

Oswego River Natural Area Management Plan

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Introduction

This management plan for the Oswego River Natural Area describes the resource features which this site contains and prescribes uses and practices that will be allowed and implemented to maintain and, if practicable, enhance these features and achieve the management objective for the area. The management objective is the goal towards which management is directed.

The Natural Areas System is established and administered pursuant to N.J.S.A. 13:1B-15.4 et seq. and N.J.S.A. 13:1B-15.12a et seq. A "Natural Area" is defined as "an area of land or water, owned in fee simple or as a conservation easement by the Department, which has retained its natural character, although not necessarily completely undisturbed, or having rare or vanishing species of plant or animal life, or having similar features of interest, which are worthy of preservation for present and future residents of the State" (N.J.A.C. 7:5A-1.3).

Oswego River Natural Area lies within Washington and Bass River Townships, Burlington County, and is part of the Outer Coastal Plain physiographic province of New Jersey. The natural area is located within Wharton State Forest. Figure 1 shows the general location of the natural area. The boundary of the natural area is indicated in Figure 2.

Boyd (1991) describes the history of the area. The old town of Martha was previously the site of the Oswego sawmill which had been in operation since 1741. In 1793 Isaac Potts built his bog-iron furnace, which he named for his wife Martha. Following a series of owners, the property came into the hands of Joseph Ball and Samuel Richards in 1808. By this time, Martha consisted of a furnace with requisite buildings, stamping mill, blacksmith shop, sawmill, gristmill, store, school, hospital, an owner's or ironmaster's home, a work force of about 60 hands, about 50 dwellings for 400 persons, and encompassed about 30,000 acres of land. Much of the pig iron produced at Martha was shipped downstream to the Wading River Forge and Slitting Mill as there was no forge at Martha. Other than pig iron, major products were cast stoves, fire backs, sash weights, kettles, and hollow ware. The furnace prospered until the fires were extinguished in 1844 or 1845, after which the site was used for the production of charcoal until 1848. A small sawmill continued to operate until at least 1860. The property was then sold to Francis Chetwood, a real estate speculator. Based on a proposed new railroad, Mr. Chetwood promoted a realty scheme to sell lots just north of Martha in a town to be called Chetwood, but neither the railroad nor the town was ever built. Joseph Wharton purchased the property in 1896. The property that has come to be known as Oswego River Natural Area was acquired by the State through the original acquisition from the Joseph Wharton estate in 1954 (Bisbee and Colesar 1976). In 1978 the Oswego River Natural Area was designated to the Natural Areas System. In 1993 the Oswego River Natural Area was expanded from 640 acres to its current 1,927 acres primarily to include populations of several endangered plant and animal species.

The management objective for this natural area under N.J.A.C. 7:5A-1.13(a)27ii includes "preservation of hardwood swamp, pitch pine lowland, pine-oak, Atlantic white cedar, and bog communities, which serve as rare species habitat." N.J.A.C. 7:5A-1.8 also

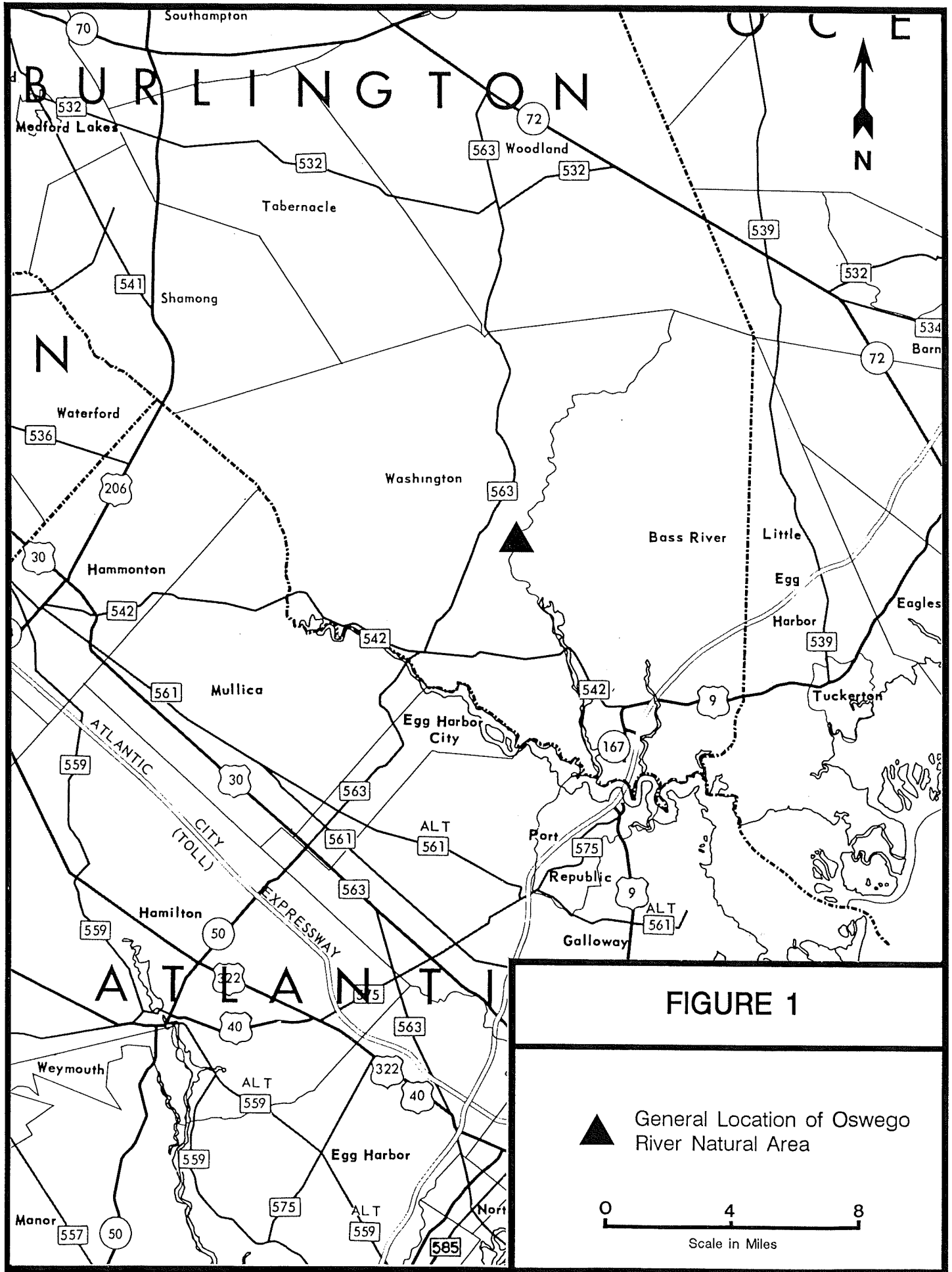
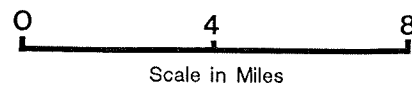


FIGURE 1



General Location of Oswego River Natural Area



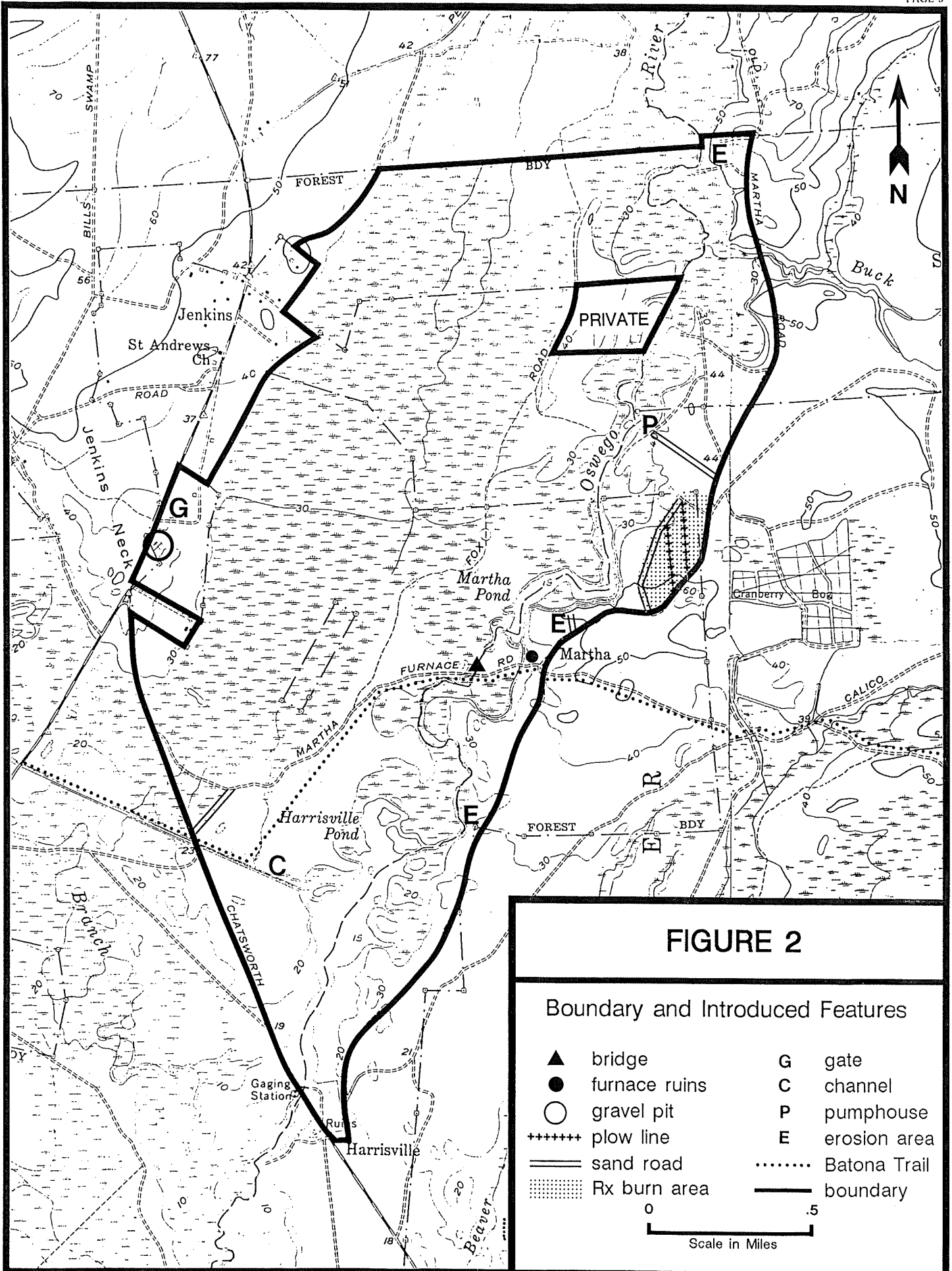


FIGURE 2

Boundary and Introduced Features

- | | | | |
|-------|---------------|-------|--------------|
| ▲ | bridge | G | gate |
| ● | furnace ruins | C | channel |
| ○ | gravel pit | P | pumphouse |
| +++++ | plow line | E | erosion area |
| ==== | sand road | | Batona Trail |
| ▨ | Rx burn area | — | boundary |

0 0.5
Scale in Miles

mandates the preparation of this management plan.

The Division of Parks and Forestry, through Wharton State Forest, serves as the administering agency, being responsible for implementing policy and, after consultation with other Divisions, organizations and individuals, making land management decisions affecting Oswego River Natural Area. Wharton State Forest shall implement the management policies necessary to achieve the management objective of this plan.

The Office of Natural Lands Management (ONLM) is responsible for overall administration of the Natural Areas System, promulgation and revision of rules governing System lands, and preparation of management plans. The ONLM also periodically monitors implementation of the management techniques outlined in management plans, and may propose amendments to plans as needed.

Description and Management Concerns

Geology and Soils

The area consists geologically of Tertiary Cohansey Sand which is chiefly quartz sand with local beds of clay and gravel (Geologic Map of NJ 1910-1912).

The predominant soil association within the natural area is Atsion-Muck-Alluvial land, sand with the Lakehurst-Lakewood-Evesboro association also represented. The muck, shallow soil series characterizes a majority of the natural area. Other representative soil series include alluvial sand, Atsion sand, Lakehurst sand, Lakehurst-Lakewood sand, Lakewood sand, and urban land (sandy) (U.S. Department of Agriculture 1971). Of these soils, muck, alluvial land, Atsion sand, and Lakehurst sand are considered hydric in New Jersey.

Topography and Surface Hydrology

Oswego River Natural Area lies within the Outer Coastal Plain physiographic province (Wolfe 1977). The elevation ranges from 10 to 60 feet with 40 foot bluffs along a portion of the southern bank of the Oswego River.

The natural area is part of the Atlantic Coastal Basin and is within the Wading River Watershed. The Oswego River flows north to south through the natural area roughly paralleling the eastern boundary. Martha Pond, a widened portion of the Oswego River, is a remnant of a much larger pond, created when the stream was dammed to provide power for the iron furnace bellows at Martha (Fikslin and Montgomery 1971).

Biotic Communities

The community classifications and Figure 3 were derived from analysis conducted by Andropogon Associates, for the New Jersey Pinelands Commission, on aerial photography dated November 1978 and March 1978 (Sauer et. al. 1980), information obtained from Breden (1989), and field examination by the author on July 22 and 28, 1992. Figure 3 indicates only general locations and approximate boundaries for the various community types. Animal species likely to be found in the natural area were derived from noted sources or from the Department's Natural Heritage Database based on the suitability of the habitat to support these species. The lists of animals are included to generally characterize those animals that may be found in the various habitats. The Database search was conducted in January 1993.

Pitch Pine Lowland Forest

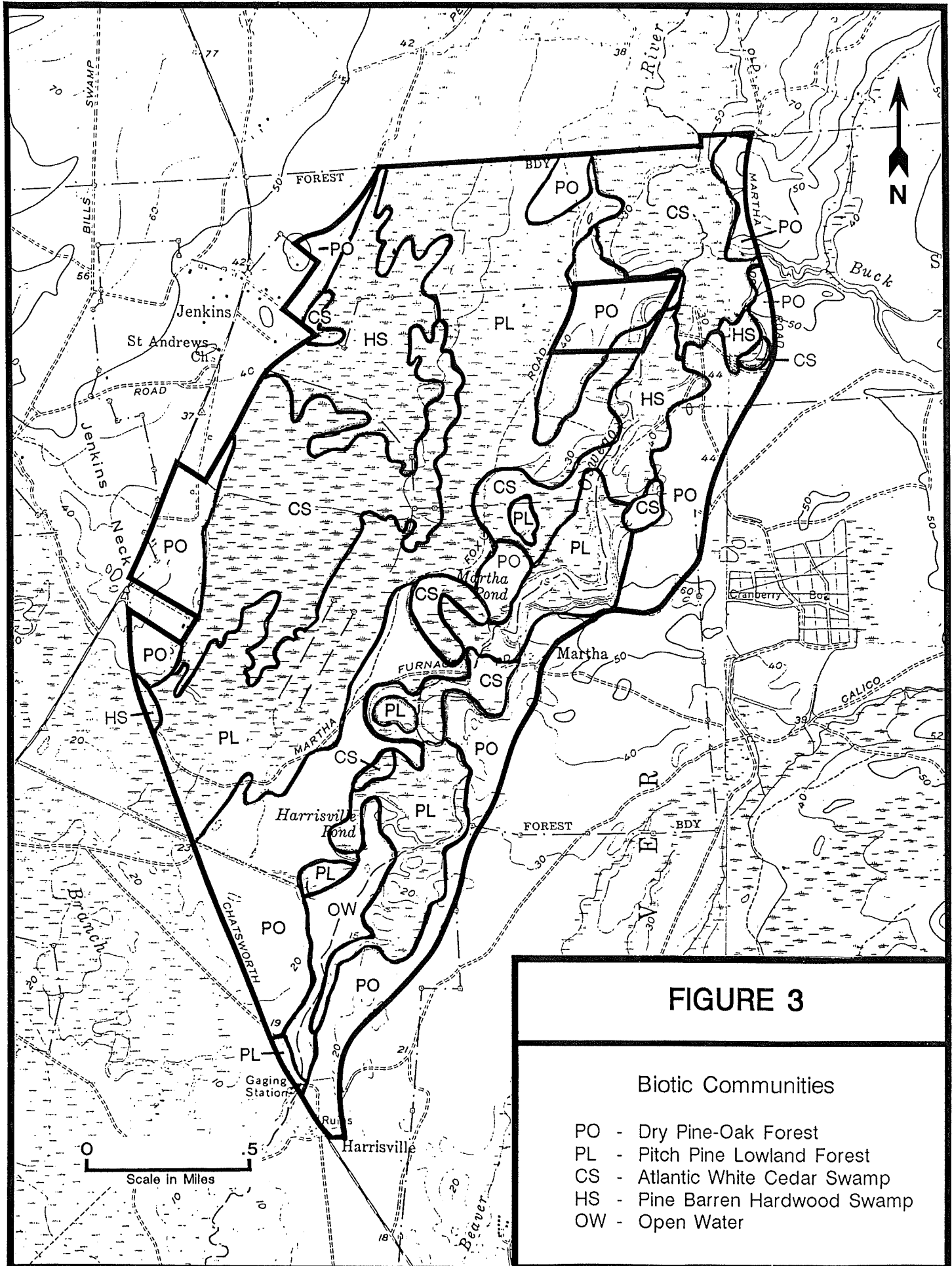
This forest community comprises approximately one-half of the natural area. The canopy is dominated by pitch pine (*Pinus rigida*) while the thick shrub layer consists of highbush blueberry (*Vaccinium corymbosum*), black huckleberry (*Gaylussacia baccata*), sheep laurel (*Kalmia angustifolia*) and staggerbush (*Lyonia mariana*). Cinnamon fern (*Osmunda cinnamomea*), sand myrtle (*Leiophyllum buxifolium*), cow-wheat (*Melampyrum lineare*) and teaberry (*Gaultheria procumbens*) are scattered throughout the forest floor.

This lowland forest contains suitable habitat for a variety of mammals including white-tailed deer (*Odocoileus virginianus*), star-nosed mole (*Condylura cristata*), meadow vole (*Microtus pennsylvanicus*) and long-tailed weasel (*Mustela frenata*). Avian species likely to be found in this lowland habitat include acadian flycatcher (*Empidonax virescens*), common yellowthroat (*Geothlypis trichas*) and wood thrush (*Hylocichla mustelina*). Amphibians and reptiles that may occur throughout these portions of the natural area include carpenter frog (*Rana virgatipes*), Pine Barrens treefrog (*Hyla andersonii*), two-lined salamander (*Eurycea bislineata*) and spotted turtle (*Clemmys guttata*).

Coastal Plain Atlantic White Cedar Swamp

Several cedar swamp forest communities occur within the natural area. Three small pockets occur along the Oswego River while an extensive portion of the northwestern corner of the natural area is cedar swamp. Atlantic white cedar dominates this community although swamp magnolia (*Magnolia virginiana*) and red maple (*Acer rubrum*) are abundant. The shrub layer includes dangleberry (*Gaylussacia frondosa*), inkberry (*Ilex glabra*) and sweet pepperbush (*Clethra alnifolia*). Pitcher plant (*Sarracenia purpurea*), spatulate-leaved sundew (*Drosera intermedia*), lance-leaved sabatia (*Sabatia difformis*) and *Sphagnum* moss cover the forest floor.

Laderman (1989) indicates that mammals inhabiting cedar swamps may include virginia opossum (*Didelphis virginiana*), raccoon, southern bog lemming (*Synaptomys cooperi*) star-nosed mole (*Condylura cristata*), pine vole and white-tailed deer. The swamp can also support a variety of amphibians and reptiles including four-toed salamander



(*Hemidactylium scutatum*), Pine Barrens tree frog, carpenter frog (*Rana virgatipes*), northern red-bellied snake (*Storeria o. occipitomaculata*) and northern pine snake (*Pituophis m. melanoleucus*). Leck (1979) indicates that breeding birds commonly found within the cedar swamps of the Pine Barrens are primarily insectivores and most are present only in summer. These may include eastern wood pewee (*Contopus virens*), catbird (*Dumetella carolinensis*), wood thrush (*Hylocichla mustelina*), white-eyed vireo (*Vireo griseus*), northern parula warbler (*Parula americana*), yellow warbler (*Dendroica petechia*), common yellowthroat (*Geothlypis trichas*), American redstart (*Setophaga ruticilla*) and song sparrow (*Melospiza melodia*). Endangered species that have the potential to occur in this habitat in the natural area include Pine Barrens treefrog, bog turtle (*Clemmys muhlenbergi*) and timber rattlesnake (*Crotalus horridus*).

Dry Pine/Oak Forest

Several small areas of this forest community exist along Martha Furnace Road and Old Martha Road. The canopy layer is dominated by pitch pine, black oak (*Quercus velutina*), blackjack oak (*Q. marilandica*) and post oak (*Q. stellata*). Many of the same plants that are found in the pitch pine lowland forest understory are found here, however, the understory is taller in the pine/oak forest.

This upland portion of the natural area contains suitable habitat for a variety of mammals including short-tailed shrew (*Blarina brevicauda*), eastern chipmunk (*Tamias striatus*), red squirrel (*Tamiasciurus hudsonicus*), southern flying squirrel (*Glaucomys volans*), white-footed mouse (*Peromyscus leucopus*), pine vole (*Pitymys pinetorum*), gray fox (*Urocyon cinereoargenteus*), raccoon (*Procyon lotor*), long-tailed weasel (*Mustela frenata*), striped skunk (*Mephitis mephitis*) and white-tailed deer (*Odocoileus virginianus*) (Wolgast 1979).

Avian species likely to be found in the upland portions of the natural area include sparrow hawk (*Falco sparverius*), ruffed grouse (*Bonasa umbellus*), whip-poor-will (*Caprimulgus vociferus*), common nighthawk (*Chordeiles minor*), Carolina chickadee (*Parus carolinensis*), rufous-sided towhee (*Pipilo erythrophthalmus*), screech owl (*Otus asio*), great horned owl (*Bubo virginianus*), hairy woodpecker (*Picoides villosus*), downy woodpecker (*P. pubescens*), red-eyed vireo (*Vireo olivaceus*), pine warbler (*Dendroica pinus*), and prairie warbler (*D. discolor*) (Leck 1979).

Amphibians and reptiles that may occur throughout the natural area include red-backed salamander (*Plethodon c. cinereus*), northern red salamander (*Pseudotriton r. ruber*), Fowler's toad (*Bufo woodhousei fowleri*), northern spring peeper (*Hyla c. crucifer*), New Jersey chorus frog (*Pseudacris triseriata kalmi*), green frog (*Rana clamitans melanota*), carpenter frog (*Rana virgatipes*), spotted turtle (*Clemmys guttata*), eastern box turtle (*Terrapene c. carolina*), northern fence lizard (*Sceloporus undulatus hyacinthinus*), northern pine snake (*Pituophis m. melanoleucus*), eastern kingsnake (*Lampropeltis g. getulus*) and black rat snake (*Elaphe o. obsoleta*) (Conant 1979).

Pine Barren Hardwood Swamp

This swamp community exists along the Oswego River and adjacent to cedar swamp and pitch pine lowland forest in the western portion of the natural area. Dominant species in the canopy include red maple (*Acer rubrum*), swamp magnolia (*Magnolia virginiana*) and black gum (*Nyssa sylvatica*).

Mammals likely to be found in the hardwood swamp habitat include southern red-backed vole (*Clethrionomys gapperi*) and raccoon (*Procyon lotor*). The hardwood swamp community contains suitable habitat for a variety of birds including white-eyed vireo (*Vireo griseus*), prothonotary warbler (*Protonotaria citrea*) and northern parula warbler (*Parula americana*). Amphibians and reptiles that may occur throughout the hardwood swamp include northern water snake (*Nerodia sipedon*), four-toed salamander (*Hemidactylum scutatum*) and northern spring peeper (*Pseudacris crucifer*).

Pine Barren Savanna

This grass and sedge dominated community occurs along the floodplains of the Oswego River. These wet areas are separated from the river by areas of higher ground and are too small to be indicated in Figure 3. It is believed that savannas may also occur throughout the natural area in ox bows that have been cut off from the river (Tom Breden pers. comm.). Many plant species occur within this community including rose pogonia (*Pogonia ophioglossoides*), golden crest (*Lophiola americana*), horned bladderwort (*Utricularia cornuta*), zig-zag bladderwort (*Utricularia subulata*), common pipewort (*Eriocaulon septangulare*), grass pink (*Calapogon pulchellus*), thread-leaved sundew (*Drosera filiformis*), round-leaved sundew (*D. rotundifolia*), spatulate-leaved sundew (*D. intermedia*), pitcher plant (*Sarracenia purpurea*), slender beaked rush (*Rynchospora gracilentia*), broomsedge (*Andropogon virginicus*), silky wild oatgrass (*Danthonia sericea var. epilis*), curly grass fern (*Schizaea pusilla*) (a plant species of concern in New Jersey), and the state endangered false asphodel (*Tofieldia racemosa*) and bog asphodel (*Narthecium americanum*).

The Pine Barren Savanna community type along the Oswego River corridor is well documented at least as far back as Stone (1911) and no doubt to the 1800s (Dale Schweitzer pers. comm.). Preservation and monitoring of the savanna is essential because it provides habitat for several endangered and threatened species as well as species of concern documented in the natural area.

Endangered Species

According to the Natural Heritage Database, the following rare species occur within the natural area. Federal, State and other status are also indicated.

| Plant Species | Status |
|---|------------|
| bog asphodel (<i>Narthecium americanum</i>) | FR, SE, LP |
| pine barren boneset (<i>Eupatorium resinosum</i>) | FR, SE, LP |

| | |
|---|--------|
| false asphodel (<i>Tofieldia racemosa</i>) | SE, LP |
| reversed bladderwort (<i>Utricularia resupinata</i>) | SE, LP |
| Barratt's sedge (<i>Carex barrattii</i>) | LP, SC |
| curly grass fern (<i>Schizaea pusilla</i>) | LP, SC |
| pine barren reedgrass (<i>Calamovilfa brevipilis</i>) | LP, SC |
| pine barren smoke grass (<i>Muhlenbergia torreyana</i>) | LP, SC |

Animal Species

| | |
|--|--------|
| northern pine snake (<i>Pituophis m. melanoleucus</i>) | FR, ST |
| Pine Barrens treefrog (<i>Hyla andersonii</i>) | SE |
| a noctuid moth (<i>Spartiniphaga carterae</i>) | S2 |
| pitcher plant borer moth (<i>Papaipema appassionata</i>) | S2/S3 |
| pine barrens bluet (<i>Enallagma recurvatum</i>) | S3 |

Explanation of Status Codes

- FR - Under Federal Review as endangered or threatened
- SE - Listed as State Endangered
- ST - Listed as State Threatened
- LP - Listed as Endangered or Threatened in the Pinelands National Reserve
- S2 - Imperiled in State because of rarity (6-20 occurrences)
- S3 - Rare in State with 21-100 occurrences
- SC - Species of concern in New Jersey

Dale Schweitzer (pers. comm.) indicates that extensive survey work for invertebrates has not been conducted in this area and that an additional 10-20 globally rare invertebrate species probably exist here.

The bog asphodel (*Narthecium americanum*) is a perennial herb that is currently found nowhere else in the world but the New Jersey Pine Barrens. This plant is easily recognized by its dense spike of small yellow flowers at the top of an erect flower stalk. It can be found in bloom from mid-June through July (Boyd 1991). The following is from Schuyler (1990a), who describes the ecology as well as threats and possible management techniques for the protection of this species: "*Narthecium americanum* appears to be dependent on water moving through the substrate. If the substrate becomes wetter through flooding or continuous surface saturation, bog asphodel may be eradicated. Reproduction in bog asphodel in most situations is vegetative from rhizomes, although seed production is high. It is known that shading inhibits flowering in bog asphodel. One botanist reported finding only vegetative plants in areas shaded by Atlantic white cedar. The greatest threat to bog asphodel, however, is disruption of the water regime. Anything that makes its habitat wetter or dryer will eliminate it. It is critical that watersheds be protected from anything that disrupts present water regimes. In the Pine Barrens, this includes flooding by beaver activity and commercial cranberry growers, and damming streams for recreational lakes. It is also critical that water flow in streams and seeps remains unimpeded. Trampling by all-

terrain-vehicles is an occasional problem. Continuous trampling of *N. ossifragum*, a related species found in Europe and western Asia, produces stands with a high density of stunted sterile shoots. Presumably the same would happen in trampled stands of *N. americanum*. Because shading is known to inhibit flowering of bog asphodel, the threat due to succession needs evaluation." *Narthecium americanum* is currently the focus of considerable Federal and State research to determine the status and critical management needs of this species.

Pine barren boneset (*Eupatorium resinosum*) is a member of the Composite family that grows in open bogs on sandy, acid soils (Mowbray 1984). Although it sometimes grows in standing water, it is generally found in saturated soils along the margins of slow flowing, sluggish streams or in partially flooded, abandoned cranberry bogs. It requires almost full sunlight and has difficulty in competition with tall shrubs and trees. It seems to do well in disturbed areas, cut-over pocosins/swamps or wet savannahs. At many of the populations in New Jersey the habitats had been subjected to some type of disturbance, such as fire or mowing, and it appeared that periodic disturbance was important for the occurrence and vigor of the species. In addition, Mowbray (1984) suggests that the management plan for populations in North Carolina incorporate some type of periodic disturbance for maintaining an open community structure, such as prescribed burning.

False asphodel (*Tofieldia racemosa*) is a perennial herb with iris-like leaves and a dense raceme of white flowers that grows in wet, peaty sands and bogs in the heart of the Pinelands (Boyd 1991) and has an extremely restricted distribution (New Jersey Department of Environmental Protection and Energy 1991). This species often grows in association with *N. americanum* and should be similarly managed (David Snyder pers. comm.). A few occurrences in New Jersey are vulnerable to increased recreational pressures and possibly flooding by beavers (New Jersey Department of Environmental Protection and Energy 1991).

Reversed bladderwort (*Utricularia resupinata*) is a violet-flowered herb that grows in muddy soil or very shallow water at the edge of ponds (Gleason and Cronquist 1963). Bladderworts generally have small leaves at or below the water surface and from the base of each have roots with bladders which catch tiny aquatic animals (Gleason and Cronquist 1963). *Utricularia resupinata* may have minute bladders or none at all. The size of the population in the natural area fluctuates from year to year, but there are usually some plants present in any one year (New Jersey Department of Environmental Protection and Energy 1993). This species is vulnerable to degradation, draining, and other impacts to wetlands (New Jersey Department of Environmental Protection and Energy 1991).

Barratt's sedge (*Carex barrattii*) is an herbaceous perennial which occurs in wet to swampy coastal plain forests, including peaty pinelands. The species occurs especially in openings, including human-altered habitats such as powerline rights-of-way, roadside ditches, mowed roadsides, railroad rights-of-way, clear-cut forest areas and abandoned cranberry bogs (Johnson 1988a). The fact that the species occurs in a pine barren habitat, prone to frequent fires, suggests that fire may help to reduce competition, maintain openings for light, and open the soil surface for seed germination (Johnson 1988a). Johnson (1988a) proposes that flowering occurs best when plants are growing in partly shaded and very wet soil. Johnson (1988a) indicates that another habitat requirement is abundant moisture, suggested by the many occurrences of the species in vernal ponds, floodplains

and intermittent swales. The optimum moisture regime, and the effect of moisture on reproduction and growth remain in question. Johnson (1988a) recommends that *C. barrattii* habitat be maintained in its present condition until research determines the effect of available light and moisture on the species' growth and reproduction.

Curly grass fern (*Schizaea pusilla*) is a small inconspicuous fern that is widespread in the Pine Barrens of New Jersey (Schuyler 1990b). This plant usually grows in or at the edge of bogs and cedar swamps often elevated on hummocks at the base of cedars or on sedge tussocks (Schuyler 1990b). Schuyler (1990b) adds that "habitats for *S. pusilla* are often kept open by disturbances to white cedar such as logging, fire, and deer grazing. The occurrence of *S. pusilla* in disturbed areas suggests that it is a species of early successional habitats. In other situations, however, such as peaty hummocks at the base of cedar trees, the habitats are in a later stage of succession. Lack of disturbance, however, may eventually threaten *Schizaea* populations. Alteration of the water regime is a major threat to *S. pusilla* and succession also may be if disturbances do not occur to retard the growth of white cedar. Its occurrence on perennially moist substrates indicates that it will not tolerate flooding or dry conditions for extended time periods. Watersheds for this species need protection to maintain the water regime. Research should focus on the extent to which *S. pusilla* is dependent on disturbances that retard succession."

Pine barren reedgrass (*Calamovilfa brevipilis*) is a perennial grass that, in New Jersey, occurs in pine-oak scrub communities, occasionally in open bogs or at the margins of swamps (Johnson 1989). Johnson (1989) adds that several occurrences are in human-modified habitats, where openings have been created by mowing for powerline rights-of-way, road construction and cranberry dikes. Johnson (1989) believes that flowering, seed distribution and seedling establishment may be dependent on fire. Mowbray (1985) cites four apparent benefits of fire for this species: (1) it stimulates sexual reproduction, (2) it reduces peat thickness, thus bringing ground level closer to water table, (3) it enhances vegetation development, and (4) it maintains an open character of the vegetation. Rawinski and Cassin (1986) state that the species is fire-dependent. Johnson (1989) indicates that threats to this species include succession and siltation of wetlands. He adds that management of this species may include mowing or cutting for certain populations and that research should include the species' response to burning, mowing and to successional changes which result in woody plant competition.

Pine barren smoke grass (*Muhlenbergia torreyana*) is a perennial grass that occurs in New Jersey primarily in seasonal wetlands: vernal ponds, savannas, pitch pine lowlands and river levees, with some in human-modified mowed powerline rights-of-way, old borrow pits, ditches and abandoned cranberry bogs (Johnson 1988b). The production of flowering culms "may be related to fire frequency or to annual variations in hydrology" (Alan Weakley pers. comm. from Johnson 1988b). Both of these as recurring disturbances appear to maintain an open successional stage and reduce competition from woody vegetation (Johnson 1988b). Threats to this species include changes in the surrounding watershed hydrology by drainage or pollution, progressive wetland succession, off-road vehicle use, herbicides, runoff, road grading and changes in roadside vegetation management practices for occurrences close to roads (Johnson 1988b). Johnson (1988b) suggests that management should maintain the conditions of present habitats while awaiting the results of research to determine more precisely the needs of this species.

Northern pine snake (*Pituophis m. melanoleucus*) is one of the largest harmless snakes found in New Jersey (Zappalorti et. al. 1983). This species is typically found in open, pine-oak forests at elevations above 40 feet and seems to prefer cleared fields or natural openings in forests (Zappalorti et. al. 1983). In the northeast, this species occurs only in the Pine Barrens of central and southern New Jersey (Zappalorti et. al. 1983). The Natural Heritage Database indicates that the greatest threat to this species is loss of foraging habitat due to development and that illegal collecting and point source mortality by automobiles are also significant threats. The Database also indicates that preservation of large pine-oak sandy soil forest tracts are important to protect snake populations and their habitats.

The Pine Barrens treefrog (*Hyla andersonii*) is a tiny treefrog which is found in New Jersey only in the Pine Barrens (Zappalorti and Johnson 1981). This species' unique breeding habitat consists of open-canopied shallow ponds (New Jersey Department of Environmental Protection and Energy 1993) and seepage bogs supporting *Sphagnum* species on hillsides below pine-oak ridges where Atlantic white cedar is a dominant species (U.S. Department of the Interior 1980). Zappalorti and Johnson (1981) indicate that during May, June and early July the males vocalize to attract the females to the breeding pond. Threats to this species include loss and destruction of habitat by development, alteration of the chemical composition of the breeding ponds and changes in the water table (New Jersey Department of Environmental Protection and Energy 1993).

Spartiniphaga carterae is a type of noctuid moth that occurs in areas with substantial populations of *C. brevipilis*, its food plant (New Jersey Department of Environmental Protection and Energy 1993). The following information about this moth comes from the New Jersey Natural Heritage Database. This moth's habitat includes recently burned pitch pine lowlands, pine barren savannas, swales, edges of bogs, disturbed habitats such as power lines and other locations where *C. brevipilis* is found. The species is very well adapted to natural (lightning) fires that occur in the summer which stimulate the food plant. Potential threats to this species include degradation or loss of its food source, gypsy moth and mosquito spraying, fall-winter-spring fires and suppression of summer fires. Management needs include preparation of fire management plans.

The pitcher plant borer moth (*Papaipema appassionata*) is a type of moth that is associated with stands of pitcher plants, its food plant (New Jersey Department of Environmental Protection and Energy 1993). Pitcher plants occur in peaty sphagnum and cedar bogs (Boyd 1991). The following information comes from the Natural Heritage Database. Larvae or pupae can be found in or near bases of pitcher plants in July or August. This species may be vulnerable to fire and flooding as well as parasitism. Management should include an attempt to protect this species from fire between September and May.

Pine barrens bluet (*Enallagma recurvatum*) is a small, mostly blue damselfly that occurs in large acidic lakes, typically cranberry reservoirs, permanently flooded cranberry bogs, and undeveloped recreational lakes (Carle 1987). It is most often found among grasses and shrubs at or in from the water's edge. Carle (1987) determined from his survey that the undeveloped portion of the New Jersey Pine Barrens represents the major remaining habitat of *E. recurvatum*. Carle's survey also indicated that reservoirs at many active cranberry operations did not support populations of this species, suggesting that insecticides or

measures which set back succession, such as changes in water levels, use of herbicides or dredging, had affected habitat suitability. In Massachusetts, the flight period is early and brief, late May throughout June, with some populations flying into July (Carpenter 1991). Threats to this species include pollution and eutrophication of lakes, pesticide drift from cranberry bogs, recreational development of lakes (New Jersey Department of Environmental Protection and Energy 1993), clearing of shrubby borders around lakes, complete water draw down during May through mid-July, and excessive stocking with insectivorous fish, especially bottom feeders (Schweitzer 1988).

Boundary

The boundary of this 1,927-acre natural area is indicated in Figure 2. A 37.8-acre private inholding (block 27, lot 16) occurs in the northern part of the natural area. This private land is bordered on the west by Fox Road and on the east by the Oswego River. A cement building exists on the property and no trespassing signs are posted by the owner to indicate to canoeists that it is private property.

Public Use

Currently the area is used for canoeing, kayaking, hiking, bird watching, botanizing, hunting, fishing, swimming, picnicking and horseback riding. The Oswego River is a popular river for canoeing. According to the local canoe rental businesses, thousands of people canoe the Oswego throughout the summer. Periodic low water levels will limit use. One canoe rental owner indicated that people canoe the Oswego as early as April and as late as October. He added that often botanists from Connecticut and Delaware, as well as teachers with their students, canoe through the natural area. A watercraft put-in exists north of the natural area at Penn State Forest and a watercraft take-out exists within the natural area at Harrisville Pond. The Division of Fish, Game and Wildlife lists Harrisville Pond as providing a fishery for pickerel, catfish and sunfish, however, the pond is not actively stocked. The car top boat launch at Harrisville Pond provides boating access. Gas-powered motors are prohibited, but electric motors are allowed. Shoreline fishing is also permitted.

A portion of the Batona Trail bisects the natural area (Figure 2). The Batona Trail is a 49.5 mile trail stretching from Ong's Hat in Lebanon State Forest through Batsto and Wharton State Forest and into Bass River State Forest. The trail is maintained jointly by the Batona Hiking Club and the State Park Service. The Batona Trail enters the natural area from Chatsworth Road (Route 563 spur). The trail follows a man-made canal for a short distance and then traverses northeast through pine-oak forest and intersects Martha Furnace Road west of Fox Road. The Batona Trail continues east on Martha Furnace Road and exits the natural area at the abandoned town of Martha.

Sand roads exist throughout the natural area (Figure 2). Martha Furnace Road runs east to west, and Fox Road runs north to south through the central portion of the natural area. Old Martha Road runs north to south along the eastern boundary. All three of these roads have low areas where water collects, making access very difficult at times. Unnamed

sand roads exist throughout the area as well. Visitors park vehicles along sand roads or at loop roads when accessing the natural area. Vehicle tracks are evident on many sand roads and trails leading to or adjacent to the Oswego River. Erosion problems are evident at several points along the river (Figure 2). One area is used as a popular swimming spot. Cars park very close to the river and have added to the erosion of the high embankment along the river. Another area of erosion occurs on a sand road that leads from a high ridge along the river down an embankment to the river's edge. Vehicles have caused ruts that have enlarged with rainfall, causing sand to be washed into the vegetation on the edge of the river. A third area has a less significant erosion problem. The situation here is similar in that it involves a road which leads downslope toward the river.

Research

In 1969 and 1970 Thomas J. Fikslin and James D. Montgomery, from the Biology Department at Upsala College, conducted research in the natural area involving the measurement of physical parameters (current, pH, and temperature) and sampling of the macroscopic flora and fauna along a transect line across the Oswego River. The transect crossed a wide portion of the river to a vegetated island and continued across a narrow portion of the river with a gravel bar to the western shore. Their study site was situated approximately one-quarter mile above Martha Pond. The purpose of this research was to study this unusual, undisturbed stream habitat and compare this habitat with generalized stream habitat descriptions. Fikslin and Montgomery (1971) found that water temperature and pH were constant across the transect at any one time. In addition, the water depth across the narrow portion was relatively stable and did not vary more than 10 cm during the year. However, water depth across the wider section of the river was more variable and ranged from zero to 40 cm. Plants are not overly abundant in the stream, except in a section in the narrow portion of the river. The plants that occur along other portions of the transect are widely scattered, especially in the shallow wider section of the river. These plants are typical of Pine Barren streams. The study documented 124 individual animal organisms from 42 different genera along the transect. The greatest abundance of organisms was found in the narrow portion of the river where the current velocity is fairly stable and abundant vegetation occurs. This study suggests that organisms are correlated with stream bottom conditions. Although the greatest number of organisms were observed in the narrow portion of the river, overall the species diversity for the transect is low, 20 ± 4 . This low species diversity indicates that the communities possess simple trophic pathways. This finding is supported by literature that attributes low species diversity to the high acid level in the stream.

A rare plant species inventory was conducted throughout the Pinelands by Caiazza and Fairbrothers (1980). Plant species were inventoried and assigned endangered, threatened or undetermined status for the Pinelands. The authors describe specific habitats, general locations, geographic affinities, flowering times, and listings by habitat type, watershed and county for each endangered and threatened species. Recommendations to the New Jersey Pinelands Commission included preservation and protection for all the critical habitats described in the report, especially significant areas such as the wetlands along the Oswego River.

In 1983, Martha Gulick, a graduate student at Rutgers University, conducted a vegetation survey at the old town site of Martha. Her thesis involved the long-term maintenance of herbaceous communities in the New Jersey Pine Barrens following human disruption of woodland vegetation and soil. The intent of this study was to analyze the ecotone separating the herbaceous vegetation from the surrounding woodlands, and to identify what factor(s) prevent the reestablishment of the woodlands. Two main hypotheses were proposed: 1) competition between the weedy herbs and shrubs excluded the native flora at the ecotone, 2) soil disturbance through human activity altered the soil conditions to the detriment of the native woodland flora. It was found that calcium enrichment and the resultant increase in cation availability in the herbaceous zone at Martha increases diversity and complexity of the site relative to another pine barren site sampled. Further, it was found that maintenance of the ecotone cannot be attributed to any single factor. It is probably a complex group of interactions including: competition for nutrients, moisture and cations, the relative accumulation of organic matter within the two communities, browse and mycorrhizal associations. Gulick (1983) suggests that additional research be pursued.

In 1993, surveys of six populations of *Narthecium americanum* were performed along the West Branch Wading River and Oswego River corridors (Windisch 1993). The surveys were used to determine the status of the populations, assess impacts from human activities and recommend needed management. Three sites were surveyed within each of the three populations along the Oswego River. Although no major disturbances to these populations were noted, some management recommendations were suggested. Signs indicating the presence of the plant should not be posted. The dead-end roads that lead to some sites should be blocked to deter use by off-road vehicles. Logs or ties should be installed on the steep access road leading to one site to help curtail erosion. Other suggested management techniques may include removal of grazing Canada geese via hunting or trapping and control or relocation of beaver found to be altering water levels around the populations. Monitoring suggestions include determining the effect of grazing geese on *N. americanum* and assessing the hydrologic regime at various sites and its effect on *N. americanum* populations.

Dale Schweitzer indicates that aside from his cursory survey in September 1986, which revealed two rare invertebrates, and Dr. Frank Carle's work on dragonflies, there has been no invertebrate survey conducted within the natural area (pers. comm.). Mr. Schweitzer adds that a few productive visits would likely double the animal list.

Introduced Features

A fenced-in area, approximately 100 feet by 100 feet, exists near the intersection of Martha Furnace Road, Calico-Warren Grove Road and Old Martha Road (Figure 2). The large earthen mound within the fence encases what remains of the old Martha furnace. In 1968 State archaeologist Budd Wilson photographed and measured the remains of Martha furnace (Budd Wilson pers. comm.). In the early 1970s the New Jersey Park Service buried the remains of the furnace to protect it from vandals. A "No Trespassing" sign is hanging on the fence near the locked gate.

An abandoned pumphouse and associated man-made canal exist on the east side of the Oswego River north of the old town site of Martha (Figure 2). At one time the pumphouse and canal supplied water to bogs east of the natural area. A sandy shoreline occurs at the pumphouse which makes it a popular spot for canoeists. A wooden bridge exists where Martha Furnace Road crosses the Oswego River (Figure 2).

A system of parallel plow lines occurs in the eastern portion of the natural area west of Old Martha Road (Figure 2). Plow lines are constructed and maintained to assist in fire suppression efforts and pre-suppression efforts. Controlled burning of this general area has occurred in the past prior to State acquisition by the owner of the nearby cranberry bogs (Horace Somes pers. comm.). After State acquisition of this property, the New Jersey Bureau of Forest Fire Management continued the practice of controlled burning. This area was burned in 1990 and 1992 and usually is burned on a 5-6 year rotation (Horace Somes pers. comm.). Mr. Somes indicated that controlled burning in this area and other areas along the Oswego River is conducted to help strengthen the natural firebreak created by the river corridor. According to Mr. Somes, five major wildfires have occurred in and/or adjacent to the Oswego River Natural Area since the 1930s.

A section of a man-made canal exists in the southwest section of the natural area (Figure 2). This canal originates west of the natural area, flows beneath Route 563 and continues southeast into the natural area to Harrisville Pond. According to Ted Gordon, this hand-dug canal diverted water from the West Branch of the Wading River to the Oswego River to increase the flow of water to the paper mill in the old town of Harrisville. The raised mound along the canal provides a path for a section of the Batona Trail.

An abandoned gravel pit exists north of the Pineland Group Residential Center on the east side of Route 563 (Figure 2). The area is now heavily vegetated and appears to have been out of use for many years. Evidence of past use is indicated by the undulating ground surface.

A padlocked gate occurs along the east side of Route 563 north of the gravel pit (Figure 2). The gate restricts access to an old sand road leading through pine-oak forest to abandoned fields that have since been acquired by the State.

Management Techniques

Natural Areas System Rules

Relevant sections of the rules and regulations concerning Natural Areas and the Natural Areas System (N.J.A.C. 7:5A-1.1 et seq.) appear in Appendix A. An important function of these rules is to provide general interim management guidelines for all natural areas for which management plans have not been prepared. Upon preparation of a management plan, interim management guidelines may continue or may be superseded by management techniques more appropriate to fulfill the management objective of the natural area. The following analysis will outline management and uses contrary or supplemental to

existing rules. Appendix A will apply and should be consulted for management issues not covered below.

Management Objective And Classification

The management objective for Oswego River Natural Area is "preservation of hardwood swamp, pitch pine lowland, pine-oak, Atlantic white cedar, and bog communities, which serve as habitat for numerous rare species."

The following management techniques are directly related to previous sections of this plan and the interim management guidelines found in Appendix A. Techniques are based in part on consultation with appropriate agencies, individuals and the Natural Areas Council, and are designed to adequately maintain, and if possible enhance the quality of the natural area.

Throughout this section, administering agency refers to the Division of Parks and Forestry, through Wharton State Forest. It is recognized that the State Park Service is severely understaffed and, as a result, some management activities may need to be extended beyond the deadlines indicated. Priorities will be established on a case-by-case basis.

Endangered Species

1. By September 30, 1995, the ONLM will survey for State endangered plants and plant species of concern recorded from the natural area. The ONLM will perform periodic inspections to assess future management needs. If funding becomes available in the future, then the ONLM will also arrange for surveys of endangered and threatened animals.

This management requirement is included to help ensure the preservation of these species, which experience varying degrees of rarity in the State and nation.

2. By October 31, 1995, the ONLM will provide the administering agency with a map indicating known and possible locations of all endangered and threatened animals and all endangered plants and plant species of concern. The map will be updated by the ONLM should locations for any additional species be discovered.

This management requirement is included to allow the administering agency to more effectively manage the natural area and the species within it, and to ensure consideration of these species in future planning in the natural area.

3. The ONLM, in cooperation with the administering agency, will monitor rare plant species populations and, if determined necessary, will prepare a prescribed burning plan for the natural area by December 31, 1995. Prescribed burning would assist in managing habitat for the following species: *Carex barrattii*, *Calamovilfa brevipilis*, *Muhlenbergia torreyana* and *Spartiniphaga carterae*.

This management technique is included for proper management of several rare plant species which require fire or other disturbance to remain viable. The Commissioner hereby approves of prescribed burning to eliminate safety hazards and manage habitat in accordance with N.J.A.C. 7:5A-1.9(e)10.

4. In the event that prescribed burning is not a viable option for rare species management, the ONLM, in cooperation with the administering agency, will prepare an alternate plan whereby mowing or cutting of vegetation will be used to open the habitat around certain plant populations threatened by succession. The implementation of such a plan will be subject to adequate State Park Service staffing and other operating priorities.

This management technique is included for proper management of populations of several rare plant species which can become threatened by habitat succession. The Commissioner hereby approves of habitat manipulation that contributes to the management objective of the natural area in accordance with N.J.A.C. 7:5A-1.9(e)12.

5. By July 31, 1995, the administering agency, in cooperation with the ONLM, will post signs indicating that motorized vehicle use and foot traffic is prohibited in selected areas where rare species have been observed.

This management technique is required to reduce trampling and degradation of habitat for certain rare species, which has been observed by the Department in the natural area.

6. Any activity that would entail removal of the shrubby border around Harrisville Pond is strongly discouraged. Any proposal that would involve removal of the shrubby border will be submitted to the ONLM for Natural Areas Council review and approval by the Commissioner.

This requirement is included to protect the habitat of *Enallagma recurvatum* which has been observed at Harrisville Pond. Limiting and/or restricting access and use to achieve the management objective is required in accordance with N.J.A.C. 7:5A-1.9(e)16. Large lakes and their bordering vegetation are essential habitat components for *Enallagma recurvatum*.

7. In the unlikely event that the State Forester has determined that egg mass counts and prior year defoliation indicates that tree mortality will be severe without intervention, the Division of Parks and Forestry will be allowed to perform gypsy moth control activities within the natural area only after Natural Areas Council review of a gypsy moth control plan prepared by the Division and approval of the plan by the Commissioner of DEP. No pine looper control activities are permitted in the natural area.

This management requirement is included to protect the three rare invertebrate species documented from the natural area (*Spartiniphaga carterae*, *Papaipema appassionata* and *Enallagma recurvatum*) and potentially

numerous other undocumented rare invertebrates, as well as to reduce possible pollution of the wetlands. This review procedure is included in this plan in accordance with N.J.A.C. 7:5A-1.9(e)13. Control of pine looper outbreaks is prohibited because the looper is a native species that experiences cyclic outbreaks that are unlikely to exert any long-term negative impact on the natural area, and because the needless control of this species may have a severe detrimental impact on populations of the many rare invertebrate species that exist or are believed to exist within the natural area.

8. The administering agency will coordinate with the ONLM if any herbicide application is necessary within the natural area.

This requirement is included to protect rare species populations from inadvertent roadside herbicide application.

9. The Division may continue the practice of releasing water at Harrisville Pond dam to relieve the pressure on the dam caused by sudden increases in water levels due to rainstorms. This practice may be conducted only to the extent necessary to maintain normal water levels.

This management requirement is necessary because disruption of the water regime in the natural area is a major threat to many of the rare plant species found there. This requirement is included in this plan in accordance with N.J.A.C. 7:5A-1.9(e)8.

10. The New Jersey Pinelands Commission, which monitors the hydrology of Oswego River waters, will report any major changes in water quality of the Oswego River to the ONLM.

This management requirement is included to help protect the rare plants and animals inhabiting the river corridor that may be affected by water quality changes within the Oswego River.

Boundary

1. If the private inholding (Block 27, lot 16) is acquired by the State (Figure 2), the ONLM recommends that it be proposed for addition to the Natural Areas System in accordance with N.J.A.C. 7:5A-1.12.

This management requirement is included because addition of this property to the natural area would ensure protection of the cedar swamp habitat as indicated in the management objective for the natural area.

2. The administering agency will post State Natural Area signs at access points and along the boundary of the natural area at a maximum of ten per mile by July 31, 1995. These signs will be replaced by the administering agency with assistance from the ONLM as needed.

Posting of the boundaries of all natural areas is required in accordance with N.J.A.C. 7:5A-1.9(e)1.

3. The ONLM will provide the administering agency with State Natural Area boundary signs as needed.

The ONLM, which is responsible for overall administration of the Natural Areas System, creates and distributes paper boundary signs for posting of all State Natural Areas.

Public Use

1. Current uses of the natural area, which include canoeing, kayaking, hiking, bird watching, botanizing, hunting, fishing (shoreline and from a boat with an electric motor), swimming, picnicking and horseback riding, as well as recreational use of the day-use area at Harrisville Pond, will be allowed to continue in the natural area. The ONLM and the administering agency will continue to monitor the above uses and/or any illegal uses to assess any potential adverse impacts on the natural features occurring in this area.

The above uses are compatible with preservation of the species and communities that occur within the natural area and are authorized in accordance with N.J.A.C. 7:5A-1.9(e)16.

2. Although restricting vehicle access in the areas of erosion is difficult, if it is determined that populations of *Narthecium americanum* are being negatively impacted by erosion resulting from vehicles, measures will be formulated by the administering agency and the ONLM to reduce or eliminate the threat.

This management technique is included to reduce the negative impact of sedimentation of the Oswego River and the rare species associated with it. Sedimentation can change the ecology of the area by filling wetlands and increasing the rate of succession.

3. The administering agency will obtain all applications to conduct research or collect specimens, forward a copy to the ONLM, and provide a response in cooperation with the ONLM.

This requirement is included in accordance with procedures for conducting research and collecting specimens in natural areas outlined in N.J.A.C. 7:5A-1.10, and to ensure thorough review of all proposals.

Introduced Features

1. The administering agency will contact the Historic Preservation Office if any plans materialize to revise the road and/or trail network near Martha or Harrisville.

This management requirement is included to allow the Historic Preservation Office to review the plans and provide comment in order to protect cultural remains in the natural area.

2. Prescribed burning by the Bureau of Forest Fire Management will continue to be allowed within the natural area west of Old Martha Road where plow lines currently exist. If the Bureau of Forest Fire Management intends to burn a larger acreage than what is currently burned, the Bureau will submit a plan to the ONLM for review by the Council and approval by the Commissioner.

This management requirement is included in this plan in accordance with N.J.A.C. 7:5A-1.9(e)10.

3. The ONLM will forward a copy of any plan by the Bureau of Forest Fire Management that prescribes burning in the area of Martha or Harrisville to the Historic Preservation Office for review.

This management requirement is included so that any cultural remains in the area of Martha or Harrisville can be preserved.

4. The administering agency and the ONLM will perform visual monitoring of cultural resources within the natural area during routine monitoring of the natural area.

This management requirement is included to protect cultural resources within the natural area.

Literature Cited

- Bisbee, H.H. and R.B. Colesar. 1976. Martha: The complete furnace diary & journal 1808-1815. Heidelberg Press, Burlington, New Jersey.
- Boyd, H.P. 1991. A field guide to the Pine Barrens of New Jersey. Plexus Publishing Inc., Medford, NJ. 423 pp.
- Breden, T.F. 1989. A preliminary natural community classification for New Jersey. In E.F. Karlin (ed.) New Jersey's rare and endangered plants and animals. Institute for Environmental Studies, Ramapo College, Mahwah, New Jersey. 280 p.
- Caiazza, N. and D. E. Fairbrothers. 1980. Threatened and endangered vascular plant species of the New Jersey Pinelands and their habitats. Unpublished report prepared for the New Jersey Pinelands Commission, New Lisbon, New Jersey.
- Carle, F. 1987. A survey of *Enallagma recurvatum* in the New Jersey Pine Barrens. Unpublished report to New Jersey Natural Heritage Program, Trenton, New Jersey.

- Carpenter, V. 1991. Dragonflies and damselflies of Cape Cod. The Cape Cod Museum of Natural History, Brewster, Massachusetts.
- Conant, R. 1979. A zoogeographical review of the amphibians and reptiles of southern New Jersey, with emphasis on the Pine Barrens. In R.T.T. Forman (ed.) Pine Barrens: Ecosystem and landscape. Academic Press, New York, New York.
- Fikslin, T.J. and J.D. Montgomery. 1971. An ecological survey of a stream in the New Jersey Pine Barrens. Bulletin of the New Jersey Academy of Science. 16(1-2):8-13.
- Gleason, H.A. and A. Cronquist. 1963. Manual of vascular plants of Northeastern United States and adjacent Canada. D. Van Nostrand Co., New York.
- Gulick, M.K. 1983. Long-term maintenance of herbaceous communities in the New Jersey Pine Barrens following human disruption of woodland vegetation and soil. Masters thesis, Rutgers, the State University of New Jersey.
- Johnson, R.T. 1989. Element stewardship abstract for *Calamovilfa brevipilis*. Prepared for New Jersey Department of Environmental Protection, Office of Natural Lands Management.
- Johnson, R.T. 1988a. Element stewardship abstract for *Carex barrattii*. Prepared for New Jersey Department of Environmental Protection, Office of Natural Lands Management.
- Johnson, R.T. 1988b. Element stewardship abstract for *Muhlenbergia torreyana*. Prepared for New Jersey Department of Environmental Protection, Office of Natural Lands Management.
- Laderman, A.D. 1989. The ecology of the Atlantic white cedar wetlands: A community profile. Biol. Rep. 85(7.21). U.S. Dept. of the Interior, Fish and Wildlife Service. 115p.
- Leck, C.F. 1979. Birds of the Pine Barrens. In R.T.T. Forman (ed.) Pine Barrens: Ecosystem and landscape. Academic Press, New York, New York.
- Mowbray, T.B. 1985. Final status report: *Calamovilfa brevipilis* Torrey Scribn. Unpublished report to U.S. Fish and Wildlife Service, Endangered Species Office, Asheville, North Carolina.
- Mowbray, T.B. 1984. Final status report: *Eupatorium resinosum* Torrey ex D.C. Unpublished report to U.S. Fish and Wildlife Service. Endangered Species Office, Asheville, North Carolina.
- New Jersey Department of Environmental Protection and Energy. 1993. New Jersey Natural Heritage Database, Office of Natural Lands Management.
- New Jersey Department of Environmental Protection and Energy. 1991. State of New Jersey endangered plant species list basis and background document. Office of Natural Lands Management, Trenton, New Jersey.

- Rawinski, T. and Jan Cassin. 1986. Final status survey reports for 32 plants. Unpublished report to U.S. Fish and Wildlife Service, Newton Corner, MA. Eastern Heritage Task Force, The Nature Conservancy.
- Sauer, L., C. Franklin, C. Franklin and R. Sauer. 1980. Forest vegetation of the Pinelands. Prepared for the New Jersey Pinelands Commission by Andropogon Associates, Philadelphia, PA.
- Schuyler, A.E. 1990a. Element stewardship abstract for *Nartheicum americanum*. Prepared for New Jersey Department of Environmental Protection, Office of Natural Lands Management.
- Schuyler, A.E. 1990b. Element stewardship abstract for *Schizaea pusilla*. Prepared for New Jersey Department of Environmental Protection, Office of Natural Lands Management.
- Schweitzer, D.F. 1988. An inventory of rare insecta of the Lakehurst Naval Air Engineering Center, Ocean County, New Jersey. Unpublished report to New Jersey Natural Heritage Program, Trenton, New Jersey.
- Stone, W. 1911. The plants of Southern New Jersey. Published as Part II of the annual report of the New Jersey State Museum for 1910. MacCrellich & Quigley, Trenton, New Jersey.
- U.S. Department of Agriculture. 1971. Soil survey of Burlington County, New Jersey. Prepared by Soil Conservation Service in cooperation with New Jersey Agricultural Experiment Station.
- U.S. Department of the Interior. 1980. Selected vertebrate endangered species of the seacoast of the United States - The Pine Barrens Treefrog. Prepared by the National Fish and Wildlife Laboratory, the Office of Endangered Species and the National Coastal Ecosystems Team, Office of Biological Services for the U.S. Fish and Wildlife Service.
- Windisch, M.A. 1993. *Nartheicum americanum* population survey of the West Branch Wading River and Oswego River corridors in New Jersey. New Jersey Department of Environmental Protection and Energy, Office of Natural Lands Management.
- Wolfe, P.E. 1977. The geology and landscapes of New Jersey. Crane, Russak and Co., Inc. New York.
- Wolgast, L.J. 1979. Mammals of the New Jersey Pine Barrens. In R.T.T. Forman (ed.) Pine Barrens: Ecosystem and landscape. Academic Press, New York, New York.
- Zappalorti, R.T., E.W. Johnson and Z. Leszczynski. 1983. The ecology of the northern pine snake, *Pituophis melanoleucus melanoleucus* (Daudin) (Reptilia, Serpentes, Colubridae), in southern New Jersey, with special notes on habitat and nesting behavior. Bull. Chi. Herp. Soc. 18(3-4):57-72.

Zappalorti, R.T. and E.W. Johnson. 1981. Species account form for *Hyla andersonii*. From the second symposium on endangered and threatened plants and animals of New Jersey. New Jersey Natural Heritage Program, Trenton, New Jersey.

Appendix A

INTERIM MANAGEMENT PRACTICES FOR NATURAL AREAS

From Natural Areas System Rules
(N.J.A.C. 7:5A-1.1 et seq.)

7:5A-1.9 INTERIM MANAGEMENT PRACTICES

- (a) Interim management practices shall be implemented by the administering agency, provided that:
 - 1. The practice will have no direct or indirect adverse impact on natural features of concern;
 - 2. The administering agency notifies the secretary of the Council, in writing, no later than 30 days after initiating the practice;
 - 3. Approval of the Commissioner is not required by provision elsewhere in this subchapter; and
 - 4. The practice is consistent with terms of any conservation easement held by the Department.
- (b) Interim management practices listed at (e) or (f) below which require the approval of the Commissioner shall first be submitted to the Council for its review and recommendation.
- (c) Upon finding that an interim management practice listed below at (e) or (f) would be detrimental to achieving a specific management objective, the Council shall recommend to the Commissioner the substitution of a more appropriate interim management practice. Should the Commissioner concur with the recommendation of the Council, the Commissioner may approve substitution by a more appropriate interim management practice.
- (d) Where there are conflicts between general practices described below at (e) and practices specific to a natural area classification described below at (f), the latter shall apply.
- (e) The following interim management practices apply generally to all natural areas upon designation to the System and until and unless superseded by the provisions of an adopted management plan:
 - 1. Natural area boundaries shall be made clearly evident by posting signs at a maximum density of ten signs per mile; entrance points shall be posted to indicate to users that they are entering a natural area; boundary signs shall be of a

standard size and format as approved by the Commissioner and provided by the Division;

2. Boundary fences that are needed to protect the natural area may be installed provided the fence shall not have a detrimental effect on movement of wildlife, air circulation, or other natural conditions;
3. Vehicular access lanes may be maintained within a natural area but may not be enlarged in any manner except upon approval of the Commissioner.
4. Existing firebreaks within a natural area may be maintained for safety purposes; temporary firebreaks made by mowing, raking, plowing or wetting, may be used in conjunction with prescribed burning for habitat management;
5. Existing structures may be maintained in a natural area; new structures and enlargement of existing structures may be undertaken upon approval by the Commissioner, provided the structures directly or indirectly contribute to the management objective; new structures, of a temporary nature, may be constructed for research purposes in accordance with N.J.A.C. 7:5A-1.10;
6. No measures, such as cutting of grass, brush, or other vegetation, thinning of trees, opening of scenic vistas, or planting, shall be taken to alter natural processes or features for the purpose of enhancing the beauty or neatness of a natural area;
7. Except as otherwise provided in this section, there shall be no introduction, removal or consumptive use of any material, product, or object to or from a natural area; prohibited activities include grazing by domestic animals, farming, gathering of plants or parts thereof, mining or quarrying, and dumping, burying, or spreading of garbage, trash, or other materials; structures or materials may be removed as follows:
 - i. Old interior fences may be removed, giving consideration to leaving posts to mark boundaries between former land uses;
 - ii. Rubbish or any other waste material may be removed; and
 - iii. Structures having no historic, scientific or habitat value may be demolished and removed unless such structures are deemed essential for administrative purposes;
8. Water levels within a natural area shall not be altered except to restore water levels which have been altered due to a sudden natural phenomena or man-induced conditions off-site; routine repairs to existing water control structures may be undertaken but the structures may not be enlarged;
9. All wildfires shall be brought under control as quickly as possible; after a fire within a natural area, there shall be no cleanup or replanting except as approved by the Commissioner to achieve the management objective or for reasons of

health and safety;

10. Prescribed burning, to eliminate safety hazards and to manage habitat, may be conducted upon review of a proposal for prescribed burning by the Council and approval by the Commissioner; use of vehicles and equipment shall be specified in the proposal for prescribed burning;
11. Erosion control within a natural area shall not be undertaken except to restore existing grades which have been altered due to a sudden natural phenomena or man-induced conditions within or beyond the natural area;
12. Habitat manipulation may be undertaken if preservation of a particular habitat type or species of native flora or fauna is included in the management objective of the natural area and upon approval by the Commissioner of a specific habitat manipulation plan prepared by the Department.
13. Gypsy moth control activities may be implemented as an interim management practice after approval of a gypsy moth control plan by the Commissioner; the Commissioner shall review a gypsy moth control plan only after the State Forester has determined that egg mass counts and prior year defoliation indicates that tree mortality will be severe without intervention; to the extent practicable, biological controls, rather than chemical means, shall be used to control gypsy moths;
14. There shall be no physical manipulation of a natural area or application of chemicals known as adulticides for the purpose of controlling mosquitoes; the application of larvacides may be permitted in salt marshes only and only as follows:
 - i. The application of *Bacillus thuringensis* var. *israeliensis* (BTI) may be initiated by a mosquito control agency at any time; and
 - ii. The application of other larvacides may be initiated upon approval by the Commissioner of a specific mosquito control plan submitted by a mosquito control agency; the plan shall identify the specific area where a larvacide application will be made, the types and amount of larvacide to be applied, the need for the application, and the reason why BTI cannot be used for this application;
15. Research activities and the collection of specimens may only be conducted in accordance with N.J.A.C. 7:5A-1.10 and upon approval of the administering agency; and
16. Public use of natural areas shall be allowed only to the extent and in a manner that will not impair natural features; the administering agency may restrict access and use as necessary to protect the natural area; the following are permissible public uses of natural areas:
 - i. Hunting, trapping, and fishing are permitted in accordance with N.J.A.C. 7:25-

- 5 and 7:25-6; except for the stocking of fish and game, habitats may not be manipulated for the purpose of enhancing hunting, trapping, or fishing;
- ii. Occasional camping along trails, boating, and swimming may be permitted in specified locations of natural areas in accordance with N.J.A.C. 7:2-2, 7:2-5, 7:2-7, 7:2-8, and 7:25-2, and are further limited as follows:
 - (1) No permanent structures may be erected;
 - (2) No motorized methods of boating or camping are permitted;
 - (3) Trailside shelters of the type called lean-tos are permitted, but there may not be two such shelters within three miles of each other; and
 - iii. Existing trails may be maintained, but not enlarged in any manner, by the administering agency to allow public use and prevent erosion, trampling of vegetation beyond the trails, and other deterioration as follows:
 - (1) New trails or enlargement of existing trails for interpretive purposes may be initiated subsequent to review of a plan by the Council and approval of that plan by the Commissioner;
 - (2) Rare plants may not be removed for the purpose of maintaining existing or constructing new trails; and
 - (3) To the extent possible, natural materials shall be used on and along trails; and
 - iv. All pets shall be kept caged or leashed and under immediate control of the owner except that dogs used while legally hunting shall be exempt from the leashing requirement.
- (f) The following interim management practices, unless superseded by an adopted management plan, apply to the appropriate specified natural area classifications:
- 1. Location markers identifying interpretation points of interest may be installed except within ecological reserves;
 - 2. Trail blazes may be used within any natural area;
 - 3. Existing vehicular access lanes may not be enlarged in any manner within an ecological reserve;
 - 4. New vehicular access lanes may be constructed only within buffer areas and upon approval by the Commissioner;
 - 5. The alteration of natural processes or features for the purpose of enhancing public use of the natural area may be conducted by the administering agency only

within buffer areas; and

6. The following management practices shall not be permitted within ecological reserves:
 - i. New, existing, or temporary firebreaks;
 - ii. Construction of new trails;
 - iii. Alteration or restoration of water levels;
 - iv. Prescribed burning;
 - v. Erosion control measures;
 - vi. Gypsy moth control activities; and
 - vii. Manipulation of vegetation and wildlife habitats.

Appendix B

NATURAL AREAS SYSTEM MANAGEMENT PLAN TASKS AND RESPONSIBILITIES

Natural Area: Oswego River

Plan Adoption Date:

Name:

Date:

| | <u>Date Indicated in Plan</u> | <u>Proposed Accomp. Date</u> | <u>Date Accomp.</u> |
|---|---------------------------------------|--------------------------------------|-------------------------|
| I. Wharton State Forest Superintendent | | | |
| 1. The administering agency will post State Natural Area signs at access points and along the boundary of the natural area at a maximum of ten per mile by July 31, 1995. These signs will be replaced by the administering agency with assistance from the ONLM as needed. | 7/31/95 | _____ | _____ |
| 2. By July 31, 1995, the administering agency, in cooperation with the ONLM, will post signs indicating that motorized vehicle use and foot traffic is prohibited in selected areas where rare species have been observed. | 7/31/95 | _____ | _____ |
| 3. Any activity that would entail removal of the shrubby border around Harrisville Pond is strongly discouraged. Any proposal that would involve removal of the shrubby border will be submitted to the ONLM for Natural Areas Council review and approval by the Commissioner. | As needed | As needed | As needed |
| 4. The administering agency will coordinate with the ONLM if any herbicide application is necessary within the natural area. | As needed | As needed | As needed |

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|----|--|-----------|-----------|-----------|
| 5. | Current uses of the natural area, which include canoeing, kayaking, hiking, bird watching, botanizing, hunting, fishing (shoreline and from a boat with an electric motor), swimming, picnicking and horseback riding, as well as recreational use of the day-use area at Harrisville Pond, will be allowed to continue in the natural area. The ONLM and the administering agency will continue to monitor the above uses and/or any illegal uses to assess any potential adverse impacts on the natural features occurring in this area. | Ongoing | Ongoing | Ongoing |
| 6. | Although restricting vehicle access in the areas of erosion is difficult, if it is determined that populations of <i>Narthecium americanum</i> are being negatively impacted by erosion resulting from vehicles, measures will be formulated by the administering agency and the ONLM to reduce or eliminate the threat. | As needed | As needed | As needed |
| 7. | The administering agency and the ONLM will perform visual monitoring of cultural resources within the natural area during routine monitoring of the natural area. | Ongoing | Ongoing | Ongoing |
| 8. | The administering agency will obtain all applications to conduct research or collect specimens, forward a copy to the ONLM, and provide a response in cooperation with the ONLM. | As needed | As needed | As needed |
| 9. | The administering agency will contact the Historic Preservation Office if any plans materialize to revise the road and/or trail network near Martha or Harrisville. | As needed | As needed | As needed |

II. NJ DEP Office of Natural Lands Management

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|----|--|-----------|-----------|-----------|
| 1. | If the private inholding (Block 27, lot 16) is acquired by the State (Figure 2), the ONLM recommends that it be proposed for addition to the Natural Areas System in accordance with N.J.A.C. 7:5A-1.12. | As needed | As needed | As needed |
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| 2. The ONLM will provide the administering agency with State Natural Area boundary signs. | As needed | As needed | As needed |
| 3. By September 30, 1995, the ONLM will survey for State endangered plants and plant species of concern recorded from the natural area. The ONLM will perform periodic inspections to assess future management needs. If funding becomes available in the future, then the ONLM will also arrange for surveys of endangered and threatened animals. | 9/30/95 | _____ | _____ |
| 4. By October 31, 1995, the ONLM will provide the administering agency with a map indicating known and possible locations of all endangered and threatened animals and all endangered plants and plant species of concern. The map will be updated by the ONLM should locations for any additional species be discovered. | 10/31/95 | _____ | _____ |
| 5. The ONLM, in cooperation with the administering agency, will monitor rare plant species populations and, if determined necessary, will prepare a prescribed burning plan for the natural area by December 31, 1995. Prescribed burning would assist in managing habitat for the following species: <i>Carex barrattii</i> , <i>Calamovilfa brevipilis</i> , <i>Muhlenbergia torreyana</i> and <i>Spartiniphaga carterae</i> . | 12/31/95 | _____ | _____ |
| 6. In the event that prescribed burning is not a viable option for rare species management, the ONLM, in cooperation with the administering agency, will prepare an alternate plan whereby mowing or cutting of vegetation will be used to open the habitat around certain plant populations threatened by succession. The implementation of such a plan will be subject to adequate State Park Service staffing and other operating priorities. | As needed | As needed | As needed |
| 7. The ONLM will forward a copy of any plan by the Bureau of Forest Fire Management that prescribes burning in the area of | As needed | As needed | As needed |

Martha or Harrisville to the Historic Preservation Office for review.

III. NJ Division of Parks and Forestry

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|----|---|-----------|-----------|-----------|
| 1. | In the unlikely event that the State Forester has determined that egg mass counts and prior year defoliation indicates that tree mortality will be severe without intervention, the Division of Parks and Forestry will be allowed to perform gypsy moth control activities within the natural area only after Natural Areas Council review of a gypsy moth control plan prepared by the Division and approval of the plan by the Commissioner of DEP. No pine looper activities are permitted in the natural area. | As needed | As needed | As needed |
| 2. | The Division may continue the practice of releasing water at Harrisville Pond dam to relieve the pressure on the dam caused by sudden increases in water levels due to rainstorms. This practice may be conducted only to the extent necessary to maintain normal water levels. | Ongoing | Ongoing | Ongoing |

IV. NJ Bureau of Forest Fire Management

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|----|---|-----------|-----------|-----------|
| 1. | Prescribed burning by the Bureau of Forest Fire Management will continue to be allowed within the natural area west of Old Martha Road where plow lines currently exist. If the Bureau of Forest Fire Management intends to burn a larger acreage than what has historically been burned, the Bureau will submit a plan to the ONLM for review by the Council and approval by the Commissioner. | As needed | As needed | As needed |
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V. The New Jersey Pinelands Commission

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| 1. | The New Jersey Pinelands Commission, which monitors the hydrology of Oswego River waters, will report any major changes in water quality of the Oswego River to the ONLM. | As needed | As needed | As needed |
|----|---|-----------|-----------|-----------|