), and the Batsto-Mullica and Oswego-Wading Rivers, which empty into Great Bay. All of the watersheds, with the exception of Rancocas Creek, flow eastward (Boyd, 1991).

The names of Pine Barren streams often reflect early patterns of land use. The name Ridgeway Branch dates to 1839, while Ridgeways Mill Branch, an earlier name dating to 1762, is more descriptive. The branch name commemorates the principal family-landowner and saw mill operator of the area. The mill had been in operation for over ten years prior to its purchase by the Ridgeways in 1762 (Zinkin, 1976).

It is a paradox that areas of the Barnegat Bay watershed may have a wilder and more forested appearance today than they did in the nineteenth century. One of the first industries in the Barrens, timber harvesting, made steady inroads into the virgin forests of pine, oak, and cedar for home construction, boat building and heating fuel. Beginning in the 1700s, and continuing through the twentieth century, successive cuttings of younger growth occurred on 20-30 year cycles, principally for charcoal production required by local glass and bog iron industries. Atlantic white cedar, used in the production of such items as roof shingles, clapboards, and fence posts, required longer cutting cycles of 60-100 years, due to the tree's slower growth (Boyd, 1991).

The Ridgeway Branch is anchored at both ends in protected areas, a fact which holds great promise for the corridor's long-term protection. At the northwestern end lies Colliers Mills Wildlife Management Area (DEP). At the southeastern end is the Manchester Township Park at Pine Lake. The Pine Lake park site sets a tone of tranquility echoed by the nearby Willow Lake (part of the Ridgeway Branch watershed within the Leisure Village West development).

Along the Ridgeway Branch, the first signs of spring are visible and audible. Brambles and catbrier flaunt a sharper green than in the deep winter months. Red maple puts forth its flurry of minute, wind-pollinated

blossoms, producing a roseate haze against the backdrop of gray trunks and branches. A lone spring peeper initiates its rites of spring with a methodical high-pitched call from a patch of swamp astride the branch. The magic of the progression of seasons is at work along this linear “wilderness.”

Riverwood Park Extensions

Manchester and Dover Township

200 Acres (Estimated)

In an encapsulated form, the proposed extension or “buffering” of Riverwood Park presents a conservation promise; a hedge against urban encroachment. One of the most logical and productive strategies in land conservation is to expand the land area of an existing preserve or to make connections between existing preserves. In so doing, park managers help safeguard resource protection areas, while reducing encroachments and negative impacts resulting from adjacent development (such as noise and water pollution, domestic predators, unauthorized access, etc.). The proposed extension area covers the Toms River flood plain as the river proceeds to the southeast along the Manchester/Dover Township line. At its northern terminus is the Jackson/Manchester Township line. The site is contiguous with the Dove Mill/Toms River corridor, a Century Plan site.

As development advances and local population increases, significant demands are placed on the green corridors and the linear parks that buffer rivers and streams on their seaward journey. In this instance, much of the acreage flanking Toms River, as it flows southeastward through the Riverwood Park, lies within a flood hazard zone. Portions of the Toms River embankment are under joint township jurisdiction (Dover Township on the eastern side of the river and Manchester Township on the western side). Wetlands conservation easements cover other sections. Freshwater wetlands designation currently protects certain lowlying areas, although efforts to undermine such regulation, are being made at national and state levels.

The upland areas which fringe wetlands, however, are bearing the brunt of development, as evidenced by a major residential construction project underway at the end of Dover Pines Road, at the southeastern edge of the Extension. The pine/oak woodland here typifies such buffering areas. The Pinelands Comprehensive Management Plan of 1987, which regulates much of the land west of the Garden State Parkway, stipulates that development be restricted to areas outside a 300 foot buffer surrounding a wetland, “unless the applicant has demonstrated that the proposed development will not result in a significant adverse impact” (N.J.A.C. 7:50 - 6.7). Determining the adequate amount of buffer or contiguous upland required to safeguard the integrity of a wetland is not an easy task, especially in the case of the proposed Riverwood Park extension. Sites differ in numerous ways, such as integrity of the ecosystem, size of watershed, depth of water table, and proximity to development or to a protected area. In a recent study, *A Watershed-based Wetland Assessment Method for the New Jersey Pinelands* (1994), R. Zampella et al. described the following characteristics of upland wetland buffers. “Upland buffer zones serve to increase the total area associated with wetland complexes, reduce edge effect and perimeter impacts, and provide some habitat for those species dependent on upland areas. However, the long-term protection of many animal species

requires more than just protecting delineated wetlands and a band of upland buffer. . . There is no simple formula that can be used to establish upland buffers. Within a regulatory context, the 300 feet buffer requirement has been shown to be a workable wetland protective strategy. Arguments for larger or smaller buffers can be made but the only definitive conclusion that can be reached is that they offer more or less protection to adjacent wetlands than that provided by a 300 feet buffer” (Zampella et al., 1994).

Irrespective of wetland regulations and buffering functions of uplands, the proposed Riverwood Park Extensions elicits a wide spectrum of response from its users. The response ranges from abuse and neglect to full appreciation and stewardship. At one extreme are the residents and visitors who view the site as a suitable trash repository, hauling in all manner of nonbiodegradable detritus. All terrain vehicle users impact soil and destroy vegetation at the sides of their trail. At the other end of the spectrum are those who value the resource as a natural area. In what has become a daily ritual, a solitary walker, a neighbor of the tract, follows an inquisitive labrador retriever down a wooded ravine. A fleet of kayaks and canoes is readied for a Sunday outing at the base of a Route 70 bridge over Toms River. The route downstream, combining the Extension with designated parkland (Riverwood Park), affords participants an increasingly rare exposure to a wild New Jersey.

Slab Branch

Dover Township

160 Acres (Estimated)

Despite a similarity of outward appearances, it can be reasonably argued that each of the branches within the Barnegat Bay watershed has a distinctive “personality.” Given location and topography, seasonal water volume, associated natural and human history, and the proximity of development, each branch asserts its peculiar character. By 1839, Slab Branch had attained its present name, a reference to a slab bridge which once crossed it. Such bridges “made of log slabs with the bark retained were built over many streams throughout the state and in many cases provided the name for the stream” (Zinkin, 1976).

One of the shorter branches within the Barnegat Bay watershed, Slab Branch flows 1.2 miles from its headwaters to its junction within Dover Township’s Riverwood Park. Encompassed by a broadleaf swamp, which, in turn, is fringed by a pitch pine lowland forest, the streambed was largely dry in early March of 1995. The branch crosses two roads on its southwesterly course. Concrete embankments, rock catchments, and steel culverts have been built to facilitate the branch’s passage beneath roads. This engineering effort and the extent of the broadleaf swamp hint at the seasonal volume of water that flows along the branch bed and swamp floor. Between Cox Cro Road and Whitesville Road, Slab Branch becomes a fully aquatic stream flanked by Atlantic white cedar. South of Whitesville Road, the branch broadens and deepens as a reservoir. The reservoir, its banks enforced at one location with sandbags and old earthen berms, suggest that cranberry cultivation was once carried out here. A natural indicator of forest clearing earlier in this century is a lone wolf tree, a white oak, on the western side of the branch. “Wolf” tree is a term which foresters use to describe an old tree that has become established in a once cleared field. The tree’s

distinctive pattern of wide branching reflects the former open conditions.

Even devoid of its stream during dry periods, the Slab Branch corridor has the air of a sanctuary. The site includes oaks, red maples, pitch pines, and Atlantic white cedars. A line of deer hoofprints follows along the branch bank. In the woodland, a Carolina chickadee announces its presence, its call higher-pitched and more rapid than the call of the black-capped chickadee. Northern cardinal and tufted titmouse songs foretell a spring that is only a few weeks away. The potential link of this site with Dover Township's Riverwood Park makes a compelling argument for further protection of the Slab Branch corridor.

Toms River/Dove Mill Branch

Jackson and Manchester Townships

900 Acres (Estimated)

The Toms River/Dove Mill Branch is an expansive and very beautiful site of great significance both as a natural area and as a component of the Barnegat Bay watershed. The site combines a 1.8 mile section of Toms River (north of the New Jersey Transit tracks at South Lakewood Station to a junction with Dove Mill Branch) with 2 miles of that branch (proceeding from headwaters near the Butterfly Bogs Wildlife Management Area (DEP)). The river/branch corridor is crossed by roads at four locations. This situation leads to some fragmentation of habitat but also holds the promise of limited access and passive recreation.

The spring season never reaches a stasis, as change is its constant theme. By early April, the Toms River/Dove Mill Branch floodplain is already bearing evidence of the onrush of this change. The greening of the landscape is first set in motion in the ground cover and in the low vegetation that lines creeks and rivulets. As the spring progresses, the green fire ascends into the woodland shrub and understory layers, causing leaves and flowers to unfold, and finally reaches the trees of the canopy. Increasing daylength has worked its magic in overcoming winter dormancy, causing the germination of seed, the breaking of bud, and the build-up of photosynthetic pigment. Pushing up through the moist ground and through the leaf litter of the past autumn are the fiddleheads of sensitive and cinnamon ferns. A fine down often covers fiddleheads, serving to trap an air layer close to the plant, thus guarding against late killing frosts. Tussock sedge (which is not a true sedge but a grass) forms acid green tufts which spring up from and through the bed of last year's light brown growth. Bright gooseberry greens the top of an old decaying stump. Small lemon-yellow flowers mark the anemophilous or wind-pollinated spice bush, a major component of the understory in the floodplain. Having already completed their task of wind pollination, the red maples have shed their minute flowers and now bear the dark crimson winged seeds, known as samara. The relative scarcity of insects in an early spring woodland explains the emphasis on wind pollination by the tree and shrub species that flower early on. White blossoms of the wood anemone stand out against the dark browns of the forest floor, indicating the method of insect pollination, which will become more prevalent in the days to come.

As April advances, the birdlife in the Toms River/Dove Mill Branch becomes extremely abundant, largely reflecting an increasing food supply. To the species which have been overwintering in the area, including black-capped chickadee, tufted titmouse, bluejay, mallard, and Canada goose, must be added numerous other species that either pass through the site on their northward migration or settle and breed in the area. Species encountered during a single afternoon on the site include: black and white warbler, yellow rumped warbler, common yellowthroat, ruby crowned kinglet, white-throated sparrow, song sparrow, Carolina wren, house wren, eastern phoebe, common flicker, rufous-sided towhee, American robin, eastern meadowlark, northern mockingbird, and red-winged blackbird. As bird-watchers know, the best time for full observation of their quarry is during the brief period in spring between bud break, when birds arrive, and full foliage development, when birds are audible but are often hidden from sight.

In addition to the gentle meandering river and branch and their associated floodplain, large water impoundments, either former reservoirs or flooded cranberry bogs, are a feature of the Toms River/Dove Mill Branch that provide increased habitat diversity and recreational potential. At the largest of these, north of the Vanhiseville-Lakewood Road, fishermen use an old berm as an access road to reach a choice fishing spot. Unfortunately, the opposing side of the access road can represent disrespect and site abuse. A sandy road along the east side of the impoundment has afforded some individuals a useful repository for construction debris.

Waretown Creek

Ocean Township

187 Acres (Estimated)

From its point of passage under Route 9, Waretown Creek entices the passerby as a partially-protected wilderness pocket with a dark stream slowly gliding toward the Bay. The woods of this tract are relatively open, with Atlantic white cedar expressing its somber green tones and marking the watercourse and the hollows. Pitch pine and red and spanish oaks intergrade and vie for dominance. Understory components include sweetbay magnolia, American holly, low gallberry holly (or inkberry), sheep laurel, highbush blueberry, and coastal pepperbush. A striking sight is provided by the magenta berries of the beauty berry bush, set against an olive green background of eastern red cedar. Rapid flitting movements in the undergrowth and amongst the leaf litter betray a foraging flock of white throated sparrows.

For such a linear and spatially restricted tract, Waretown Creek harbors surprising botanical diversity. East of the head of Waretown Lake can be found old cranberry bogs, which were in operation from c. 1936 to 1960. In this area, in the vicinity of the creek bed, flourish natural bog vegetation, plants which specialize in a nutrient-poor, water-laden habitat. The white tufts of cotton grass, the widespread spongy mats of Sphagnum moss, and the bulbous, insect-trapping leaves of the pitcher plant announce that a fragment of a very ancient and unique habitat is being entered. Bog clubmoss, a relative of the giant trees that made up the bulk of the coal forming forests of the Carboniferous period (over 300 million years ago), is also present as a bog specialist, trailing its green stems over the moist ground. Contiguous with the bog, the wall

of Atlantic white cedars marks the location of the creek. While it is important to promote access to recreational areas (Waretown Lake), it is equally important to deflect access where it is not appropriate, as in the vicinity of the bog.

The protection of the central corridor of Waretown Creek, including Waretown Lake and adjacent woodland, has largely been achieved by Ocean Township. Centered on Waretown Lake, with its beaches and recreational facilities, the publicly owned land contains approximately 95 acres, most of which are in a natural condition. An argument can be made for the expansion of dedicated open space to include adjacent privately owned lands to the west, north, and east. Such an approach could involve fee acquisition or conservation easement from willing sellers. These lands, totalling some 187 acres, have the potential to buffer and augment the Waretown Creek recreational area. The Waretown Creek drainage to the Bay, between Route 9 and Main Street, could also be included. Additionally, a linkage could be forged to the Pancoast Inland Area, where Waretown Creek exits from the larger tract via a culvert under Wells Mills Road.

Wells Mills Girl and Boy Scout Camps

Ocean Township

600 Acres (Estimated)

This Ocean Township site extends about 0.9 - 1.3 miles westward from a north-south line at the dam of Wells Mills Pond to Brookville and Old Brookville Roads. It is bounded by Route 532 (Wells Mills Road) and Wells Mills County Park. The southern boundary passes along a branch of Oyster Creek beginning at Route 554 (Straight Road) to, and then along, Jones Road. This site is significant in size, and contains close to ten percent of the land area of Ocean Township.

The topography includes small, rolling hills, typically with gentle to moderate slopes. The elevational difference is nearly 100 feet spread over a one-mile axis. Cart paths and trails provide easy passage through the site, although travel in upland areas can be a plodding affair due to the sometimes dense growths of black huckleberry and bear oak. The scout camps comprise much of the northwestern quarter of the site; public access is prohibited except for passage on trails belonging to Wells Mills County Park. The remainder of the site is private property, and passage is properly conducted along the long-established, named cart paths and public right-of-way.

Wetlands proliferate along Oyster Creek and its tributaries, yielding extensive Atlantic white cedar swamps and pitch pine lowlands associated with Wells Mills Pond. Pitch pine lowlands and red maple hardwood swamps are likewise associated with the Oyster Creek. Here, the abandoned cranberry bogs support sedge swamps with scattered red maples. The shrub layer in these swamps contains inkberry, highbush blueberry, cranberry, American holly, and swamp azalea. The herb layer includes a variety of sedges and rushes, switchgrass, bushy beard-grass, and Sphagnum moss.

The uplands in the northern part of the site support a fine-quality pitch pine forest. The upland woods in the southern portion of the site consist of oak-pine forests — principally, white oak, scarlet oak, chestnut oak, and bear oak. Black huckleberry and mountain laurel are common understory species throughout the upland areas. The mountain laurel is often exceptionally abundant.

This site contains potential habitat for many endangered, threatened, and rare species, including the timber rattlesnake, pine snake, Pine Barrens treefrog, and red-headed woodpecker. The Atlantic white cedar and sedge swamps also provide potential habitat for endangered, threatened, and rare plants including sedges, rushes, orchids, and Sphagnum mosses, as well as pine barren boneset, swamp pink, and curly grass fern.

Wells Mills County Park is considering an expansion as lands and funds become available. Protection of this site by Ocean County would protect the quality of most of the surface water entering Wells Mills Pond and that leaving the park via Oyster Creek to enter Barnegat Bay. At the same time, such conservation efforts would protect the varied and sensitive habitats.

Wells Mills Park - Area 'E'

Ocean Township

620 Acres (Estimated)

This site contains approximately ten percent of the land in Ocean Township, and the western boundary extends fully across the width of the township. Area 'E' extends westerly 1.5 - 2.0 miles from its eastern boundary at the Garden State Parkway to Wells Mills (unpaved, north-south) and Bryant Roads. Route 532 (Wells Mills Road, east-west) is the only improved road in and along the site. The site is most easily accessed from the contiguous Wells Mills County Park, which has connecting trails and cart paths.

The topography features small, rolling hills with gentle to moderate slopes. The difference in elevation is as much as 125 feet, but that difference is generally spread over a distance of 2.0 miles. In terms of structures, the site is barely disturbed (Ocean County Vo-Tech High School is located nearby), but ground level survey stakes, set at a consistent distance suggesting the boundaries of residential lots, are found in Morey Road. The wetlands associated with Oyster Creek and its tributaries, as well as the branch of Waretown Creek, can be expected to suffer a diminution of water quality should the uplands be developed as indicated.

The main channel of Oyster Creek supports a well-established Atlantic white cedar swamp. The smaller tributary streams also support hardwood swamps variously dominated by red maple and/or black gum, as well as some sedge swamp. Pitch pine lowlands are also present. The full array of shrubs typical of Pine Barrens wetlands are found in these swamps. A carpet of Sphagnum moss proliferates over much of the saturated wetland soil.

The uplands in the northern part of the site contain a mix of pitch pine and pine-oak forests. The dry woodland in the southern portion of the site contains areas of pine-oak and oak forests. Black huckleberry, mountain laurel, and bear oak are common understory species throughout the upland areas.

Signs in the adjacent Wells Mills County Park depict the state endangered timber rattlesnake and the extent of undisturbed upland area suggests potential habitat for the state threatened pine snake. The wetland areas contained depressions that have potential as habitat for vernal pond-breeding amphibians, such as the state endangered Pine Barrens treefrog. The runs of Atlantic white cedar and sedge swamps also provide potential habitat for endangered, threatened, and rare plants — especially certain sedges, rushes, orchids, and Sphagnum mosses, as well as pine barren boneset, swamp pink, and curly grass fern.

This general vicinity has been the site of non-native human activity for about two and a half centuries. Most of the activity apparently centered in present-day Wells Mills County Park, where a sawmill was erected in the late 1700's as part of the regional Atlantic white cedar lumber industry. Although the site has a long history of rural industry (products included lumber, firewood, Sphagnum moss, and clay), there is little evidence of serious earth movement. The impoundment of Oyster Creek by James Wells for the sawmill is apparently the only long-lasting perturbation, and can be viewed as a stable, if not benign, circumstance.

Expansion of Wells Mills Country Park potentially could bring the site's valuable floral and faunal habitat "under protective wing."

Westecunk Creek

Little Egg Harbor Township

260 Acres (Estimated)

One of the many streams within the Pine Barrens that makes its way toward Barnegat Bay and the Little Egg Harbor, Westecunk Creek has the potential to form a "green link" between state forest lands of the interior and coastal tracts of the Forsythe Refuge. The Creek forms a 1.2 mile corridor in the vicinity of Parkertown, where it joins Little Egg Harbor north of Long Point Thoroughfare.

To initial appearances, Westecunk Creek represents an unspoiled drainage system, unimpacted by the input of sediments and pollutants that are found in streams further north. Yet Westecunk Creek suffers from high levels of ammonia and phosphorous, the result of fecal and chemical contamination. As part of a survey of water quality, the Pinelands Commission and Ocean County Health Department investigated 20 streams, including Westecunk Creek, over the period 1988-1991. Undisturbed Pinelands sites were used as controls. Periodic measurements were made of such factors as specific conductance, pH, calcium, magnesium, total phosphorous, total nitrite and nitrate, and ammonia in each of the streams. The overall trend in measurements can be described as a decrease in water quality paralleling an increase in disturbance of the land cover, through development or conversion to agriculture. While falling within or near the parameters for an undisturbed pinelands stream regarding most of the factors studied, "Westecunk Creek displayed

unusually high concentrations of ammonia and phosphorous” (Zampella et al., 1994). The presence of a sewage treatment facility and nonpoint source pollution through run-off from farmland are probable contributors. By calling attention to the most intact and fully functional ecosystems, such studies will help to set priorities for land protection in the future.

For much of its length, until it reaches the Forsythe Refuge marshes, Westecunk Creek displays the characteristic features of an Atlantic white cedar swamp: the brooding olive green walls of cedar, the cool, dark, and silent woodland interior, the dull mirror of shallow waters, and the slow but incessant pull of the creek Bayward, marked by the streamlined fronds of submerged aquatic plants.

Tax maps reveal multiple ownership and potential for significant subdivision and development of the banks of Westecunk Creek. If the corridor is protected in whole or in part, allowance needs to be made for public access to the waterway. Boat launching sites for kayaks and canoes already exist but would need to be formalized and monitored.

While residential development impinges on the Creek’s western boundary along Silver Lake Road and on the eastern boundary along Stafford Forge Road, a complete corridor has two major impediments — Railroad Avenue and Route 9, with Route 9 obviously being more significant. It should be noted that tunnels and vegetated bridges have succeeded in other localities in facilitating passage of wildlife over or under a roadway. If the creek basin and adjacent lands can be secured, such techniques could be investigated.

Whiting Clay Pits

Manchester and Lacey Townships

480 Acres (Estimated)

Straddling the Manchester-Lacey Township line, Whiting Clay Pits, known locally as “clay holes,” present a very fine example of the pitch pine uplands of the New Jersey Pine Barrens. Bounded to the north by an expanding Roosevelt City subdivision and to the west by Route 539, the site is contiguous with state conservation lands in the vicinity of Bamber Lake (lands acquired under the Pinelands Program). Likewise, the site is in proximity to Double Trouble State Park (DEP) to the southeast.

A 480-acre tract, Whiting Clay Pits still bear the scars of mining activity — linear water-filled gouges in the earth south of the junction of Harry Wright Boulevard, Brooklyn and Newark Avenues (the latter two being paper streets). The actual mining area lies near lowlands associated with a tributary of the Davenport Branch. The clay mining industry in this region was active from the end of the Civil War until the turn of the century. Large clay beds exist in western Ocean County, and the extraction of this resource became feasible with the establishment of railroads in the late 1860s. Narrow gauge rail lines typically served the mining pits and connected to the regular gauge line. The Whiting Clay Pits are approximately one mile south of an abandoned railway line. In some areas such as Pasadena and Woodmansie, the industry went beyond extraction. Clay works, or factories, processed the grayish green raw material into large terra cotta pipes to supply water for municipalities, including Trenton, Burlington City, and Philadelphia. (Elizabeth

Morgan, personal communication). This clay-mining industry came to a halt once the mines had been exhausted. The Pinelands have quietly closed in on the evidence of all this activity.

Separated from the expansion of Roosevelt City by the unpaved Harry Wright Boulevard, a road which is heralding and facilitating further residential expansion, Whiting Clay Pits epitomize this portion of the Pinelands on the verge of transition. In fact, township taxmaps indicate that a massive residential subdivision of the site is planned.

Entry into the site by one of the sand tracks leading south from Harry Wright Boulevard quickly reveals a timeless expanse of the Pine Barrens. The closely woven and intricate ecosystem of the Barrens is believed to date to the time of the retreat of the Wisconsin glacier from New Jersey. Pitch pine rules the landscape and forms the canopy of an extensive woodland. Scattered among the pines and occupying a lower stratum are a number of deciduous trees, featuring the following oak species: blackjack oak, scrub oak, post oak, and black oak. The shrub layer, resplendent in fall coloration, with russets and browns set against the persistent green of the pines, consists primarily of highbush blueberry and huckleberry, along with seedlings of the pines and oaks. The ground cover is made up, in part, of low bush blueberry, patches of beach heath or false heather, and wildflower specialists of the Barrens, such as sand jointweed and pixie. Underlying the vegetation and defining its character is a fine white powdery sand, which some have likened to confectionary sugar.

The area of Whiting Clay Pits has a wilderness aspect to it, a hearkening back to the Pine Barrens of prehistory. Appropriately, it harbors a number of reptilian and amphibian species of great antiquity and conservation interest. The Pine Barrens treefrog utilizes the old clay pits as breeding pools. On a warm, moist night in May or June, one can hear the distinctive nasal “quonking” sound of the male Pine Barrens treefrog in full courtship song. The Pine Barrens treefrog, “emerald green with lavender and white markings, may be totally common to abundant in protected pinelands habitats, but is classified as an endangered species in New Jersey due to threat of habitat destruction” (Boyd, 1979). In addition to the Pine Barrens treefrog, the carpenter frog, southern leopard frog, spring peeper, Fowler’s toad, and green frog all use the clay holes as a breeding site. Both the timber rattlesnake and the northern pine snake hunt for small mammals around the pits and in the surrounding pitch pine lowlands (Robert Zappalorti, personal communication).

The relative integrity of Whiting Clay Pits as an ecosystem and its important location in relation to protected areas argue for the conservation of this site. If the Whiting Clay Pits site eventually achieves protected status, it will provide an important buffer against the ongoing growth of residential areas to the north and will insure a more effective linkage between Double Trouble State Park, the Pinelands Bamber Lake tracts, Greenwood Forest Wildlife Management Area, and the Forked River Mountains.

Recreation and Restoration

“A land ethic, then, reflects the existence of an ecological conscience, and this in turn reflects a conviction of individual responsibility for the health of the land. Health is the capacity of the land for self-renewal. Conservation is our effort to understand and preserve this complexity.”

Aldo Leopold, *A Sand County Almanac*

Anchor Reef Marina

Dover Township

14 Acres

In addition to conserving open lands for habitat and watershed protection, the challenge today throughout the Barnegat Bay region centers on the acquisition, development, and adaptive reuse of waterfront recreational sites. Interviews with citizens and municipal officials pursuant to our work on the Century Plan highlighted the need for waterfront parks and public piers for fishing or crabbing activities. Despite their small size and municipal orientation, several of the most heavily-visited park sites are those where individuals or families can “drop a line” or a crabpot after work or on the weekend.

We found a striking need for public spaces that integrate active or passive recreation (i.e., ballparks, nature preserves, or cultural areas) with physical and visual access to the Barnegat Bay. With increasing frequency, former streetends, trails, and open lots — a classification of land uses broadly defined as “quasi-public” — have been developed or “privatized” through fencing or posting of illegal trespass signs. With the real estate market placing a premium on water views, many local streetends have been subdivided and replaced with homes that restrict or eliminate public views of the Bay. This trend toward privatization is continuing and should be countered by a local effort to increase public waterfront access.

The former Anchor Reef Marina is one site that could provide Dover Township residents or the region with a unique waterfront park and amphitheater. A 14-acre derelict marina and pool club, Anchor Reefs sits on the south side of Route 37 in the shadow of the Mathis Bridge, en route to the barrier island containing the communities of Lavallette, Ortley Beach, Seaside Heights and Seaside Park, and Island Beach State Park.

For several years, Dover Township has pondered the acquisition and redevelopment of the Anchor Reef site for municipal park purposes. The site, which is comprised of vacant lots, a derelict pool and clubhouse, boathouses, and drydock facilities, offers a system of piers unequalled in their fishing and crabbing access. Local citizens, anglers’ organizations, township officials, and the members of the environmental committee have been publicizing their “vision” for adaptive reuse of the property, which the Trust for Public Land supports (See our proposed site rendering below). Until it was tabled at a budget vote last year, Dover Township held a substantial DEP Green Acres grant-loan commitment to assist with the acquisition of the property. It may still be possible for the township committee to reactivate the Green Acres commitment, or to move the sponsorship to another entity such as the Ocean County Department of Parks and Recreation or a local nonprofit interested in owning and managing the site.

The status of the Anchor Reef Marina is wound into a complex legal receivership and environmental action involving the FDIC and a former developer who intended to construct a marina/condominium community. The site is still available for a marine commercial-type project and, barring acquisition by the public, will undoubtedly be developed in the future.

Similar to the Seaside Park debate on the Berkeley Harbor project (a Century Plan site), the relatively high cost of site acquisition and development have spawned a public debate on the issue of facilities mix (i.e., should the principal use be active or passive recreation, marina or fishing, or public amphitheater) and what user group(s) will benefit most from the park's development i.e., residents or non-residents).

The issues before Dover Township are enormously challenging, but given the overall loss of physical and visual Bay access throughout the Barnegat Bay region, it would be a shame for the community to equivocate or turn away from the chance to design and construct a first-rate public park space replacing a derelict marina.

Berkeley Harbor Marina

Borough of Seaside Park

11 Acres

Public spaces combining waterfront recreation, physical and visual access are needed throughout the Barnegat Bay region. Not too long ago waterfront parks were deemed unnecessary as there were adequate streetends, private trailheads and open lots affording public (or semi-public) access. Even on developed barrier islands, there were always "special places" bayside where an individual or family might catch a sunset. Due, however, to the intense development pressure throughout the northern and central Barnegat Bay, the special places themselves are fast becoming threatened or endangered "species."

In addition to conserving open lands for habitat and watershed protection, a challenge facing conservationists and Bay residents is the acquisition and development or adaptive reuse of waterfront recreational sites. In our interviews for the Century Plan, citizens and municipal officials literally cried out for more "waterfront parks" and access areas to meet the needs of permanent residents and summertime visitors, two rather distinct user groups. Our Century Plan site survey turned up several properties which appear to meet these general requirements.

The Borough of Seaside Park, the gateway community to Island Beach State Park, has the unique opportunity to acquire and redevelop a flagship property for municipal park purposes. The Borough has a substantial DEP Green Acres grant-loan commitment to acquire — on behalf of the public — an 11-acre derelict development property known as the Berkeley Marina (or Berkeley Harbor Marina). The site, which is largely vacant, offers outstanding Barnegat Bay access. The property fronts on Central Avenue between I and K Streets and combines a level upland area with a 188-slip marina and 1,200 linear feet of adjacent Bay frontage which could be developed into an outstanding pedestrian walkway and fishing access area.

Presently the subject of a complex foreclosure and legal receivership action, the site gained a “mixed-use” development approval from the Borough’s planning board in the mid-1980s. Situated on the tract’s periphery are two partially complete 39-unit condominium structures, the future of which hinges on a legal settlement and/or court judgment. It is worth noting, however, that completion of the housing component could occur concurrently with development of a municipal park on the balance of the site.

Beyond the cost of site acquisition and development, citizens and elected officials from Seaside Park are now beginning to address the issue of facilities mix, centering on active versus passive recreation and on the residential status of users (Jay Delaney, personal communication). It is worth noting that questions of use and constituency form the basis for all public land acquisition projects, be they for recreation, habitat protection, or watershed buffering.

Given the imagination and commitment of its community, Berkeley Harbor Marina may yet realise its significant potential as open space for recreation.

Dredge Spoil Islands

Located Throughout Barnegat Bay

Acreage: Varies by Site

In contrast to all of the other sites specifically described in the Century Plan, dredge spoil islands are presented as a general category, reflecting their unusual and unnatural origins. As sedge islands continue to be eroded away by the forces of nature, one type of island in the Bay actually has the capacity to increase in size. Dredge spoil islands take form as a result of sediment deposition, chiefly sand and mud, on shoals or on sedge islands during the dredging of channels. Numerous Bay islands have been partly affected by dredging. The landforms and vegetation of Sandy Island, High Island and Mordecai Island, for example, reflect this process, particularly in areas adjacent to channels. Several islands, however, are more visibly the product of dredging operations.

The term dredge spoil implies altered habitat, an area of little merit other than as a repository for sediment that has been clogging up the Bay’s waterways. Although heavily influenced and literally sculpted by the hand of humankind, these distinctive sites have significance both as open space and as plant and wildlife habitat. While they are surrogate natural areas, they nevertheless merit recognition, and, in some instances, restoration.

Two islands, in particular, demonstrate their dredge spoil heritage — Beach Haven Wild Bird Refuge (Beach Haven Borough) and the large dredge spoil island, named “Barnegat Dredge Spoil” in this report, which lies south of Great Sedge and west of Barnegat Inlet. The often steep, sloping sides of sand of these two islands provide a characteristic profile which is very easily discernable from afar. Barnegat Dredge

Spoil's white crest of sand juts above the surrounding marshes like a beacon, the large pipes that pump the sediment from the Bay floor being clearly visible. An older and inactive dredge spoil, Beach Haven Wild Bird Refuge cuts a high and flat-topped silhouette.

A dredge spoil island in the process of formation can be likened to a "clean slate," a bare substrate that awaits colonization by the flora and fauna capable of reaching the island. Unfortunately, the natural marsh at the island's center has been destroyed by dredge deposition. Ironically, it might be argued that the island habitat is being diversified by human interference, particularly if the original marshes persist on the perimeter. Where before low and high marshes had existed at or only several feet above sea level, spoil deposition immediately generates an upland condition. This upland area, if bermed, can even give rise to an interior complex of freshwater wetlands.

Beach Haven Wild Bird Refuge demonstrates the great success that the more vagile and aggressive of the island colonists can experience. Phragmites, or giant reed, climbs from the very edge of the shore, up the sloping sides of the island, some seven to ten feet in elevation, and cascades across the island's interior. This is not a monoculture, however, as other plant species, including various asters and goldenrods and groundsel tree, are able to take root. Introduced giant reed has become notorious to wetland managers because of its rapid spread and ability to crowd out native marsh plants. Methods of eradication, including herbicides and controlled burning, continue to be investigated. On the other hand, giant reed's ability to form habitat, specifically shelter and nesting sites, and its limited food value for wildlife, have also been recognized. The long term usefulness of the dredge spoil islands as nesting habitat for colonial seabirds is possible only if succession can be held in check (a controversial process which may involve herbicide use.)

As available land for wildlife has become increasingly restricted, the dredge spoil islands are gaining greater prominence as refuges and management areas. Two osprey poles on the Beach Haven Wild Bird Refuge point to the successful reestablishment of that species along the Atlantic coast, following the depredations of DDT. Dredge spoil islands are known as important nesting areas for a number of bird species. Stretches of bare sand are used as nesting sites by black skimmers and least terns. Barnegat Dredge Spoil has a colony of herring gulls in residence during the breeding season. A species which is typically more southern in distribution, brown pelicans have been seen frequenting the crown of the island, quite possibly prospecting for future nesting sites (Joanna Burger, personal communication). A sand bar on Barnegat Dredge Spoil, undoubtedly nourished over time by the sediments pumped on the island, was supporting a large aggregation of gulls and terns during a late October visit. This activity was but a shadow of the activity encountered during the breeding season.

Dredge spoil islands have value not only as havens for birds, but also for the organisms on which birds feed. Shallows associated with dredge spoil islands are attractive to marine invertebrates and to many fish species. Such shallows, however, are even more attractive if a natural marsh rim has been left intact or has redeveloped. It should be noted that sites of future dredge spoil islands need to be carefully chosen in order not to destroy good fishing grounds or submarine habitat (Willie deCamp, Jr., personal communication).

Given their recent and unnatural origins, dredge spoil islands, in general, are difficult to pin down regarding ownership and jurisdiction. Predictably, the state is an owner if it has been involved in the dredging process. In that case, the state has the right to sell or lease the land it has created. To promote colonial bird nesting on the Bay, in particular, it is important to protect and manage these odd pieces of the Bay landscape.

Historic Seaport Project

Barnegat Bay Decoy and Baymen's Museum

Tuckerton Borough

16 Acres - Phase I

The little Borough of Tuckerton, which is situated low at the southern end of the Barnegat Bay, has played a leading role in the economic, cultural, and natural history of the region.

This history of Tuckerton and the Bay is celebrated today in a 1,350 square foot replica hunting shanty known as the Barnegat Bay Decoy and Baymen's Museum, located at Tip Seaman Ocean County Park, on Route 9 in Tuckerton Borough. The Baymen's Museum is brimming with display cases of decoys, folk art, and historic artifacts spanning two centuries of life on the Barnegat Bay. To visit the museum is to understand the vital role played by natural resource conservation in the Bay region — past, present and future. And if the land (or the Century Plan) cannot sing, then surely the Museum's staff will infect you with their fever for the Bay.

The Museum is preparing to expand and diversify its mission by adding a "historic seaport" component to its decoy exhibits. The nonprofit entity managing the project recently received DEP Green Acres funds to acquire a 16-acre tract abutting the historic Tuckerton Creek, adjacent to Route 9 in Tuckerton Borough. It is at this site that a facility will be developed to unite the region's natural and economic history with hands-on learning, environmental education, and a wide variety of exhibits and artifacts.

As a public space, the present museum site assists with interpretation of the Barnegat Bay. More importantly, the future museum, if constructed, will provide valuable physical and visual access to the Bay, a Century Plan objective. As raw land, trails, and public open space are lost to development or "privatization" through fencing and posting of "no trespass" signs, the role of a living Baymen's and Historic Seaport Museum will continue to grow.

Tuckerton and the Bay: A Distinctive and Unusual History

Local residents and knowledgeable Barnegat Bay “insiders” know the facts, but did you know that:

- *Tuckerton was named the third Port of Entry in 1791 by President George Washington and Secretary of State Thomas Jefferson?*
- *Port shores were a construction center of sailing vessels sized up to 800 tons and gave birth to the country’s sailing ships in the 1800s, including the square-rigged brig?*
- *Creative boat designs, including Jarvis Pharo’s “garvey” and Hazelton Seaman’s renowned “sneakbox,” were developed to accommodate Barnegat’s shallow waters and tidal flats?*
- *Harry Vinuckson Shourds (1861-1920) carved some 2,000 wooden decoys a year for 40 years, with deliveries worldwide? That a Shourds goose recently sold at auction for \$60,000?*
- *Shourds’ grandson, carver Harry V. Shourds II of Seaville, as well as boatbuilder Charles Hankins of Lavallette, are National Heritage Fellows honored by the National Endowment for the Arts for their contributions to American folk art?*

Barnegat Bay Decoy and Baymen’s Museum

Huddy Park/Proposed Expansion

Downtown Toms River (Dover Township) and South Toms River Borough

Up to 85 Acres

Beyond the conservation of large tracts for habitation and watershed protection, the challenge throughout the Barnegat Bay area centers on the development and adaptive reuse of urban waterfront recreational sites. As presented elsewhere in the Century Plan (See Anchor Reef Marina, Berkeley Harbor Marina, and the Baymen’s Museum), municipal parks are often under exceptional visitation pressure, regardless of their remote location or scale. Our interviews with citizens and municipal officials evidenced a desire for waterfront parks and public spaces capable of increasing physical and visual access to the Bay.

Within this context we present Huddy Park as one of the Bay area’s most significant open space “opportunities.” Commemorating the heroic Revolutionary War actions of Captain Joshua Huddy, the site currently functions as a small waterfront park on the main branch of the Toms River, at the foot of Main and Water Streets in downtown Toms River. Those who live or work in Toms River know the site, yet few bother to acquaint themselves with the park. Numerous visits on our part (over several seasons) have yet to uncover anyone using Huddy. Why? Does the problem stem from one of public access, perceived safety, visitor facilities, or urban design/connectivity?

We believe the problem with Huddy Park arises from its failure to “naturally” draw visitors to the water’s edge. Limited size, a lack of public amenities, and difficult pedestrian access from the adjacent streetgrid are components of the problem. Many of these issues have been raised by others, including the Toms River Chamber of Commerce, Main Street merchants, and public officials from Dover Township and Ocean County.

Our recommended solution involves the expenditure of public funds in three phases to: (a) acquire title to a superior quality and aesthetically pleasing freshwater wetlands complex west of Main Street South; (b) construct a pedestrian walkway along the length of the Toms River; and (c) purchase and convert the large warehouse along Main Street South to an indoor recreation center featuring an ice or rollerskating rink. (Please refer to the accompanying site plan.)

The key to successful adaptive reuse of Huddy Park centers on raising or relocating the Route 166 bridge to better facilitate pedestrian movement beneath it. Currently, the bridge is rather low, and its footings ill-placed to accommodate perpendicular walkways (although cantilevering remains a possibility). Recognizing that bridge relocation and/or reconstruction is never easy (or cheap), we present this plan as fuel for thought.

Huddy Park has the potential to function as a full-service local and regional facility for both active and passive recreational use. Completion of the project will not only revive the park, but should provide a very positive economic impact on the downtown Toms River retail and office market.

Mallard Point

Brick Township

2 Acres

The two-acre peninsula on the north side of Mallard Point, at the northwestern reaches of Kettle Creek, offers proof of nature’s ability to colonize an area previously devoid of life. Given a “clean slate” in the form of a spoil bar dredged in 1955, adequate moisture, and nutrients, vegetation has succeeded in laying claim to the area. In addition to the ever-present Phragmites, which has invaded the lower areas, pitch pine has made a determined stand and intergrades with the Phragmites. This has helped to strengthen the ecological integrity of the site. The pitch pines appear to be relatively young, within the 30-40 year range, and thriving. For such a small area, there is a surprising amount of botanical diversity. In addition to the pines and giant reed, gray birch, red oak, black oak, red maple, American holly, northern bayberry, and catbrier can be found. False heather, or beach heath, a low-growing plant that puts forth yellow blossoms, resplendent against white or grey sand in late May, is also found. Gray birch and giant reed are classic colonizers of disturbed uplands and wetlands respectively. The presence of other species indicates that a good seed source is nearby and that the peninsula is experiencing the stages of plant succession commonly experienced by larger tracts.

The tenuous presence of nature is recognized on and near Mallard Point. Local residents have petitioned the U. S. Army Corps of Engineers, maintaining that, “The creek and adjacent lagoon are already overburdened with run-off pollutants from the existing neighborhood, where so many people live on or near the water’s edge. The abundant wildlife is struggling to exist. In spite of man’s encroachment, animals amazingly manage to hunt and feed...the plans to add fill and to build will poison the life that is left on the land and in the water” (unpublished petition of local residents, 1994).

Despite proximity to residences, Mallard Point and adjacent waters harbor wildlife. Bird life was fully evident in June. Among the species encountered were great egret, great blue heron, laughing gull, Canada goose, red-winged blackbird, catbird, and song sparrow. Snapping and painted turtles are known to frequent the creek.

A narrow trail leads through the interior of the peninsula, beckoning a limited and quiet access. In the most congested of Ocean County townships, there is a widely recognized need for more open space that can be used for passive recreation, habitat study, or retreat. A trail within the site is actively used by local residents, particularly walkers, birders, and fishermen. Prospective marine biologists were at work, sampling the aquatic environment, during a site visit. Nearby residents support efforts to safeguard this sliver of regenerating wilderness. “In 1990, Brick Township’s Zoning and Planning Committee advocated that the 2.3 acre site be placed in an RR1 residential zone, limiting development due to the site’s sensitivity.”

As of February 1995, a 10-lot residential subdivision called “Mallard View Estates,” had received approval for the area adjacent to and south and west of the neck of the peninsula. Clearing has occurred at several lots. Part of the development plan requires the mitigation of illegal filling of on-site wetlands by the previous owner. Spartina marsh re-establishment will be carried out through dredging and planting of a section of the peninsula’s eastern shore. Carrying bulkheading onto the peninsula to counter erosion also remains a possibility.

Despite recent land clearing activities, the conservation status of the peninsula has improved somewhat. The site’s RR1 zoning designation should protect roughly 70 percent of the peninsula’s land area. Even in this more optimistic scenario, construction of a residence at the neck would detract from the site’s parkland potential, as access may be difficult or may be denied. Maintaining the microcosm of reclaimed land at Mallard Point in its current wild state would benefit wildlife and the surrounding community. If landowners are willing sellers, Brick Township would indeed benefit from protection of the site as a township park.

Sand and Gravel Mining Sites

Berkeley, Jackson, Lacey, and Manchester Townships

250 - 2,500 Acres

There are several active sand and gravel extraction pits within the various watersheds of the Barnegat Bay. Since the sites cover portions of four townships in Ocean County, this evaluation will not focus on any one particular borrow pit, but will endeavor to provide a general description of the positive and negative aspects of sand and gravel mining in the Pinelands.

Sand and gravel extraction in the southern New Jersey Pine Barrens remains an important industry and supports the local economy through jobs and property tax revenue. Gravel is used in the paving industry as a stabilizing base for secondary, unimproved roads, or beneath paved roads as a solid substrate. Sand is also used to mix into the asphalt or concrete for road paving. Good quality, construction-grade sand is in great demand as one of three ingredients in cement (the other two are powdered concrete and water). Silica, a specialized sand product used for glass making, is also mined in the Pine Barrens. In the past, clay was also mined in Ocean County, notably at Crossley in Berkeley Township and Whiting in Manchester, where the wet pits can still be viewed (See Whiting Clay Pits and Berkeley Triangle, herein). The clay was used for pipes, pottery, and bricks.

Extracting sand and gravel from the ground requires specialized equipment and skilled operators. These actions, although necessary, cause major long-term disturbance to upland forest habitat. There are two ways to mine sand from the ground; both require the cutting and clearing of forest. Dry mining entails scraping the top soil (humus) away and exposing the "B Horizon," or construction grade orange sand. At various levels within the "B Horizon," veins of gravel can also be found. Mining engineers can predict where the best sand and gravel is located through a series of test boring which allows an evaluation of the soil's profile. Once the best underground areas have been located, the sand or gravel is mined either by mechanical dry scraping for gravel, or by wet mining for sand. Wet mining literally sucks the sand out of the ground by a giant floating machine that is connected to the refining plant by 16-inch diameter metal pipes. Once pumped into the processing plant, the sand is washed, filtered, and then stockpiled. Gravel is removed from the ground by front-end loader, large backhoe, or crane and loaded into trucks; it is then carried to the plant where it is also screened to separate the large stones from smaller ones, as needed. Sand and gravel products are in demand and are widely used throughout southern and central New Jersey.

Sand and gravel mining is an allowable land use in the Pinelands, but individual companies must apply for extraction permits from the Pinelands Commission every two years. The applicant must demonstrate that the proposed new mining area will not adversely impact important or critical habitat to any endangered and/or threatened plant or wildlife species. Prior to the Pinelands Act of 1979, sand mining was not strictly regulated and reclamation requirements were minimal or nonexistent. As a result, abuses to sensitive plant and wildlife habitat were recorded. Open mining ponds were sometimes left with steep slopes that became dangerous traps for people or animals that ventured too close. In the absence of grass and shrub planting,

erosion and siltation were common problems. The abandoned mining site would have the appearance of a sterile “moonscape” that offered little in the way of plant or animal habitat.

All of this changed with the implementation of Pinelands mining regulations. As part of the permit application, mining companies must present a post-mining reclamation plan. The shores of mining ponds must be graded at a ratio of one inch per three foot drop in pitch. This ratio yields a gradual slope that can be stabilized with rye grass, pitch pine, and other native vegetation. Mining operators are now required to properly grade and seed the surface of all mined areas to prevent erosion.

While some important upland habitat types may have been lost as a result of wet sand mining over the past 75 years, the process has created large ponds which provide aquatic animals (e.g.: fish, frogs, turtles, some birds, insects, etc.) with additional habitat. These large open water ponds offer feeding opportunities for many birds such as waterfowl, osprey, terns, and bald eagles. The old sand mining spoil piles also offer habitat for a variety of terrestrial plants and animals such as sickle-leaved golden asters, fence lizards, five-lined skinks, pine snakes, Fowler’s toads, and killdeer to name a few. Some open, sunny spoil piles offer suitable grassy areas for butterflies to forage and find nectar. Dragonflies and damselflies also find small flying insects upon which to feed in these open spoil areas.

Abandoned mining areas can once again become important plant and wildlife habitat if managed correctly. These sites provide good diversity and ecotone habitat for a number of Pinelands plant and animal species. Over time, there may be several reclaimed sections at various stages of natural succession, thus presenting alternative habitats for animals to select and carry out biological activities. Sand and gravel mining in the Pinelands is an important industry, and one that has functioned over one hundred years. Most mining companies or operators endeavor to reclaim abandoned extraction sites and leave them in a condition that is pleasing to look at by the casual observer, but more importantly, that is suitable habitat for native plants and wildlife.

While clean-up and grading of certain areas along the pond edges is essential, small portions should be left with steep embankments. These conditions provide good nesting habitat for bank swallows and kingfishers. In addition to this, more open grassy areas should be prepared and managed for snakes, butterflies, and other wildlife. All existing fields or open grassy areas with native vegetation should be managed and kept in an early successional stage for butterflies, grassland birds, and other wildlife. Small mammals such as meadow voles, pine voles, white-footed mice, etc. will thrive in old field habitat. In addition, some open sand and gravel areas (sand spoil piles) are also desirable to provide nesting habitat for killdeer and other ground nesting birds.

Abandoned sand and gravel pits can become valuable plant and wildlife habitats and merit consideration for protection. Once sand products have been extracted from a given site, the fair market value of the

property typically drops and the property can be acquired at attractive rates. Mining companies may wish to donate or sell at discount portions of their mining sites to qualified conservation organizations in exchange for tax and other public benefits.

Bibliography

- Anderson, J.D.** “The status of the tiger salamander, *Ambystoma tigrinum*; blue-spotted salamander, *Ambystoma laterale*; Tremblay’s salamander, *Ambystoma tremblayi*; gray treefrog, *Hyla versicolor*, and *Hyla chrysoscelis*; bog turtle, *Clemmys muhlenbergii*; and Pine Barrens treefrog, *Hyla andersonii* in New Jersey”. Unpublished report to the Nongame and Endangered Species Project, New Jersey, 1976.
- Association of New Jersey Environmental Commissions.** *The Environmental Manual for Municipal Officials*. Trenton, N.J.: New Jersey Department of Environmental Protection and Energy, 1992.
- Benyus, Janine M.** *The Field Guide to Wildlife Habitats of the Eastern United States*. New York: Simon & Schuster Inc., 1989.
- Boyd, Howard P.** *A Field Guide to the Pine Barrens of New Jersey*. Medford, N. J.: Plexus Publishing Inc., 1991.
- Britton, N.L.** “Catalogue of Plants Found in New Jersey”. Final report to the Geological Survey of New Jersey, Vol.2, Sec. 2 (1889): 25-619 .
- Brown, O.H., and Wherry, E.T.** “Check-list of the Vascular Flora of Cape May County, New Jersey”. *Bartonia*, 40 (1970): 1-18.
- Brush, T.** “Habitat Use by Breeding Birds in the New Jersey Pine Barrens”. *Bulletin of New Jersey Academic Sciences*, 35(2) (1990): 13-16.
- Burger, Joanna, and Zappalorti, Robert T.** “Nest Site Selection by Pine Snakes (*Pituophis melanoleucus*) in the New Jersey Pine Barrens”. *Copeia*, 1 (1986): 116-121.
- Burger, Joanna, and Zappalorti, Robert T.** “Habitat Use in Free-ranging Pine Snakes (*Pituophis melanoleucus*) in the New Jersey Pine Barrens”. *Herpetologica*, 44(1) (1988): 48-55.
- Burger, Joanna, and Zappalorti, Robert T.** “Habitat Use by Pine Snakes (*Pituophis melanoleucus*) in the New Jersey Pine Barrens: Individual and Sexual Variation”. *Journal of Herpetology*, 23(1) (1989): 68-73.
- Burger, Joanna; Zappalorti, Robert T.; et al.** “Hiberacula and Summer Den Sites of Pine Snakes (*Pituophis melanoleucus*) in the New Jersey Pine Barrens”. *Journal of Herpetology*, 22(4) (1988): 425-433.
- Burger, W.J.** “The Hibernation of the Rattlesnake of the New Jersey Pine Barrens”. *Copeia*, 3 (1934): 142.
- Burke, Patricia H.** *Barnegat Bay Decoys and Gunning Clubs*. Toms River, N.J.: Ocean County Historical Society, 1985.
- Conant, Roger.** “A Zoogeographic Review of the Amphibians and Reptiles of Southern New Jersey, with Emphasis on the Pine Barrens.” *Pine Barrens: Ecosystem and Landscape*. Edited by Richard T. T. Forman. New York: Academic Press, 1979.

Cromartie, William J., ed. *New Jersey's Endangered and Threatened Plants and Animals*. Pomona, N.J.: Center for Environmental Research, Stockton State College, 1982.

The Conservation and Environmental Studies Center, Inc. *An Environmental Resource Inventory of the Township of Barnegat, Ocean County, New Jersey*. Browns Mills, N.J.: The Conservation and Environmental Studies Center, Inc., 1978.

Fairbrothers, David E. "Endangered, Threatened, and Rare Vascular Plants of the Pine Barrens and their Biogeography". *Pine Barrens: Ecosystem and Landscape*. Edited by Richard T.T. Forman. New York: Academic Press, 1979.

Forman, Richard T.T., ed. *Pine Barrens: Ecosystem and Landscape*. New York: Academic Press, 1979.

Gordon, Ted. "Floristic Surveys of Two Natural Trust Properties: The Crossley Tract and the Oswego River Headwaters Tract, Both in Ocean County". Unpublished article submitted to the New Jersey Department of Environmental Protection, The Natural Lands Trust, Trenton, N.J., 1985.

Gordon, Ted. "Final Report: Survey of Historical Populations of *Helonias bullata* in New Jersey—1989". Unpublished report for the New Jersey Department of Environmental Protection, Office of Natural Lands Management, Trenton, N.J., 1989.

Gordon, Ted. "Monitoring and Survey of *Rhynchospora knieskernii* in New Jersey—1992". Unpublished report to the New Jersey Department of Environmental Protection, Office of Natural Lands Management, Trenton, N.J., 1993.

Gordon, Ted, and Vivian, V. Eugene. "A Survey of Vascular Plants (Including Rare, Threatened and Endangered Species) and a Description of the Floristic Communities in Selected Areas of the Oyster Creek Drainage Between US Route 9 and Barnegat Bay in Lacey and Ocean Townships". Southampton, N.J., 1994. (Photocopied.)

Harshberger, John W. *The Vegetation of the Pine Barrens*. Philadelphia: Christopher Sower Company, 1916.

Hough, M.Y. *New Jersey Wild Plants*. Harmony, N.J.: Harmony Press, 1983.

Jahn, Robert. *Down Barnegat Bay*. Mantoloking, N. J.: Beachcomber Press, 1980.

Knieskern, P.D. *A Catalogue of Plants Growing without Cultivation in the Counties of Monmouth and Ocean, New Jersey*. Trenton, N.J.: By the "True American Office," 1857.

Kraft, Herbert C. *The Lenape*. Newark, N.J.: New Jersey Historical Society, 1986.

Kennish, Michael J., and Lutz, Richard A., eds. *Ecology of Barnegat Bay, New Jersey*. New York: Springer-Verlag, 1984.

Leck, Charles F. "Birds of the Pine Barrens." *Pine Barrens: Ecosystem and Landscape*. Edited by Richard T. T. Forman. New York: Academic Press, 1979.

MacArthur, R. H., and Wilson, E. O. *The Theory of Island Biogeography*. Princeton, N.J.: Princeton University Press, 1967.

Martin, Alexander C.; Zim, Herbert S.; and Nelson, Arnold L. *American Wildlife and Plants - A Guide to Wildlife Food Habits*. New York: Dover Publications, 1951.

McCormick, J. *The Pine Barrens: A Preliminary Ecological Inventory*. N.J.: New Jersey State Museum, 1970.

Miller, Pauline. *The Great Sedges*. Toms River, N.J.: Ocean County Historical Society, 1994.

Montgomery, J.D., and Fairbrothers, D.E. *New Jersey Ferns and Fern-Allies*. New Brunswick: Rutgers University Press, 1992.

Natural Lands Trust of Pennsylvania. "Conservation Planning Study for The Berkeley Triangle," Berkeley Township, Ocean County, N.J., 1987.

New Jersey Department of Environmental Protection. *Endangered and Threatened Species of New Jersey*. Special publication of the Endangered Species Program, 1984.

New Jersey Department of Environmental Protection, Division of Fish, Game and Wildlife; and U.S.D.A. Soil Conservation Service. *Endangered and Threatened Species of New Jersey*. Special Publication of the Endangered Species Program, 1980.

New Jersey Department of Environmental Protection and Energy, Division of Parks and Forestry. *Natural Heritage Priority Site Maps*. Trenton, N.J.: N.J.D.E.P.E., 1994.

New Jersey Department of Environmental Protection and Energy (Fowler, Theresa). *A Watershed Management Plan for Barnegat Bay*. Volumes I and II. Trenton, N.J.: N.J.D.E.P.E., 1993.

New Jersey Natural Heritage Program (Schuyler, A.E.). *Element Stewardship Abstracts*. Trenton: Office of Natural Lands Management, N.J.D.E.P., 1990.

New Jersey Natural Heritage Program. *Special Plants of New Jersey*. Trenton: Office of Natural Lands Management, N.J.D.E.P., 1992.

New Jersey Natural Heritage Program. *County lists of Rare Species for Gloucester, Monmouth, and Ocean Counties, New Jersey*. Trenton: Office of Natural Lands Management, NJDEP, 1994.

New Jersey Pinelands Commission. "Endangered and Threatened Plants". *New Jersey Pinelands Commission Management Plan* (1980), 63-67.

Niles, L.; Clark, K.; and Ely, D. "Breeding Status of Bald Eagle in New Jersey". *Records of New Jersey Birds*, 17(1) (1991), 2-5.

Noble, G.K., and Noble, R.C. "The Anderson Treefrog (*Hyla andersonii*), Baird; Observations on its Habitat and Life History". *Zoologica*, II(8) (1923), 416-455.

Ocean County Planning Board. *Ocean County Comprehensive Master Plan*. Toms River, N. J.: Ocean County Planning Board, 1988.

Pinelands Commission. *Pinelands Protection Act*. New Lisbon, N.J., 1979.

Price, T. T. *Atlas of the New Jersey Coast*. Philadelphia: Woolman and Rose, 1878.

Radis, Richard P., and Sutton, Clay C. *Threatened and Endangered Wildlife Survey and Habitat Evaluation of the Potential US Fish and Wildlife Service Land Acquisition Areas, from Good Luck Point South to the Double Creek Area*. Forked River, N.J.: Herpetological Associates, 1991.

Rogers, Golden, and Halpern, Inc. *Profile of Barnegat Bay*. Philadelphia: Rogers, Golden and Halpern, Inc., 1990.

Salter, Edwin. *A History of Monmouth and Ocean Counties*. Bayonne, N.J.: E. Gardner & Son, 1890.

Snyder, D.B., and Vivian, V. E.. *Rare and Endangered Vascular Plant Species in New Jersey*. Washington, D.C.:U.S. Fish and Wildlife Service, 1981.

Stone, W. "The Plants of Southern New Jersey". Annual Report of the New Jersey State Museum for 1910 (1911) Part II.

Sutton, Clay C., and Sutton, Patricia. "The Status and Distribution of the Barred Owl and the Red-shouldered Hawk in Southern New Jersey". *Cassinia*, 61 (1986), 10 -29.

Sutton, Clay C., and Sutton, Patricia. "A Six Year Study of Wintering Eagle Populations and Winter Eagle Habitat in Southern New Jersey". *Cassinia*, 59 (1982), 3-35.

Swinebroad, J. "Edge Effect and Bird Populations in Southern New Jersey". *New Jersey Nature News*, The New Jersey Audubon Society, Vol. XVIII, No. 2 (June 1963), 66-73.

Terborgh, John. *Where Have All the Birds Gone?* Princeton, N.J.: Princeton University Press, 1989.

John S. Truhan Consulting Engineers, Inc. *Environmental Impact Statement for Wyndham Place at Dover*. Manasquan, N.J., 1988. (Photocopied).

U.S. Fish and Wildlife Service. *Swamp Pink (*Helonias bullata*) Recovery Plan*. Newton Corner, MA, 1991.

U.S. Fish and Wildlife Service. *Final Environmental Assessment and Land Protection Plan Proposal to Expand the Boundary of the Edwin B. Forsythe National Wildlife Refuge*. Hadley, MA, 1994.

Van Gelder, G. "The Mammals of New Jersey: A Preliminary Annotated List". New Jersey Audubon Society, Special Publication, 1984.

Zampella, R.A., et al. *A Watershed-Based Wetland Assessment Method for the New Jersey Pinelands*. New Lisbon, N. J.: Pinelands Commission, 1994.

Zampella, R.A.; Craig, L.; and Windisch, M. *Water Quality Characteristics of Ocean County Pineland Streams*. New Lisbon, N.J.: New Jersey Pinelands Commission, 1994.

Zappalorti, Robert T. "The Ecology and Distribution of the Corn Snake (*Elaphe guttata*) in New Jersey, Part I". Unpublished progress report to the NJDEP, Vol 4, 1978.

Zappalorti, Robert T. "An Updated Progress Report on the Distribution and Locality Records of New Jersey's Endangered and Threatened Reptiles and Amphibians". Unpublished report for the NJDEP, ENSP, Vol. 10, Parts 1, 2, 3, 4, 1978-1979.

Zappalorti, Robert T., and Burger, Joanna. "On the Importance of Disturbed Sites to Habitat Selection by Pine Snakes in the Pine Barrens of New Jersey". *Environmental Conservation*, 12(4) (1985), 358-361.

Zappalorti, R.T., and Johnson, E.W. "The Status and Distribution of the Northern Pine Snake (*Pituophis melanoleucus*) in New Jersey". Unpublished Research Report for the NJDEP, 1978.

Zappalorti, R.T., and Johnson, E.W. "The Ecology of the Northern Pine Snake (*Pituophis melanoleucus*) in New Jersey, Part II". Unpublished report to the NJDEP, 1978.

Zappalorti, R.T., and Johnson, E.W. "Additional Updated Locality and Distribution Records of Endangered and Threatened Herptiles in New Jersey, Third Supplement". Unpublished report to the NJDEP, 1980.

Zappalorti, R.T., and Johnson, E.W. "Proposed Management Plans for Endangered and Threatened Amphibians and Reptiles in New Jersey". Unpublished report to the NJDEP, 1981.

Zappalorti, R.T., and Johnson, E.W. "Additional Updated Locality and Distribution Records of Endangered and Threatened Amphibians and Reptiles in New Jersey (Fifth Supplement)". Unpublished report to the NJDEP, 1982.

Zappalorti, R.T., and Reap, P.A. "A Management Plan for Endangered Amphibians and Reptiles on the Jake's Branch Section of the Davenport Basin". Unpublished report to Hovsons, Inc., Toms River, N.J., 1983.

Zappalorti, R.T., and Reap, P.A. "A Mitigation Plan and Additional Notes on the Creswood Interceptor Alignment, Berkeley Township, Ocean County, New Jersey". Unpublished report to Ocean County Utilities Authority, Feb. 13, 1984.

Zinkin, Vivian. Place Names of Ocean County New Jersey 1609 - 1849. Toms River, N.J.: Ocean County Historical Society, 1976.

Legislation and Land Use

A Survey of Laws Regulating Land Use within the Barnegat Bay Watershed

I. Coastal Area Development Review Act (CADRA) (N.J.S.A. 13:19-1 et seq.), formerly known as Coastal Area Facility Review Act (CAFRA)

In 1994, the New Jersey Legislature substantially amended the Coastal Area Facility Review Act (CAFRA) and renamed it the Coastal Area Development Review Act (CADRA). Similar to its predecessor, CADRA authorizes the New Jersey Department of Environmental Protection (DEP) to regulate and approve the location, design and construction of facilities within a 1,400 square-mile coastal region running from Middlesex County to Cape May County, which includes the Barnegat Bay and its tidal tributaries.

A key component of the 1994 amendments provides added protection for sensitive coastal areas while deregulating inland facilities review. In particular, CADRA closes a loophole in the law that allowed residential developments of less than 25 units to be constructed along the coast without state review. This controversial component had been a source of debate among environmentalists, developers and municipal officials for many years.

The crux of the new CADRA amendments allows for regulation of all residential development located within 150 feet of beaches, dunes and the first house or other development within 150 feet of the mean high water line. The construction of an individual single-family or duplex home is regulated under CADRA only if it is on a beach or dune or would be the first house located within 150 feet of beaches, dunes or tidal waters. Even when within the 150 feet, single family and duplex dwellings are not regulated if there is another building located between the proposed dwelling and the beach, dune or tidal water.

II. New Jersey Wetlands Act of 1970 (N.J.S.A. 13:9A-1 et seq.)

The New Jersey Wetlands Act of 1970, in essence, authorizes the state DEP to regulate land use activity within coastal wetlands (salt marshes). Specifically, DEP has jurisdiction over all development, disturbance and modification of mapped coastal wetlands, except for mosquito ditching and traditional agricultural practices, such as the harvest of salt hay. The Act requires DEP to survey, publish and periodically update comprehensive state wetland maps.

III. Waterfront Development Law (N.J.S.A. 12:5-1 et seq.)

The Waterfront Development Law (N.J.S.A. 12:5-1), originally enacted in 1914 and since amended, authorizes the DEP to regulate water related commerce by reviewing land use and development site plans incident to navigable waters and streams of New Jersey. The Waterfront Development Law and the New Jersey Wetlands Act of 1970 work together to minimize adverse impacts of development upon or along the tidal waterways of the state. The Waterfront Development Law and adopted regulations currently cover the construction or alteration of wharves, docks, piers, bulkheads, bridges, pipelines and upland development or redevelopment activities. A public or private development entity seeking to build on a waterfront site must file plans and obtain a Waterfront Development Permit from the DEP. The Wetland Development Law applies to tidal wetlands within CAFRA areas and to both tidal waterways and adjacent uplands outside of CAFRA areas.

IV. Tidelands Management Act and Riparian Lands Statutes (N.J.S.A. 12:3-1 et seq.)

By virtue of several 19th and early 20th century court decisions at the federal and state level, tidal lands (presently or formerly flowed) are owned and managed by the State of New Jersey acting as trustee for the people. Tidelands, or riparian lands, constitute the area below the mean high tide line and include subaqueous lands. Through the series of laws reviewed in this Appendix, including the Waterfront Development Law and CADRA, the State of New Jersey directly regulates land use activities in the tideland zone. Under the Tidelands Management Act, however, the State is empowered to sell, lease, or otherwise convey its interests in tidelands through the Tidelands Resource Council (DEP). The Council is authorized to make decisions regarding the size and value of leases or grants of tidelands to private parties, public, or quasi-public entities. For example, a developer seeking to construct a private pier within a state-mapped tideland area must obtain a lease or grant containing appropriate conditions of use. Funds collected through the Council's leases and grants support a state-administered public education fund.

V. Shore Protection Act (N.J.S.A. 12:6A-1 et seq.)

A state companion to the federal Coastal Zone Management Act, the Shore Protection Act, addresses all types of man-made improvements to the shore, including beach nourishment, stabilization, and protection. The Act calls upon DEP to do extensive planning before dispensing bond funds for such improvements. Regarding capital intensive shoreline projects, DEP has established an extensive set of rules, inclusive of CAFRA or CADRA permits, on which permit decisions are made. As an outgrowth of the Shore Protection Act, DEP has jurisdiction over numerous areas, including shellfish beds, prime fishing grounds, submerged vegetation, navigable channels, submerged infrastructure, borrow pits, dunes, barrier islands, bay islands

and erosion hazard areas. Under the Shore Protection Act and CADRA, DEP policies are extended to cover wetlands, wetland buffers, coastal bluffs, and endangered or threatened coastal flora and fauna.

VI. Pinelands Protection Act (1979) (N.J.S.A. 13:18A-1 et seq.)

The Pinelands Protection Act was enacted by New Jersey in 1979 and was followed by a federal law of 1978, in which Congress established the Pinelands National Reserve. This reserve area of southern New Jersey comprises 1.1 million acres or 23% of the state's lands. Pursuant to the federal initiative, the state Pinelands Protection Act authorizes a 15-member commission to formulate a Comprehensive Management Plan (CMP) for the Pinelands (N.J.A.C. 7:50-1.1 et seq.) and to oversee implementation of the Plan. The Act designates a 337,000-acre inner core of the Pinelands as a Preservation Area, in which natural resources are protected, traditional agriculture (primarily blueberry and cranberry cultivation) is permitted to continue, and development is strictly regulated. The land area surrounding the Preservation Area is designated as a Protection Area, which serves as a natural buffer while allowing for controlled growth. Together, these two areas comprise 937,000 acres.

Adopted in 1980, the CMP divides the Protection Area into subareas which address resource use and management level. These subareas include: forests, agriculture, regional growth, rural development, Pinelands towns and villages, and military and federal institutions. Under the Pinelands Protection Act, all master plans and zoning ordinances of the 52 municipalities, as well as comprehensive plans of the seven counties that lie within the Pinelands Area, must conform to the CMP, thereby providing consistency of land use regulation.

VII. Federal Clean Water Act (1977) (33 U.S.C.A. 1251-1387, including Section 404, relating to permits for dredged or fill material)

The Federal Clean Water Act and Amendments creates a framework for restoring water quality and has given rise to a series of programs for addressing specific water quality issues. One program, the New Jersey Pollution Discharge Elimination System (NJPDDES) allows DEP to regulate all point source discharges through a permit process. A permit is needed, for example, for point source discharges by waste water treatment facilities and by industrial users, detailing such factors as flow rate, maximum flow, and components of flow. The Clean Water Act assures that state standards are met and that dischargers compensate the state according to established effluent (or pollution) schedules. A non-point source pollution control program, addressing such issues as run-off from roads and from agricultural lands, has also been created under Section 319 of the Clean Water Act.

The National Estuary Program is part of this same non-point source pollution program. The National Estuary Program distributes funds that may be applied to management, planning, and protection from non-

point source pollution. During the summer of 1995, the Barnegat Bay and its watershed were named to the National Estuary Program. This program provides up to \$500,000 per year for three years for non-point source pollution research and the development and implementation of a comprehensive management plan.

VIII. Freshwater Wetlands Protection Act (1987) (N.J.S.A. 13:9B-1)

The Freshwater Wetlands Protection Act requires permits for an extensive range of activities in freshwater wetlands. Regulated activities include dredging, excavation or removal of soil, drainage or disturbance of water levels, filling or discharge of any materials, driving of pilings, placing of obstructions, or the destruction of plant life. Guidelines for delineating freshwater wetlands are provided by the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, and the U.S. Soil Conservation Service. Wetlands maps are available through the U.S. Fish and Wildlife Service and through New Jersey DEP.

IX. New Jersey State Planning Act (1986) (N.J.S.A. 52:18A-196)

Largely in response to growth pressures affecting the entire state, the New Jersey Legislature enacted the State Planning Act in 1986. The Act calls for the periodic adoption of a State Development and Redevelopment Plan to manage physical growth, public and private investment and infrastructure decision making. Although the Act specifically exempted the CAFRA / CADRA region from the State Planning Commission's jurisdiction, an effort is currently underway to provide consistency of land use planning and regulatory oversight in the coastal zone. Coastal municipalities, counties, the DEP, Pinelands Commission and State Planning Commission have been considering uniform recognition of planning and growth areas which can be administered under DEP's CADRA regulations.

X. Barnegat Bay Study Act of 1987 (P.L. 1987, Ch. 397)

This law mandated DEP's five year study of the Barnegat Bay and watershed, including the development of a Management Plan for improving the Bay's environmental and commercial values. Among several requirements, the Study Act required DEP to assess the relationship between land development, boat traffic and water quality and to provide recommendations for improved maritime navigability. The Study was funded with state and federal monies available under the Coastal Zone Management Act. A three volume, "Watershed Management Plan for Barnegat Bay" was published by DEP in 1993.

XI. Municipal Land Use Law (1975) (P.L. 1975 , Ch. 291)

The Municipal Land Use Law serves as a statewide enabling statute for all planning and zoning activities by all municipalities in New Jersey.

Defining Endangered and Threatened Species

Different species of flora and fauna of a state have different levels of risk regarding potential depletion and extinction. Biologists have developed conservation categories which track and prioritize individual species. Such information is useful in targeting habitats for conservation - habitats which are of particular significance for a given species. Listing of plant or animal species can be at regional, state, federal, or global levels and can be presented as rankings which incorporate listing at various levels. As conditions warrant, new species may be added to a listing and other species may be withdrawn or de-listed.

The listing and the criteria for listing are different for plants and animals but a general definition of terms is provided in the following excerpt from New Jersey Department of Environmental Protection's Endangered and Threatened Plants and Animals (1982). Species listed in the endangered category are at the highest risk.

Definitions

“1. Endangered - facing extinction because its existence in New Jersey (or elsewhere) is jeopardized by habitat destruction or alteration; excessive exploitation; predation or disease; or other factors, natural or human.

2. Threatened - likely to become endangered in New Jersey if certain specific conditions are not met in the near future and if present deteriorating trends continue.

3. Special Concern - likely to become endangered or threatened because of possible future factors. Should be monitored because:

- a. they exist in small populations or in a very few populations
 - or
 - b. they are targeted for possible threatening exploitation
 - or
 - c. they have exhibited a continuing decline in abundance in recent times
 - or
 - d. they are excessively vulnerable to specific pressures”
- (Cromartie, 1982).

The Natural Heritage Program of the Department of Environmental Protection, located in Trenton, New Jersey, is responsible for maintaining a statewide inventory of rare plants and animals as well as of the state's most significant natural areas. The Natural Heritage Program's database draws on information from numerous sources, including the New Jersey Endangered and Nongame Species Program, the New Jersey Office of Natural Lands Management, nonprofit conservation organizations (such as The Nature Conservancy and New Jersey Audubon Society), and independent research biologists and environmental consulting firms (such as Herpetological Associates, Inc.).

List of Scientific Names of Species

Birds

Common Name	Scientific Name
American Bittern	<i>Botaurus lentiginosus</i>
American Crow	<i>Corvus brachyrhynchos</i>
American Kestrel	<i>Falco sparverius</i>
American Robin	<i>Turdus migratorius</i>
American Wigeon	<i>Anas americana</i>
Bald Eagle	<i>Haliaeetus leucocephalus</i>
Barred Owl	<i>Strix varia</i>
Belted Kingfisher	<i>Megaceryle alcyon</i>
Black and White Warbler	<i>Mniotilta varia</i>
Black Duck	<i>Anas rubripes</i>
Black Skimmer	<i>Rynchops niger</i>
Black-bellied Plover	<i>Pluvialis squatarola</i>
Black-capped Chickadee	<i>Parus atricapillus</i>
Black-crowned Night Heron	<i>Nycticorax nycticorax</i>
Black-throated Blue Warbler	<i>Dendroica caerulescens</i>
Blue Jay	<i>Cyanositta cristata</i>
Blue-winged Teal	<i>Anas discors</i>
Bobolink	<i>Dolichonyx oryzivorus</i>
Bobwhite	<i>Colinus virginianus</i>
Brown Thrasher	<i>Toxostoma rufum</i>
Bufflehead	<i>Bucephala albeola</i>
Canada Goose	<i>Branta canadensis</i>
Canvasback	<i>Aythya valisineria</i>
Carolina Chickadee	<i>Parus carolinensis</i>
Carolina Wren	<i>Thryothorus ludovicianus</i>
Clapper Rail	<i>Rallus longirostris</i>
Common Flicker	<i>Colaptes auratus</i>
Common Goldeneye	<i>Bucephala clangula</i>
Common Loon	<i>Gavia immer</i>
Common Merganser	<i>Mergus merganser</i>
Common Nighthawk	<i>Chordeiles minor</i>
Common Tern	<i>Sterna hirundo</i>
Common Yellowthroat	<i>Geothlypis trichas</i>
Cooper's Hawk	<i>Accipiter cooperii</i>
Double-crested Cormorant	<i>Phalacrocorax auritus</i>
Downy Woodpecker	<i>Picoides pubescens</i>
Eastern Bluebird	<i>Sialia sialis</i>

Eastern Meadowlark	<i>Sturnella magna</i>
Eastern Phoebe	<i>Sayornis phoebe</i>
Fish Crow	<i>Corvus ossifragus</i>
Forster's Tern	<i>Sterna forsteri</i>
Glossy Ibis	<i>Plegadis falcinellus</i>
Golden-crowned Kinglet	<i>Regulus satrapa</i>
Grasshopper Sparrow	<i>Ammodramus savannarum</i>
Great Blue Heron	<i>Ardea herodias</i>
Great Egret	<i>Casmerodius albus</i>
Great Horned Owl	<i>Bubo virginianus</i>
Greater Black-backed Gull	<i>Larus marinus</i>
Greater Yellowlegs	<i>Tringa melanoleuca</i>
Henslow's Sparrow	<i>Ammodramus henslowii</i>
Herring Gull	<i>Larus argentatus</i>
Horned Lark	<i>Eremophila alpestris</i>
House Finch	<i>Carpodacus mexicanus</i>
House Wren	<i>Troglodytes troglodytes</i>
Hudsonian Godwit	<i>Limosa haemastica</i>
Killdeer	<i>Charadrius vociferous</i>
Lapland Longspur	<i>Calcarius lapponicus</i>
Least Tern	<i>Sterna antillarum</i>
Little Blue Heron	<i>Florida caerulea</i>
Long-billed Marsh Wren	<i>Cistothorus palustris</i>
Mallard	<i>Anas platyrhynchos</i>
Mute Swan	<i>Cygnus olor</i>
Northern Cardinal	<i>Cardinalis cardinalis</i>
Northern Harrier	<i>Circus cyaneus</i>
Northern Mockingbird	<i>Mimus polyglottos</i>
Osprey	<i>Pandion haliaetus</i>
Pectoral Sandpiper	<i>Calidris melanotos</i>
Peregrine Falcon	<i>Falco peregrinus</i>
Pileated Woodpecker	<i>Dryocopus pileatus</i>
Pine Warbler	<i>Dendroica pinus</i>
Piping Plover	<i>Charadrius melodus</i>
Purple Finch	<i>Carpodacus purpureus</i>
Red-bellied Woodpecker	<i>Melanerpes carolinus</i>
Red-headed Woodpecker	<i>Melanerpes erythrocephalus</i>
Red-shouldered Hawk	<i>Buteo lineatus</i>
Red-tailed Hawk	<i>Buteo jamaicensis</i>
Red-winged Blackbird	<i>Agelaius phoeniceus</i>

Ring-billed Gull	<i>Larus delawarensis</i>
Ring-necked Pheasant	<i>Phasianus colchicus</i>
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>
Ruby Throated Hummingbird	<i>Archilocus colubris</i>
Ruddy Turnstone	<i>Arenaria interpres</i>
Ruffed Grouse	<i>Bonasa umbellus</i>
Rufous-sided Towhee	<i>Pipilo erythrophthalmus</i>
Sanderling	<i>Calidris alba</i>
Savannah Sparrow	<i>Passerculus sandwichensis</i>
Saw-whet Owl	<i>Aegolius acadicus</i>
Seaside Sparrow	<i>Ammospiza maritima</i>
Semi-palmated Sandpiper	<i>Calidris pusilla</i>
Sharp-tailed Sparrow	<i>Ammospiza caudacuta</i>
Short-billed Marsh Wren	<i>Cistothorus platensis</i>
Short-eared Owl	<i>Asio flammeus</i>
Snow Bunting	<i>Plectrophenax nivalis</i>
Snowy Egret	<i>Egretta thula</i>
Song Sparrow	<i>Melospiza melodia</i>
Spotted Sandpiper	<i>Actitis macularia</i>
Swainson's Thrush	<i>Catharus ustulatus</i>
Upland Sandpiper	<i>Bartramia longicauda</i>
Vesper Sparrow	<i>Poocetes gramineus</i>
Whip-poor-will	<i>Caprimulgus vociferus</i>
White Throated Sparrow	<i>Zonotrichia albicollis</i>
Wild Turkey	<i>Meleagris gallopavo</i>
Willet	<i>Catoptrophorus</i> <i>semipalmatus</i>
Wood Duck	<i>Aix sponsa</i>
Yellow Rumped Warbler	<i>Dendroica coronata</i>

Reptiles and Amphibians

Common Name	Scientific Name
Black Racer	<i>Coluber constrictor</i>
Coastal Plain Milksnake	<i>Lampropeltis triangulum X</i> <i>elapsoides</i>
Common Snapping Turtle	<i>Chelydra serpentina</i>
Corn Snake	<i>Elaphe guttata</i>
Eastern Box Turtle	<i>Terrapene carolina carolina</i>
Eastern Hognose Snake	<i>Heterodon platyrhinos</i>
Eastern Kingsnake	<i>Lampropeltis getulus</i>

Eastern Painted Turtle	<i>Chrysemys picta</i>
Eastern Spadefoot Toad	<i>Scaphiopus holbrooki hurteri</i>
Four-Toed Salamander	<i>Hemidactylium scutatum</i>
Fowler's Toad	<i>Bufo woodhousei fowleri</i>
Green Frog	<i>Rana clamitans melanota</i>
Marbled Salamander	<i>Ambystoma opacum</i>
Northern Diamondback	
Terrapin	<i>Malaclemys terrapin</i>
Northern Fence Lizard	<i>Sceloporus undulatus</i>
Northern Pine Snake	<i>Pituophis melanoleucus</i>
Northern Ringneck Snake	<i>Diadelpphis punctatus</i>
Pine Barrens Treefrog	<i>Hyla andersoni</i>
Red-bellied Turtle	<i>Chrysemys rubriventris</i>
Southern Leopard Frog	<i>Rana utricularia</i>
Spring Peeper	<i>Hyla crucifer</i>
Tiger Salamander	<i>Ambystoma tigrinum</i>
	<i>tigrinum</i>
Timber Rattlesnake	<i>Crotalus horridus horridus</i>

Mammals

Common Name	Scientific Name
Beaver	<i>Castor canadensis</i>
Bobcat	<i>Lynx rufus</i>
Domestic Dog	<i>Canis familiaris</i>
Eastern Cottontail	<i>Sylvilagus floridanus</i>
Eastern Gray Squirrel	<i>Sciurus carolinensis</i>
Eastern Mountain Lion	<i>Felis concolor</i>
Gray Fox	<i>Urocyon cinereoargenteus</i>
Long-tailed Weasel	<i>Mustela frenata</i>
Meadow Vole	<i>Microtus pennsylvanicus</i>
Muskrat	<i>Ondatra zibethica</i>
Opossum	<i>Didelphis marsupialis</i>
Raccoon	<i>Procyon lotor</i>
Red Fox	<i>Vulpes fulva</i>
River Otter	<i>Lutra canadensis</i>
Striped Skunk	<i>Mephitis mephitis</i>
White-footed Mouse	<i>Peromyscus leucopus</i>
White-tailed Deer	<i>Odocoileus virginianus</i>
Wolf	<i>Canis lupus</i>
Woodchuck	<i>Marmota monax</i>

Insects

Common Name	Scientific Name
Bumblebee	Family Apidae
Honeybee	<i>Apis mellifera</i>
Monarch	<i>Danaus plexippus</i>
Mourning Cloak	<i>Nymphalis antiopa</i>
Orange Sulphur	<i>Colias eurytheme</i>
Red Admiral	<i>Vanessa atalanta</i>
Spider Wasp	Family Pompilida
Spring Azure	<i>Celastrina ladon</i>
Syrphid Fly	Family Syrphidae

Invertebrates (Marine)

Common Name	Scientific Name
Atlantic Horseshoe Crab	<i>Limulus polyphemus</i>
Blue Crab	<i>Callinectes sapidus</i>

Fishes

Common Name	Scientific Name
Bay Anchovy	<i>Anchoa mitchilli</i>
Black Sea Bass	<i>Centropristes striatus</i>
Bluefish	<i>Pomatomus saltatrix</i>
Common Killifish	<i>Fundulus heteroclitus</i>
Striped bass	<i>Morone saxatilis</i>
Summer Flounder (Fluke)	<i>Paralichthys dentatus</i>
White Perch	<i>Morone americana</i>
Winter Flounder	<i>Pseudopleuronectes americanus</i>

Trees

Common Name	Scientific Name
American Holly	<i>Ilex opaca</i>
Atlantic White Cedar	<i>Chamaecyparis thyoides</i>
Bear Oak	<i>Quercus ilicifolia</i>
Black Cherry	<i>Prunus serotina</i>
Black Gum	<i>Nyssa sylvatica</i>
Black Locust	<i>Robinia pseudoacacia</i>

Black Oak	<i>Quercus velutina</i>
Black Walnut	<i>Juglans nigra</i>
Black Willow	<i>Salix nigra</i>
Blackjack Oak	<i>Quercus marilandica</i>
Chestnut Oak	<i>Quercus prinus</i>
Eastern Red Cedar	<i>Juniperus virginiana</i>
Grey Birch	<i>Betula populifolia</i>
Norway Maple	<i>Acer platanoides</i>
Norway Spruce	<i>Picea abies</i>
Pignut Hickory	<i>Carya glabra</i>
Pitch Pine	<i>Pinus rigida</i>
Post Oak	<i>Quercus stellata</i>
Red Maple	<i>Acer rubrum</i>
Red Oak	<i>Quercus rubra</i>
Sassafras	<i>Sassafras albidum</i>
Scarlet Oak	<i>Quercus coccinea</i>
Scrub Oak	<i>Quercus ilicifolia</i>
Shagbark Hickory	<i>Carya ovata</i>
Shortleaf Pine	<i>Pinus echinata</i>
Sour Gum	<i>Nyssa sylvatica</i>
Spanish Oak	<i>Quercus falcata</i>
Sugar Maple	<i>Acer saccharum</i>
Sweet Gum	<i>Liquidambar styraciflua</i>
Trident Maple	<i>Acer rubrum</i> var. <i>trilobus</i>
White Ash	<i>Fraxinus americana</i>
White Oak	<i>Quercus alba</i>
White Pine	<i>Pinus stroba</i>
Willow Oak	<i>Quercus phellos</i>
Yellow Birch	<i>Betula lutea</i>

Shrubs and Vines

Common Name	Scientific Name
Alder	<i>Alnus</i> sp.
American Bittersweet	<i>Celastrus scandens</i>
Beautyberry	<i>Callicarpa americana</i>
Black Cherry	<i>Prunus serotina</i>
Black Chokeberry	<i>Pyrus melanocarpa</i>
Black Huckleberry	<i>Gaylussacia baccata</i>
Brambles	<i>Rubus</i> sp.
Clammy Azalea	<i>Rhododendron viscosum</i>

Coastal Pepperbush	<i>Clethra alnifolia</i>
Common Highbush Blueberry	<i>Vaccinium corymbosum</i>
Dangleberry	<i>Gaylussacia frondosa</i>
Fetterbush	<i>Leucothoe racemosa</i>
Gooseberry	<i>Ribes</i> sp.
Greenbrier	<i>Smilax rotundifolia</i>
Groundsel Tree	<i>Baccharis halmifolia</i>
Highbush Blueberry	<i>Vaccinium corymbosum</i>
Inkberry	<i>Ilex glabra</i>
Juneberry	<i>Amelanchier</i> sp.
Late Low Blueberry	<i>Vaccinium angustifolium</i>
Leatherleaf	<i>Chamaedaphne calyculata</i>
Low Gallberry	<i>Ilex glabra</i>
Marsh Elder	<i>Iva frutescens</i>
Mountain Laurel	<i>Kalmia latifolia</i>
Northern Arrowwood	<i>Viburnum recognitum</i>
Northern Bayberry	<i>Myrica pensylvanica</i>
Osage-orange	<i>Maclura pomifera</i>
Persimmon	<i>Diosypros virginiana</i>
Poison ivy	<i>Rhus radicans</i>
Red-osier dogwood	<i>Cornus stolonifera</i>
Sheep Laurel	<i>Kalmia angustifolia</i>
Smooth Alder	<i>Alnus serrulata</i>
Spice Bush	<i>Lindera benzoin</i>
Staggerbush	<i>Lyonia mariana</i>
Staghorn Sumac	<i>Rhus typhina</i>
Swamp Azalea	<i>Rhododendron viscosum</i>
Swamp Blackberry	<i>Rubus hispidus</i>
Sweet Pepperbush	<i>Clethra alnifolia</i>
Sweetbay Magnolia	<i>Magnolia virginiana</i>
Tree-of-Heaven	<i>Ailanthus altissima</i>
Virginia Creeper	<i>Parthenocissus quinquefolia</i>
Winged Sumac	<i>Rhus copallina</i>
Wisteria	<i>Wisteria</i> sp.

Wildflowers and Herbs

Common Name	Scientific Name
Arrow Arum	<i>Peltandra virginica</i>
Arrow-leaf Tearthumb	<i>Polygonum sagittatum</i>
Beach Heath	<i>Hudsonia tomentosa</i>

Blueflag Iris	<i>Iris versicolor</i>
Bog Asphodel	<i>Nartheceium americanum</i>
Bur-reed	<i>Sparganium</i> sp.
Bushy Aster	<i>Aster dumosus</i>
Calico Aster	<i>Aster lateriflorus</i>
Canada Goldenrod	<i>Solidago canadensis</i>
Common Cattail	<i>Typha latifolia</i>
Common Milkweed	<i>Asclepias syriaca</i>
Compact Dodder	<i>Cuscuta compacta</i>
Cranberry	<i>Vaccinium</i> sp.
Crane-fly Orchid	<i>Tripularia discolor</i>
Crested Yellow Orchid	<i>Platanthera cristata</i>
Dragon Mouth Orchid	<i>Arethusa bulbosa</i>
Elliott's Goldenrod	<i>Solidago elliotii</i>
Field Garlic	<i>Allium vineale</i>
Fragrant Ladies' Tresses	<i>Spiranthes odorata</i>
Golden Crest	<i>Lophiola americana</i>
Golden Heather	<i>Hudsonia ericoides</i>
Grass Leaved Goldenrod	<i>Solidago graminifolia</i>
Grass Pink	<i>Calopogon pulchellus</i>
Indian Pipe	<i>Monotropa uniflora</i>
Marsh Rattlesnake Master	<i>Eryngium yuccifolium</i>
Mountain Mint	<i>Pycnanthemum</i> sp.
Mudbank Paspalum	<i>Paspalum dissectum</i>
Mugwort	<i>Artemisia vulgaris</i>
Partridge-berry	<i>Mitchella repens</i>
Perennial Salt Marsh Aster	<i>Aster tenuifolius</i>
Pickering's Morning-Glory	<i>Stylisma pickeringii</i>
Pine Barrens Bellwort	<i>Uvularia puberula</i> (var. <i>nitida</i>)
Pine Barrens Boneset	<i>Eupatorium resinosum</i>
Pine Barrens Gentian	<i>Gentiana autumnalis</i>
Pink Lady's Slippers	<i>Cypripedium acaule</i>
Pitcher Plant	<i>Sarracenia purpurea</i>
Prickly Pear	<i>Opuntia humifusa</i>
Purple Bladderwort	<i>Utricularia purpurea</i>
Pyxie	<i>Pyxidantha barbulata</i>
Queen Anne's Lace	<i>Daucus carota</i>
Rose Pogonia	<i>Pogonia ophioglossoides</i>
Round-head Bush-clover	<i>Lespedeza capitata</i>

Round-leaved Sundew	<i>Drosera rotundifolia</i>
Salt Marsh Fleabane	<i>Pluchea purpurascens</i>
Sand Jointweed	<i>Polygonella articulata</i>
Sea Lavender	<i>Limonium nashii</i>
Sea Pink	<i>Sabatia stellaris</i>
Seaside Goldenrod	<i>Solidago sempervirens</i>
Sickle-leaved Golden Aster	<i>Chrysopsis falcata</i>
Slender Glasswort	<i>Salicornia europaea</i>
Slender Marsh Pink	<i>Sabatia campanulata</i>
Southern Twayblade Orchid	<i>Listera australis</i>
Spatulate-leaved Sundew	<i>Drosera intermedia</i>
Spotted Knapweed	<i>Centaurea maculosa</i>
Star Flower	<i>Trientalis borealis</i>
Stiff Aster	<i>Aster linariifolius</i>
Strawberry	<i>Fragaria</i> sp.
Striped Wintergreen	<i>Chimaphila maculata</i>
Swamp Pink	<i>Helonias bullata</i>
Swamp Rose	<i>Rosa palustris</i>
Turkey Beard	<i>Xerophyllum asphodeloides</i>
Wandlike Goldenrod	<i>Solidago stricta</i>
White Panicked Aster	<i>Aster simplex</i>
Winterberry	<i>Ilex verticillata</i>
Wintergreen	<i>Gaultheria procumbens</i>
Wood Anemone	<i>Anemone cinquefolia</i>
Wood Violets	<i>Viola</i> sp.

Grasses/Rushes/Sedges

Common Name	Scientific Name
Atlantic Manna Grass	<i>Glycera obtusa</i>
Barratt's Sedge	<i>Carex barrattii</i>
Bayonet Rush	<i>Juncus militaris</i>
Beard Grass	<i>Andropogon gerardi</i>
Broom Sedge	<i>Andropogon virginicus</i>
Bushy Broom Sedge	<i>Andropogon virginicus</i> var. <i>abbreviatus</i>
Button Sedge	<i>Carex bullata</i>
Common Reed	<i>Phragmites australis</i>
Common Woodreed	<i>Cinna arundinacea</i>
Cotton Grass	<i>Eriophorum virginicum</i>

Eel Grass	<i>Zostera maritima</i>
Giant Reed	<i>Phragmites communis</i>
Knieskern's Beaked Rush	<i>Rhynchospora knieskernii</i>
Little Bluestem	<i>Schizachyrium scoparium</i>
Livid Sedge	<i>Carex livida</i>
New Jersey Rush	<i>Juncus caesariensis</i>
Pale Beaked Rush	<i>Rhynchospora pallida</i>
Path Rush	<i>Juncus tenuis</i>
Pine Barren Reedgrass	<i>Calamovilfa brevipilis</i>
Pine Barren Smoke Grass	<i>Muhlenbergia torreyana</i>
Redtop	<i>Agrostis gigantea</i>
Salt Marsh Cord Grass	<i>Spartina alterniflora</i>
Salt Marsh Hay Grass	<i>Spartina patens</i>
Seashore Saltgrass	<i>Distichilis spicata</i>
Slender Nut Rush	<i>Scleria minor</i>
Soft Rush	<i>Juncus effusus</i>
Spike-rush	<i>Eleocharis sp.</i>
Switch Grass	<i>Panicum virgatum</i>
Three-square Bulrush	<i>Scirpus pungens</i>
Tussock Sedge	<i>Carex stricta</i>
Widgeon Grass	<i>Rupia maritima</i>
Wild Flax	<i>Linum sp.</i>
Wool Grass	<i>Scirpus cyperinus</i>

Ferns, Club Mosses, and Mosses

Common Name	Scientific Name
Bog Clubmoss	<i>Lycopodium inundatum</i>
Bracken Fern	<i>Pteridium aquilinum</i>
Cinnamon Fern	<i>Osmunda cinnamomea</i>
Curly Grass Fern	<i>Schizaea pusilla</i>
Netted Chain Fern	<i>Woodwardia areolata</i>
Royal Fern	<i>Osmunda regalis</i>
Running Pine	<i>Lycopodium complanatum</i>
Sensitive Fern	<i>Onoclea sensibilis</i>
Sphagnum Moss	<i>Sphagnum sp.</i>

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Authors and Sources (Where Obtainable) for Quotations in The Century Plan:

Philip Conkling, *Islands in Time*, 7

John Hay, *The Undiscovered Country*, 80

Aldo Leopold, *A Sand County Almanac*, 117

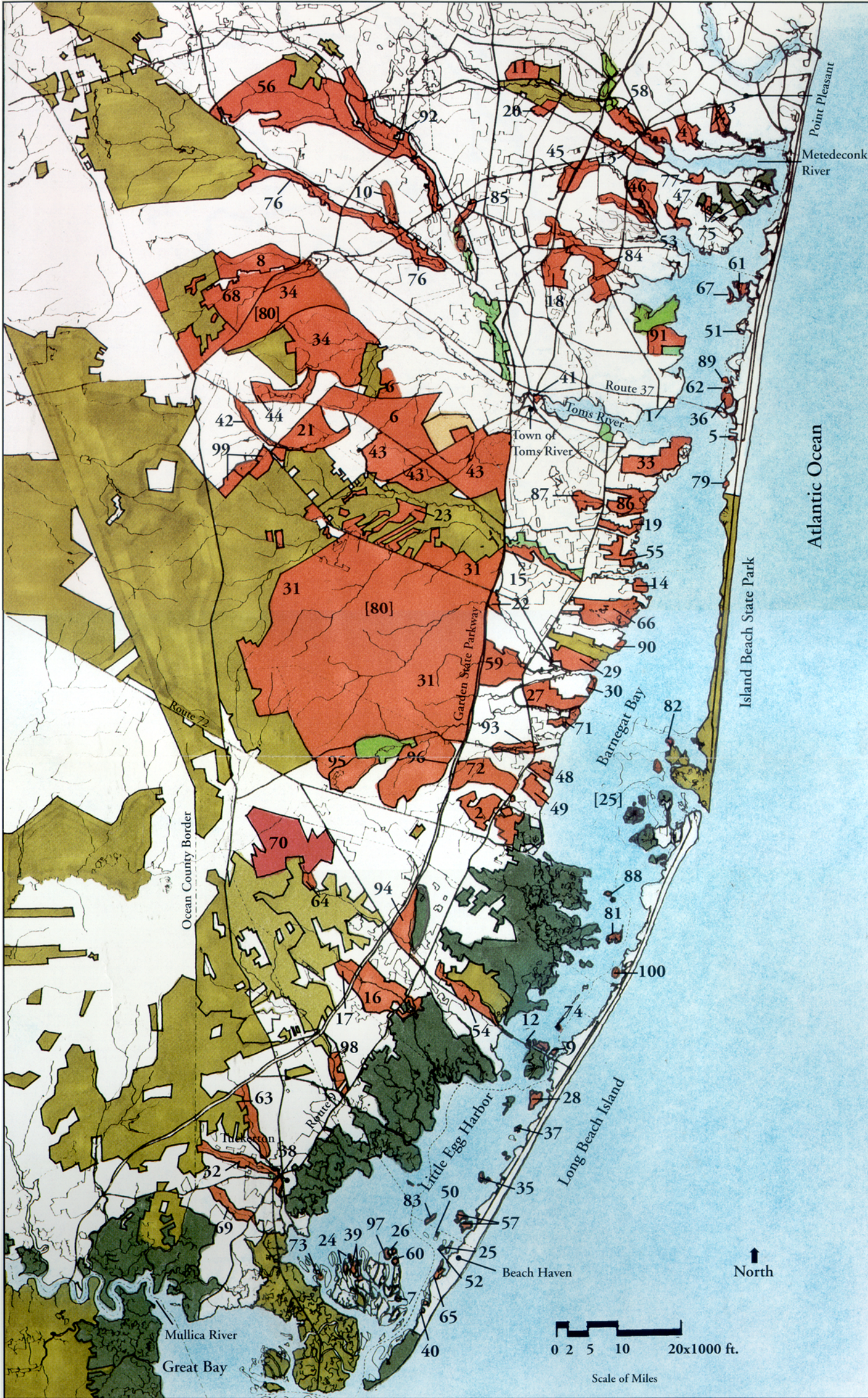
John Muir, *John of the Mountains*, 1

Wallace Stegner, *The Wilderness Idea*, 7

Edward Weeks, 34

The Century Plan

TPL's One Hundred Conservation Sites in the Barnegat Bay Watershed



Century Plan Sites

(I) = Islands
 (CNS) = Coastal/Near Shore
 (P) = Pinelands
 (RR) = Recreation/Restoration
 [#] = indicate a general area and not a specific location.

1. Anchor Reef Marina (RR)
2. Barnegat Bay Beach Inland Area (CNS)
3. Beaver Dam Creek/North Branch (CNS)
4. Beaver Dam Creek/South Branch (CNS)
5. Berkeley Harbor Marina (RR)
6. Berkeley Triangle (P)
7. Black Whale Sedge (I)
8. Blacks and Ruckels Branches (P)
9. Bonnet Island (I)
10. Cabin Branch (P)
11. Cabinfield Branch (P)
12. Cedar Bonnet Island (I)
13. Cedar Bridge Branch (CNS)
14. Cedar Creek Point/Lanoka Harbor (CNS)
15. Cedar Creek South (CNS)
16. Cedar Run Creek/East of Parkway (CNS)
17. Cedar Run Creek/Northwest Extension (CNS)
18. Church Road Property (CNS)
19. Clamming Creek (CNS)
20. Cotterals Branch (P)
21. Davenport Branch West (P)
22. Deer Head Lake North (P)
23. Double Trouble State Park Out Parcels (P)
24. Drag Sedge and Hester Sedge (I)
25. Dredge Spoil Islands (RR)
26. East Sedge (I)
27. Finninger Farm (CNS)
28. Flat Island and Islets (I)
29. Forked River Annex and Adjacent Uplands (CNS)
30. Forked River Beach (CNS)
31. Forked River Mountains and Vicinity (P)
32. Giffords Mill Branch (P)
33. Good Luck Point (CNS)
34. Green, Big Wrangle, and Run Branches (P)
35. Ham Island and Islets (I)
36. Harbor Island (with Al's Island) (I)
37. High Island (I)
38. Historic Seaport Project (RR)
39. Hither Island (I)
40. Holgate Marshes (CNS)
41. Huddy Park/Proposed Expansion (RR)
42. Irish Branch (P)
43. Jake's Branch Corridor (P)
44. Keswick Lake Corridor (P)
45. Kettle Creek/Green Branch (CNS)
46. Kettle Creek North (CNS)
47. Kettle Creek Peninsula (Chamberlain Point) (CNS)
48. Liberty Harbor (CNS)
49. Lighthouse Camp and Bowker Property (CNS)
50. Little Island (I)
51. Little Sedge Island (I)
52. Lower Little Island (Post Island) (I)
53. Mallard Point (CNS)
54. Manahawkin Baptist Church Tract (CNS)
55. Maple Creek (CNS)
56. Maple Root Branch and Long Brook (P)
57. Marsh-Elder Islands (I)
58. Metedeconk River/Forge Pond (CNS)
59. Middle Branch/Forked River (CNS)
60. Middle Sedge (I)
61. Middle Sedge Island (I)
62. Mike's Island with Bill's and Wilde's Islands (I)
63. Mill Branch/Tuckerton Creek (P)
64. Mill Creek West (P)
65. Mordecai Island (I)
66. Murray Grove/Stouts Creek (CNS)
67. Northwest Point Island (I)
68. Old Hurricane Brook (P)
69. Otis Bogs/Willis Creek (Tuckers Creek) (P)
70. Oxly Tract (P)
71. Oyster Creek/Sands Point Harbor (CNS)
72. Pancoast Inland Area (CNS)
73. Parkers Island (I)
74. Pettit Island (I)
75. Reedy Creek Additions (CNS)
76. Ridgeway Branch (P)
77. Riverside Woods (CNS)
78. Riverwood Park Extensions (P)
79. Roberts Avenue Marsh (CNS)
80. Sand and Gravel Mining Sites (RR)
81. Sandy Island (I)
82. Sedge Island (I)
83. Shelter Island (I)
84. Silver Bay Westward Extensions (CNS)
85. Slab Branch (P)
86. Sloop Creek Road Area (CNS)
87. Sloop Creek Western Extension (CNS)
88. Sloop Sedge and Islet (I)
89. Stooling Point Island (I)
90. Sunrise Beach (CNS)
91. Tilton Point (CNS)
92. Toms River/Dove Mill Branch (P)
93. Waretown Creek (P)
94. Waterford (CNS)
95. Wells Mills Girl and Boy Scout Camps (P)
96. Wells Mills Park - Area 'E' (P)
97. West Sedge (I)
98. Westcunk Creek (P)
99. Whiting Clay Pits (P)
100. Woods Island (I)

Please note: The sites are listed in alphabetical order. The order of site listing does not, in any fashion, constitute a ranking. The categories of Coastal Near Shore Sites (CNS) and Pinelands (P) often overlap and intergrade. A specific listing may therefore be arbitrary. Recreation/Restoration Sites (RR) may occur on islands, in coastal near shore areas and in the pinelands.

- Federally-owned Land
- State-owned Land
- County-owned Land
- Municipally-owned Land
- Nonprofit-owned Land
- Century Plan Sites
- Century Plan Sites (already protected)