Project: Long Island Central Pine Barrens Forest Fuel Reduction and Ecological Restoration Demonstration Site

New York State Department of Environmental Conservation Region 1

The Nature Conservancy

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I. Introduction

Overview

The pitch pine, oak, and ericaceous shrub dominated forests of the Long Island Central Pine Barrens represent an extremely volatile fuel type with a long history of severe fires. They are the most dangerous wildland fuel complex in the Northeast. Coupled with a dense human population and decades of extensive development, the Central Pine Barrens presents a significant wildland-urban interface hazard. These fire-dependent barrens are also an important habitat for a variety of rare, threatened, and endangered plant and insect species.

Following the most recent round of catastrophic fires in 1995, the Central Pine Barrens Commission formed a Wildfire Task Force to develop a coordinated approach to fire management. With forty-one independent members, the Wildfire Task Force has identified the need to begin a proactive approach to managing forest fuels through ecologically compatible mechanical treatments and prescribed fires.

Prescribed fire is a relatively new and unfamiliar tool for land managers, decision-makers, and the general public on Long Island. Only in the last decade has prescribed fire even become a viable land management alternative through revisions to New York State law. To date, forest fuel treatments on Long Island have been limited in variation and scope to occasional dormant season burns, most less than 10 acres. Projects at this small scale are minimally effective for fuel treatments or for fire restoration. No local examples of mechanical forest fuel reduction treatments exist at the present time.

In order for prescribed fire or mechanical fuel reduction techniques to be applied at a meaningful scale, local demonstration projects are needed for public education and as a learning opportunity for land managers to observe first hand the results of different types of fire or mechanical management. Accordingly, the New York State Department of Environmental Conservation and The Nature Conservancy have jointly proposed a demonstration project within a portion of the David Sarnoff Preserve. The project entails two major goals: the use of various combinations of prescribed fire and mechanical treatments to reduce the likelihood and severity of wildfires and to provide for ecological restoration at the same time. The proposed activities are being undertaken to establish an approximately 350-acre fire management demonstration site within the Long Island Central Pine Barrens.

Justification and Rationale

There are various statutes, policies and plans which support the implementation of a demonstration project. These are enumerated and discussed below:

New York State Environmental Conservation Law Article 57

(The Long Island Pine Barrens Protection Act)

The Long Island Pine Barrens Protection Act contains a number of sections which provide clear support for the demonstration project proposed. For example:

§ ECL Section 57-0107. Definitions states the following:

> *13. "Development" shall mean the performance of any building activity or mining operation, the making of any material change in the use or intensity of use of any structure or land and the creation or termination of rights of access or riparian rights. Without limitation, the following activities or uses shall be taken for the purposes of this article to involve development as defined in this subdivision:*
>
> > *(c) commencement of mining, excavation or material alteration of grade or vegetation on a parcel of land* ***excluding environmental restoration activities****;*

The following operations or uses do not constitute development for the purposes of this article:

> > ***(i) public improvements undertaken for the health, safety or welfare of the public.*** *Such public improvements shall be consistent with the goals and objectives of this article, and shall include, but not be limited to, maintenance of an existing road or railroad track;*

As noted above, development does not include environmental restoration activities. The environmental restoration activities proposed to be undertaken do not include mining or excavation of the project site nor permanent, material alteration. No clear-cutting or grading of the site will occur but it will remain in its existing forested state. It is well documented that the Central Pine Barrens of Long Island are a fire-dependent ecosystem and prescribed fire and mechanical treatments are accepted measures for restoration of the natural physical processes which formerly occurred in the Central Pine Barrens. The two proposed physical processes to be used will mimic these natural processes which have been suppressed for a considerable period of time and will help to restore the ecological communities found on the site.

As was stated in the Overview section, the proposed demonstration project is also being undertaken to reduce the likelihood and severity of wildfires both on the project as well as to provide data to guide the development of similar fuel reduction projects on other sites within the Central Pine Barrens. Clearly, then the proposed project also qualifies as non-development as it is a public improvement which will protect the health, safety and welfare of the public. The wildfires of 1995 demonstrated how dangerous wildfires can be even on Long Island when human lives were threatened. In addition, the wildfires threatened property and caused significant disruptions,

especially to nearby residents and transportation systems. Large volumes of smoke were generated by these wildfires over an extended period of time which resulted in effects as well. The proposed project will help to reduce this human threat and its consequences and will also provide a framework for conducting similar protective projects elsewhere in the Central Pine Barrens.

Additional rationale for the proposed demonstration project is found in other parts of the Long Island Pine Barrens Act. In section **57-0121.3: The Central Pine Barrens Comprehensive Land Use Plan; Interim regulations**, the following is stated:

> **2.** "*The land use plan with respect to the core preservation area shall be designed to protect and preserve the ecologic and hydrologic functions of the Pine Barrens by:*
>
> *(a) preserving the Pine Barrens area in their natural state thereby insuring the continuation of Pine Barrens environments which contain the unique and significant ecologic, hydrogeologic and other resources representative of such environments;*
>
> *d) accommodating specific Pine Barrens management practices, such as prescribed burning, necessary to maintain the special ecology of the preservation area".*

As is noted above, the Long Island Pine Barrens Act specifies the use of prescribed burning to maintain ecological function, as the demonstration project proposes to accomplish. Furthermore, the Act does not limit management practices to prescribed burning alone but implies that other methods are suitable. Accordingly, it can be presumed that selective mechanical treatments are therefore also included under the umbrella of "Pine Barrens management practices." It should be noted that such mechanical treatments constitute accepted practices utilized in other areas of the United States when managing forested areas subject to a fire regime.

In section **57-0121.6**, additional support is provided in regard to the demonstration project as the following excerpt indicates:

> *The land use plan shall provide for, address and include but not be limited to the following:*
>
> *(t) Provisions for fire management for controlled, prescribed burning, and responses to unanticipated fires. This shall include coordination among the department and local fire departments.*

Again, the Act provides support for the use of prescribed fire as well as overall fire management. In addition, though, the Act discusses responses to unanticipated fires such as wildfires. This indicates a clear rationale for the fuel

reduction component of the demonstration project as it will help to reduce the incidence of unanticipated fires.

The Central Pine Barrens Comprehensive Land Use Plan
Volume 1: Policies, Programs and Standards:

The Central Pine Barrens Comprehensive Land Use Plan also contains significant discussion which is directly related to the goals of the demonstration project. Significant portions of Chapter 7 of Volume 1 of the Plan entitled, "Public Land Management," cover much of the important aspects of prescribed fire, appropriate management techniques and response to wildfire. The following section is pertinent:

> **7.6.1 Recommendations for natural upland communities on public lands**
> *The three natural upland pine barrens communities are the pitch pine-oak forest, pitch pine-oak heath woodland, and dwarf pine plains (including heath variants in local areas). All of these communities depend upon periodic fires or other disturbance for their rejuvenation and maintenance. These communities should be maintained in various successional stages, in a shifting landscape mosaic.*

As noted in the aforementioned section, the Plan acknowledges the need for prescribed fire to maintain ecological integrity, one of the purposes of the proposed demonstration project. Furthermore, the Plan acknowledges "other disturbance" as a necessary component of ecological health. Such natural processes may include storm and wind damage, disease and insect outbreaks (all which can result in the downing of individual trees or parts thereof). The proposed mechanical treatments are akin to such natural disturbances as all can result in the selective removal of trees from a woodland as well. The last part of Section 7.6.1 endorses the maintenance of Central Pine Barrens ecological communities in a variety of successional stages and an overall, dynamic montage of community types. Again, the demonstration project conforms to these principles as a variety of fire prescriptions and prescribed fire-mechanical treatments will be employed which will result in just such a landscape mosaic.

Other sections of Chapter 7 also support the rationale behind the demonstration project:

> **7.6.9 Wildland fire management**
> *Natural lands within the core area of the pine barrens consist of a variety of habitats ranging from dry stands of pine to moist deciduous woodlands with streams, ponds, lakes and marshlands. Management of these systems could call for a prescribed burning or may require other techniques such as control of invasive non native species…*

Historic evidence concerning precolonial pine barrens is somewhat contradictory in that there are opinions stating that the pine barrens cover approximately 250,000 acres while other scholars view of the pine barrens is much smaller and confined to the drier, nutrient poor soils of Long Island. However, fires set by man and wood cutting are well documented and could be a major factor in the extent of the postcolonial pine barrens on Long Island….
At present only the U.S. Fish and Wildlife Service, the Department of Environmental Conservation, and The Nature Conservancy have trained individuals to carry out prescribed burns in the pine barrens area. Suffolk County is currently sending park personnel to burn school. All of these resources should be utilized in preparing a prescribed burn program…

As noted in Section 7.6.1, the use of prescribed burning is promoted by the Plan and therefore provides further verification that the demonstration project is consistent with the Plan. In addition, section 7.6.9 again reiterates the use of "other techniques" (other than prescribed fire) which may be used to manage natural lands in the Central Pine Barrens. It is expected, therefore, that this would include the judicious use of mechanical treatments, as is proposed in the demonstration project. Further credence for the use of mechanical methods is borne out by the Plan's acknowledgement that "…wood cutting…" is among the human activities which influenced the "…extent of the postcolonial pine barrens on Long Island."

The following section of the Plan provides support for the demonstration project's use of prescribed fire and its intent to reduce fuel loads thereby reducing future wildfire potential:

7.6.10 Wildfire
Total fire suppression would result in continued, unchecked fuel buildup, which increases the risk of catastrophic fires outside the natural variability of this fire regime. Experience elsewhere in the country has shown there is a point of negative returns from total fire suppression. At that point, even heavy staffing is unable to suppress 100 percent of fires. Eventually events and conditions (i.e., heavy fuel loadings, multiple ignitions, weather events with low relative humidity, strong winds, and high temperatures) overburden suppression capabilities, resulting in conflagrations or multiple fires beyond the control of resources. A solution for this lies in the development of a prescribed burning program…

Appendix B of the Plan, entitled "Development of a Prescribed Burning Plan," also contains elements which support the demonstration plan including the need for prescribed fire, especially in maintaining pine barrens; the need to reduce fuel to reduce the potential for wildfires and their threat to human life and the need to reduce the potential wildfires due to their impacts on air quality:

Appendix B

An emerging challenge within the pine barrens is sustaining short interval fire dependent ecosystems. These efforts will encounter significant difficulties; however, avoiding treatments creates various consequences (United States Department of Agriculture, 1993). For example, without these efforts the pine barrens may:

Change from experiencing relatively low damage, stand maintenance fires to more severe high damage, stand destroying fires.
Convert from fire resistant and resilient species to fire intolerant species having less resilience to fire disturbances.
Experience less controllable and more costly wildfires, which increase the danger to firefighters,
Lose existing wildland and developed area interface values.
Have and increased potential for higher particulate matter emissions during fires, due to an increase in fuel loads and understory biomass.

Central Pine Barrens Fire Management Plan:

Section 11.9 (Recommendations) in Chapter 11(Prescribed Fire Program) of The Central Pine Barrens Fire Management Plan contains several recommendations which are pertinent and which support the tenets of the demonstration project-. These are as follows:

Recommendations :
Utilize prescribed fire to reduce standing dead fuel in strategic locations to increase public and firefighter safety and aid suppression efforts.

Develop an ecological research prescribed fire management program. To maintain a shifting mosaic of natural Central Pine Barrens communities and favor rare and characteristic species of the Central Pine Barrens.

Article 9, Title 11 of the New York State Environmental Conservation Law

The authority and legal guidelines to conduct prescribed fires are found in New York State Environmental Conservation Law Article 9 (Lands and Forests), Title 11 (Forest Fire Control), Section 9-1105.6 (General Prohibitions). This section states:

For the purposes of this subdivision, the term "prescribed burn" shall mean the intentional setting of forest land on fire, under carefully controlled conditions, in order to manage, enhance, or restore populations of plants or animal species or natural communities on such land.

Accordingly, the demonstration project's prescribed fire elements are also in conformance with this additional statute of the Environmental Conservation Law.

Title 11, Section 9-1105.6 grants specific authority and responsibility to the State of New York, in particular the New York State Department of Environmental Conservation, in regard to prescribed fire. The Department may authorize a landowner to conduct a prescribed burn after a written prescribed burn management plan is prepared by or for such a landowner. No burning shall be prescribed within 75 feet of the boundary of an adjacent landowner without their written approval. Title 11 Section 9-1103.5 grants the additional power to the Department, with the consent of the owner, to "build or improve fire roads, ditches, trails or fire lines." Accordingly, the Department has clear authority under this statute to conduct prescribe fire activities on land it manages, as is proposed under the demonstration project.

Forest Practices Regulations

In conformance with the aforementioned Article 9, Title 11, Section 9-1105 of the Environmental Conservation Law, the New York State Department of Environmental Conservation promulgated regulations to oversee activities related to prescribed burning. These are found in *Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York* Part 194 (6 NYCRR Part 194). Part 194 further details the processes and conditions permissible to conduct prescribed fires. Management ignited prescribed fire is further defined as "the intentional setting of forest land on fire under carefully controlled conditions to achieve a vegetative or wildlife management goal adhering to a written and approved prescribed fire plan". Authorization is permissible for both management ignited and naturally ignited prescribed fires for purposes including, but not limited to silviculture, wildlife management, habitat management, insect and/or disease control, forest fuel reduction, wildfire suppression or as an alternative action to mechanical or chemical control of vegetation. The demonstration plan meets the requirements of these regulations

The activities and principles contained within the draft Central Pine Barrens Comprehensive Prescribed Fire Management Plan, which is complementary to the demonstration project, also satisfy the requirements of 6 NYCRR Part 194.

Regulatory Requirements

There are a number of regulatory requirements which are applicable to the demonstration project. Because the project is being undertaken on State land under the control of the New York State Department of Environmental Conservation the activity is not subject to approval by municipal entities. Applicable regulatory requirements are discussed below.

Article 19 of the Environmental Conservation Law - Air Pollution Control

Article 19 of the State Environmental Conservation Law regulates air emissions and air pollution. In New York State the Federal Clean Air Act has been delegated to New York State, via the Department of Environmental Conservation. These Federal requirements have been incorporated into Article 19. These in turn have been incorporated into the Department's regulations which are found in Chapter III - Air Resources of Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York, in particular Subchapter A: Prevention and Control of Air contamination and Air Pollution. The most pertinent aspects of these regulations are found in 6 NYCRR Part 200: General Provisions and 6 NYCRR Part 201: Permits and Certificates.

However, under 6 NYCRR Part 194 regarding Forest Practices, section 194.9 states that , "Management ignited prescribed fires and prescribed burns for which authorization under this Part is granted will not be subject to the permit requirements of Article 19." Furthermore, Section 194.9 also states that "Prescribed natural fires do not require a permit." Accordingly, because the demonstration project includes a plan prepared in conformance with Part 194 and the project will be implemented in accordance with Part 194, the demonstration project does not need an air pollution control permit.

Wetland Permits

No Tidal Wetlands are located near the demonstration project site. However, Freshwater Wetlands mapped and regulated by the New York State Department of Environmental Conservation, are found within 1/4 mile of the project area. Any regulated activities occurring within 100 feet of the landward edge of freshwater wetlands requires a permit from the New York State Department of Environmental Conservation pursuant to Article 24 of the Environmental Conservation Law (Freshwater Wetlands and its implementing regulations 6 NYCRR Part 663 (Freshwater Wetlands Permit Requirements Regulations). As the demonstration project will employ a buffer zoned/setback adjacent to freshwater wetlands of no less than 200 feet, no Freshwater Wetland permit is required from the Department.

Wild, Scenic and Recreational Rivers (WSRR)

The demonstration project is located completely outside the Peconic River Wild, Scenic and Recreational River corridor, so no permit is required pursuant to Article 5, Title 27 of the Environmental Conservation Law or its implementing regulations, 6 NYCRR Part 666 (Regulation for Administration and Management of the Wild, Scenic and Recreational River System in New York State Excepting the Adirondack Park).

II. Background

Restoration/Implementation Techniques

Fire burns through continuous fuels. Fire can move vertically up from surface fuels of pine needle or leaf litter to low growing huckleberry understory, into mid-story scrub oak, and into the crowns of pine trees. Fires can then move horizontally from tree-top to adjacent tree-top, exhibiting active and independent crown fire behavior. A break in fuel continuity, for example the removal of ladder fuels or a firebreak to bare mineral soil, can assist in controlling fire behavior and even stopping the progression of a fire. Fuel is the single factor that can be manipulated proactively by resource managers in order to achieve hazard reduction and ecological objectives.

A fire allowed to burn unmanaged in areas where fuel has been accumulating for decades due to fire suppression may have negative impacts on the resources being managed. The accumulation of fuel can consist of a build up of both dead and live material. Dead fuel accumulation, consisting of pine needles and hardwood leaves, can lead to an increasingly deeper layer of duff and litter. When this thick layer of duff burns in a severe fire, vegetation root systems may be destroyed. Jackpots of dead branches and logs on the forest floor can cause a fire to build in intensity and kill mature trees above. In areas where fire has not been allowed to play its role in disturbance by thinning out young stands of seedlings and saplings, high numbers of mature struggling trees compete for limited sunlight, water and nutrients. These dense “dog-hair” stands are susceptible to insect and disease damage and stress. Once fire torches out an individual tree it can easily spread through touching crown tops. Compared with surface fires, crown fire characteristics are associated with fires that are more difficult to control (Scott and Reinhardt 2001), higher rates of spread (Rothermel 1983), frequent spotting occurring over long distances (Butler and Cohen 1998), spotting and increased radiant heating making structures more difficult to defend(Butler and Cohen 1998), longer flame lengths dictating larger safety zones(Butler and Cohen 1998), and ecological effects that are more immediate and long lasting(Scott and Reinhardt 2001).

There are areas of the Central Pine Barrens as a whole, and the majority of this demonstration site where, due to the prolonged absence of fire, prescribed fire could have negative consequences if applied without complementary mechanical treatments. These scenarios can create complex containment and safety issues for fireline personnel and equipment as well as the public. In order to safely and desirably restore fire into these areas, vegetation first needs to be altered through mechanical means. In some areas fire

can not be used as a restoration tool but only for maintenance. Mechanical means must first be used to restore an area to desired conditions and then use fire to maintain appropriate densities, health, and regeneration.

Using mechanical equipment, shaded fuelbreaks can be created by selectively removing trees and other vegetation to create gaps in the canopy. This space between trees will provide distance in order to reduce fire spread from direct flame contact and provide room for heat to dissipate. Ladder fuels, such as mature decadent scrub oak growing into the forest overstory or the low hanging branches of pitch pine, can be cut or mowed down in order to reduce the chances of fire moving into the forest overstory. Available fuel loading can be reduced by separating fuels and/or increasing fuel moisture. Thinning pitch pine will reduce canopy bulk density and increase the wind speed needed to sustain an active crown fire (Patterson and Crary 2004).

During mechanical treatment slash is created. Slash is the debris left after pruning, thinning, or brush cutting that can include logs, bark, branches, and broken understory trees or brush. Slash must be treated in order to achieve successful fuel reduction and ecological benefits. Slash treatment can be accomplished through thinning with whole tree removal, thinning with stem removal followed by hand piling and burning, or thinning with stem removal with lopping and scattering followed by a broadcast burn (Kalabokidis,Omi, 1998, Reduction of Fire Hazard through Thinning/Residue Disposal in the Urban Interface). A broadcast burn is a prescribed fire spread over a designated area to reduce fuel hazard or accomplish some other management objective. A pile burn is a prescribed fire limited to a relatively small pile of slash and other woody debris in a limited location.

Total fuel loading will be reduced through the reduction of biomass by one of these methods. For safe and effective operations, temporary control lines may require mowing and raking to mineral soil in select areas in preparation for prescribed fire treatments.

Mechanical treatments followed by prescribed fire reduce the time required to restore vigorous, young scrub oak stands from 6 years to less than 2 years (Patterson and Crary 2004). Mechanical treatments reduce predicted intensity of surface fires by 60% (Patterson and Crary 2004). Mechanical thinning allows the land manager to reintroduce fire in a safe and effective manner with the expected ecological and wildfire risk reduction benefits. The alteration or removal of vegetation may be done to treat an entire management area or to serve as a buffer area around a unit needing more intense fire behavior. Mechanical treatments will be determined on a unit by unit basis and developed in conjunction with each prescribed fire plan. Once initial mechanical restoration treatments have been made, maintenance can often rely on reduced mechanical treatments and favor use of more cost effective prescribed burns. A plan will be developed that details the goals and specific prescription for mechanical treatment.

Fuel Reduction in the Wildland-Urban Interface

The Central Pine Barrens is a fire dependent ecosystem. As demonstrated yearly, and significantly in the 1995 wildfire season, fire continues to be a presence in the pine barrens despite nearly a century of wildfire suppression. The wildland-urban interface (WUI) is an area where wildland fuels meet improved properties at a well-defined boundary (NFPA 299, 2002). The wildland-urban interface includes areas where the Pine Barrens Core Area abuts homes, businesses and other development in the Compatable Growth Area. Public lands within the Central Pine Barrens are a valuable resource that are extensively used for recreation by these neighboring landowners and Long Islands greater population alike. People's lives and property are at risk from intense wildfire. One of the goals of this project is to reduce fuels in the WUI.

When it comes to the wildland-urban interface, fuel consists of all vegetative biomass, living or dead, as well as any other combustible material found in and around development. The greater number of wildfires that are extinguished by suppression resources, the less fire is allowed to play its role in the landscape. This leads to an accumulation of both live and dead fuel. This built up fuel loading can contribute to the size and intensity of the fires that escape initial attack, such as the 1995 Sunrise wildfires. Prescribed fire can be used to reduce the fuel loading of the vegetative biomass thereby reducing the risk or severity of wildland fires occurring in these treated areas.

The goals and objectives of hazardous fuel reduction are to reduce the rate of spread and intensity of wildland fires. Slowing the rate of spread provides additional time for firefighters to safely assess and contain a wildfire. The lower the intensity of the wildfire the easier it is for suppression resources to succeed once on scene.

Hazardous fuel reduction needs to include reduction of surface and ladder fuels, increasing the height of the forest canopy from the ground, and reducing crown density (Effects of Forest Management Activities on the Spread and Fire Intensity Levels of the Hi Meadow Fire). These goals can often be accomplished through the planned timing and ignition pattern of a prescribed fire. To effectively reduce an excessive build up of fuel in a safe and controlled manner, several prescribed fires may need to occur at the same location within a relatively short time frame. In some cases prescribed fires must be preceded by mechanical treatments in order to achieve the desired results.

The use of prescribed fire to mitigate the effects of wildfire has been well documented. There are a great number of examples where wildfires have burned into forest stands previously treated by prescribed fire. When wildfires have hit prescribed burns they have drastically altered their behavior. A 1998 prescribed fire on 130 acres of Boulder County open space helped stop a wildfire in September of 2000 heading towards homes (Boulder Open Space, Colorado, website 2003). The Cottonwood prescribed fire was set in April of 1994 in Boise National Forest. Three months later the Star Gulch Wildfire, exhibiting massive crown runs, hit the area and dropped to the ground. Most of the trees survived the wildfire. In the fall of 2001, the USDA Forest Service set a prescribed fire, the Polhemus burn, in the Pike-SanIsabel. In June 2002 the Hayman Fire, the largest in

Colorado's history, threatened the Roxborough subdivision, hit the Polhemus burn, ran out of fuel, and was easily contained along that boundary. In a comparative study of fuel reduction treatments it was concluded that "any treatment that couples a low thinning with a broadcast burn will significantly reduce wildfire hazard" (Scott, 1998). The Hi Meadow fire burned neared Bailey, Colorado in 2000 destroying 58 structures, costing $4.5 million dollars. The Hi Meadow fire burned into one area that had been thinned and prescribed burned the year before. Here the surface fire went out without the aid of suppression resources. The Cone Fire in September of 2002 hit the Blacks Mountain Experimental Forest where it entered a plot that had been thinned and burned. The wildfire just stopped (Gorman, James, How a Forest Stopped a Fire in Its Tracks, The New York Times, July 22, 2003). A study in Three Lakes Wildfire Management Area in Florida concluded that as the use of prescribed fire increases, there are documented decreases in the number of wildfires, acres burned, and the average acres per wildfire (http://flame.fl-dof.com/Env/koehler.html).

Areas to consider for fuel reduction may include zones near development, areas bordering road or trail systems where suppression resources may have access, and areas that could interrupt a large continuos wildfire run. In order to be effective, fuel reduction projects must be of a significant enough scale that will provide for the alteration of fire behavior.

Air Quality and Smoke Management

Smoke from wildland fires mainly consists of water and carbon dioxide, along with additional matter resulting from the inefficient combustion of biomass fuels (Wildland Fire in Ecosystems-Effects on Air Dec2002). The concentrations of emissions of concern decrease dramatically within short distances from the area of combustion (Batcher Hawver 2002). Why is smoke a concern? If not managed properly smoke can pose a risk to public health, safety, and reduce visibility. Fire adapted ecosystems, such as the Central Pine Barrens, that experience and are maintained by regular wildfires are affected by smoke.

The production of smoke from wildland fires is an unavoidable reality in the Central Pine Barrens. Smoke output during episodic wildfire events is uncontrolled. During large wildfire events, smoke output can have major impacts on air quality and safety. The use of prescribed fire produce many of the same inherent smoke related risks, with the distinct advantage that smoke production from prescribed fires can be strategically managed at safe levels. Prescribed fires provide the opportunity to release smoke in a planned and controlled fashion. Past experience with prescribed fire in the Central Pine Barrens and elsewhere has shown that smoke can be managed safely with minimal inconvenience to the public, and may even reduce the potential for unwanted smoke impacts from unwanted wildfires by reducing fuels and controlling the timing of fires.

Smoke and Health

Particulate matter consists of liquid or solid particles suspended in or falling through the atmosphere. Particulate matter is generated from a wide variety of sources including vehicle emissions, factory emissions, windblown dust, and wildfires. It is generally believed to be the greatest component health hazard in smoke presented to humans.

The major subgroups of the population that appear likely to be most sensitive to the effects of particulate matter include individuals with chronic pulmonary or cardiovascular disease, those with influenza, asthmatics, the elderly and children (Batcher Hawver 2002).

Personnel on the fireline are at the greatest risk from the health impacts of smoke. Five components in smoke have been determined to be local potential health hazards: acrolein, benzene, carbon monoxide, formaldehyde, and respiratory particulates (e.g. ash). Researchers found that one to fourteen percent of firefighters may be exposed to respiratory irritant, and eight percent exposed to carbon monoxide, levels above limits recommended by advisory organizations. Certain tasks (line holding, line supervision, and direct attack) involved intense exposure to smoke that could exceed recommended short term exposure limits. Burning under higher wind speed conditions also tended to lead to excessive smoke exposures. (Smoke Exposure Among Firefighters at Prescribed Burns in PacNW, 2000).

Safety and Visibility

Visibility is defined as the greatest distance at which an observer can see a black object viewed against the horizon sky. Particulate matter in the atmosphere can absorb and scatter light. The amount of scattering is dependent on the size of the particle. Small particles can attract water from the atmosphere and/or through the combustion process. These processes can lead to a reduction in visibility.

A reduction in visibility can cause a number of safety concerns. Vehicles on the fireline need to proceed with heightened awareness and caution when visibility becomes restricted. Drivers on public roads can be caught unaware of prescribed fire activities resulting in a potential increase in accident rates. Emergency vehicles can be slowed due to the impacts of smoke.

Public Nuisance

Nuisance smoke, as defined by the US Environmental Protection Agency (EPA), is the amount of smoke in the ambient air that interferes with a right or privilege common to members of the public, including the use or enjoyment of public or private resources. A variety of potential nuisance complaints can include loss of visibility, odors, soiling from ash, and eye or nose irritation.

Most often nuisance complaints occur in valley bottoms or drainages during the night. Within approximately one half hour of sunset, air cools rapidly near the ground, and wind speeds decline as the cooled stable airmass "disconnects" from faster-moving air just above it. High concentrations of smoke can accumulate near the ground and settle down drainages. (Smoke Guide 2001). Burning during stable weather conditions may reduce the ability for smoke to disperse and result in greater nuisance complaints. Complaints from the public usually occur prior to smoke exposures exceeding air quality standards.

Regulations for Smoke Management

The Clean Air Act is a legal mandate to protect public health and welfare from air pollution. States develop specific programs for implementing the goals of the Clean Air Act. Under the Clean Air Act, the EPA has established National Ambient Air Quality Standards(NAAQS) that determine the amounts of various pollutants that can be in the air without detrimental effects to public health and welfare. "Non-attainment" areas are those that are in violation of a primary NAAQS. For example, Suffolk County has been designated as an ozone non-attainment area due to its proximity to New York City.

It is not the primary intent of the Clean Air Act to manage the impacts of natural sources of impairment. Recognizing the importance of prescribed burning in ecological management, the EPA has issued an interim policy on wildland and prescribed fires. Under this policy the EPA will not designate an area as "non-attainment" when prescribed or wildland fires managed for resource or environmental benefits cause or significantly contribute to violations provided that a basic smoke management program is implemented (Batcher Hawver 2002).

Smoke Management Techniques

Fires are not point sources of smoke, but rather tend to be spatially and temporally distributed individual events. Temporary impacts to the public may occur. Smoke output during episodic wildfire events is uncontrolled. During large wildfire events, smoke output can have major impacts on air quality and safety. As stated previously, prescribed fires provide the opportunity to release smoke in a planned and controlled fashion.

The following techniques have been successful in mitigating some of the impacts of smoke from prescribed fire operations. These techniques have been documented in the National Wildland Coordination Group Smoke Management Guide for Prescribed and Wildland Fire 2001 Edition, USDA general technical report Wildland Fire in Ecosystems: Effects of Fire on Air 2002, Fire Management Plan for the Albany Pine Bush 2002, in addition to fireline experience.

A land manager's decision to use a specific management technique is influenced by many considerations, only one of which is a goal to reduce smoke emissions. Emission reduction techniques are not without potential negatives and must be prescribed and used with careful professional judgment and full awareness of possible tradeoffs.

In general two approaches are available:

1. Use techniques that reduce the emissions produced for a given area treated.
2. Redistribute the emissions through meteorological scheduling.

Reducing Emissions

Prescribed fires can have complex effects producing a mosaic of burned and unburned fuels across the landscape. A mosaic of burned and unburned fuels are planned across the project area. Mechanical removal or alteration of fuel will also reduce the amount of fuel available to fire. Separating crown and surface fuels, by reducing or altering ladder fuels can limit torching of vegetation. Flaming combustion is cleaner than smoldering combustion. Smoldering combustion results in approximately ten times' greater release of particulate matter. Use of backing fires is recommended where possible in order to cause more fuel combustion to take place in the flaming phase.

Redistributing the Emissions

Prescribed fires will be conducted on days where dispersion is forecast to be favorable, when the atmosphere is unstable allowing smoke to rise and dissipate. Mixing height is the distance at which smoke will rise due to convection, before it drifts and disperses. A high mixing height will allow smoke to adequately rise into the atmosphere and disperse.

Burning at a slower rate can sometimes provide the dilution of smoke in a given volume of air. Conversely, rapid ignition of burn unit, creating a strong plume or convection column, may result in improved smoke dispersal. Rapid ignition can concentrate the effects of smoke temporally, controlling when impacts will best be timed.

Wind direction should push smoke away from sensitive areas such as highways, airports, and populated areas. When reintroducing fire into pine barrens ecosystems that have experienced fire exclusion beyond typical fire return intervals, there may be an accumulation of fuel that can lead to increased smoke output. As restoration progresses and maintenance phases ensue, burning more frequently will prevent unwanted fuels from accumulating, thereby reducing the emissions per burn.

Each burn plan identifies sensitive receptors such as residents or highways. Burns will typically be conducted during weekdays, when a large proportion of the area's population commute to work or are absent from the area. Particular wind directions and velocities will be specified in each plan.

Prior to conducting the burn, notifications are made to the various agencies and private individuals. Increasing awareness will prepare people for the presence of smoke. Sign will be posted to increase awareness, as well as mitigate traffic problems associated with visual impacts.

When considering specific days and times for implementation of burn plans the weather is carefully monitored and evaluated. The burn will only occur if conditions are favorable, including the management of smoke impacts.

Monitoring Smoke Impacts

Weather predictions are gathered and actual weather is monitored on-site prior to and throughout the prescribed burn. A test fire, conducted in a small area of representative fuel, is ignited prior to the treatment of the entire unit. During this phase, smoke direction and dispersion are carefully monitored. The observed smoke behavior is weighed against the approved prescription in the burn plan before proceeding to the full unit.

At the time of the test fire and throughout the burn smoke impacts will be monitored. If there is a concern about the impacts of smoke to sensitive receptors, a smoke monitor whose job is to report smoke observations to the burn boss, can be appointed. If smoke behavior falls out of prescription or has unanticipated impacts, operations will be re-examined. In some cases ignition techniques may need to be adjusted. Smoke impacts can be reason enough for firing operations to be suspended and suppression efforts commenced. This decision must also weigh other safety factors into the decision to suppress fire for smoke impacts.

Personnel on the fireline need to be monitored for the negative impacts of smoke. During the briefing, prior to ignition, smoke management issues should be discussed. As part of individuals personal protective equipment, a bandanna or smoke mask should be considered to reduce the amount of particulate inhalation during periods of high smoke. Personnel being impacted by smoke while performing high exposure jobs, such as holding and direct attack, should be rotated into lower smoke areas during operations. Adequate rest and hydration can help offset some short-term effects of smoke exposure.

Fire and Fauna

Note: For purposes of this discussion, the effects of fire and mechanical treatments are assumed to be similar. Where effects on fauna differ between mechanical and fire treatments are expected, these differences are singled out, but otherwise the words “fire effects” are meant to describe both fire and mechanical treatments. Specific differences between fire and mechanical treatments might include variation in residual structures such as density of snags (either trees or shrubs), soil compaction, or residence time of disturbance.

The most important effect of fire on animals is the way fire shapes and influences their habitat. Fauna dependent on pine barrens habitat are adapted to survive patterns of fire frequency, season, size, severity, and uniformity that characterize their habitat. For animals, the vegetation structure provides resources needed to live and reproduce, including food, shelter and hiding cover. Fires vary in their size, intensity, and severity and therefore have varying effects on habitat structure. Understory fires change the canopy and regeneration by killing or top-killing the most fire susceptible trees. These fires reduce understory plant biomass, often in a patchy pattern. In shrub dominated communities, such as scrub oak, canopy cover is greatly reduced but quickly resprouts. Dead woody stems often remain standing and serve as perch sites for songbirds, raptors, and other wildlife.

Burning or mowing may increase seed viability and availability for small mammals but also increases their visibility to predators. Cover for deer may be temporarily reduced in treatment areas by fire or mowing which, along with a concurrent increase in post-disturbance forage, may result improved tree regeneration through an overall decrease in deer browse. In forests and woodlands, crown fires or severe surface fire kills most of the trees in a stand, surface vegetation is consumed in most of the area, and cover for animals that use the tree canopy is reduced. The fire killed trees become food for insect larvae and provide perches for raptors. Trees infected by decay before the fire provide nest sites for woodpeckers and then for secondary cavity nesters. Initially after a fire biomass is concentrated on the forest floor, as grasses, forbes, shrubs, and tree saplings reoccupy the site. These provide forage and dense cover for small mammals, nest sites for shrubland birds, and a concentrated food source for deer. As time progresses saplings become trees and begin to suppress the early successional shrub and herb layers. The forest again provides hiding and thermal cover for deer and nesting habitat for animals that use the forest interior. The remaining fire killed snags decay and fall, reducing nesting sites for cavity nesting birds and mammals but providing large pieces of wood on the ground. This fallen wood serves as cover for small mammals, salamanders, and ground nesting birds. The fungi and invertebrates living in dead wood provide food for birds and small mammals. When managed appropriately, the result is a mosaic of conditions to benefit flora and fauna.

Prescribed fire use often seeks to achieve long term benefits on a landscape scale to the community of flora and fauna. Short term impacts to individuals within burn units may occur in order to maintain the diversity and shifting mosaic of community types and associated populations.

Direct Effect of Fire and Animal Responses

Animal species respond predictably to the passage of fire. These responses vary widely among species. Many vertebrate species flee or take refuge, but some are even attracted to burning areas. Behavioral responses can include approaching flame and smoke for forage, and entering recent burned areas to feed on charcoal and ash. Fires generally kill or injure a relatively small proportion of animal populations. Animals with limited mobility living above ground appear to be the most vulnerable to fire caused injury and mortality. Burning during nesting season appears to be most detrimental to bird and small mammal populations. Many non-burrowing mammals and most birds leave their habitat while it is burning but many return within hours or days. Others emigrate because the food and cover they require are not available immediately after a fire. The length of time before these species return depends on how much fire altered the habitat structure and food supply. Many animals are actually attracted to fire, smoke, and recently burned areas such as birds of prey which benefit from improved hunting conditions. Most birds and mammals that immigrate are attracted by food resources.

Fire Effects on Animal Populations

Animal population changes are the net result of the behavioral and short term responses as well as the long term responses.

Birds

Bird populations respond to changes in food, cover, and nesting habitat caused by fire. Fires during the nesting season have greater direct negative, short-term effects than fires in other seasons. However, many specific habitats require periodic fire or mechanical disturbance to maintain and/or enhance their quality over the long term, which greatly outweighs any short-term losses. These include shrublands/barrens required by species such as the eastern towhee, prairie warbler, brown thrasher or field sparrow. These species tend to utilize the dense 6-15 foot tall scrub oak thickets that will be replaced by shorter, more vigorous new growth as a result of these treatments. Mowing patterns often leave small pockets of mature scrub oak near pitch pine trees intended for retention. These pockets of higher structure scrub oak will be left in a way that will benefit the retention of mature pitch pine trees during fire events and have little influence on the fuel reduction or lepidoptera habitat goals of the demonstration site. In addition, significant areas of mature scrub oak will be left unmanaged by this demonstration in the surrounding area.

Non-nesting migratory bird populations (those that are passing through the area but not nesting or breeding there) may be affected only indirectly, or not at all, by burns that occur before their arrival or after their departure.

Most raptor populations are unaffected or respond favorably to burned habitat. Fires reduce hiding cover and expose prey populations. When prey species increase in response to post fire increases in forage, raptors are also favored. Fire effects on insect and plant eating bird populations depend on the alterations in food and cover. Ground-dwelling bird populations are most likely to be affected by fires in general, whereas canopy-dwelling populations are likely to be unaffected by understory fire. Fires that increase the number of snags, dead standing trees, increase habitat for cavity nesting birds. Species that utilize pitch pine-oak forests or oak forests such as; eastern towhee, veery, pine warbler, whip-poor-will, along with scarlet tanager, ovenbird or wood thrush, should not be greatly impacted as areas of mature forest without the presence of scrub oak in the understory are targeted for limited thinning or understory burns only.

Fires influence bird populations indirectly by altering the populations of associated invertebrate species. In Massachusetts, mowing and prescribed fire treatments in scrub oak habitats has improved forage conditions for juvenile turkeys by lowering the height of the shrub cover and increasing availability of insects as a food source.

It should also be noted that fires can be planned such that only portions of a specific bird habitat are burned so that only a portion of a specific species population is affected at any one time.

Mammals

Mammals respond directly to fire-caused changes in food and cover. Small mammals, tend to be the most vulnerable but, most have high reproductive rates, that typically allow their populations to recover rapidly. Research shows that mixed severity fire had little impact on populations of small mammals in pitch pine forests of the southern Appalachians. Animals that are dormant in underground burrows during and immediately after fire are particularly well protected from direct fire effects. Deer often benefit from increased food and nutrition on recent burns. Mammal populations change little in response to fire, but they tend to thrive in areas where their preferred prey or forage is plentiful, often in recent burns.

Reptiles and Amphibians

Species that prefer open sites are expected to increase during the first 3 years after a fire. Species that use or tolerate densely vegetated habitat may decrease but will not be eliminated. Many herptofauna show little response to understory and mixed-severity fire. After mixed severity fire in pitch pine stands in southern Appalachians, populations of woodland salamanders were generally unchanged. Fires during the growing season may increase nest sites and enhance food supplies for new hatchlings. Where species of particular concern are present, such as threatened and endangered species, fires can be planned such that only a portion of the habitat is treated at any one time or conducted at a time of year when the specific species is either not present in the treatment area or will otherwise not be adversely affected by the treatment.

Invertebrates

Fire likely has no long term effects on invertebrate populations unless the fire is very severe. Many species of butterflies and moths are dependent on periodic fires to maintain their preferred habitat types. Several species are dependent on scrub oak for larval feeding and often show a preference for actively growing stems which would be in great abundance in the wake of a fire.

Trajectories of Vegetation Change

Pine Barrens ecological communities are distributed on the landscape in a complex, shifting mosaic determined by an interaction of environmental factors (fire, soil texture and nutrients, frost damage and insect herbivory) and past land use history (clearing, cutting, other disturbance). Repeated intense, top-killing and duff-consuming fire is the primary casual agent for barrens creation and maintenance (CPB Protected Lands Council 5S Process).

Pitch pine, scrub oak and heath shrubs are adapted to a combination of fire and coarse, droughty, nutrient poor, acidic soils. These pine barrens plants contain oils, resins and waxes that make them highly flammable, and increase the amount of heat emitted during a fire. Plant litter decomposes slowly due to its low moisture and nutrient content. The combination of flammable vegetation, rapidly drying soil and litter, high fuel loads and ladder fuels leads to frequent fires, which further deplete nutrients and organic matter, and eliminate competing non-barrens plant species (Rundel 1981). This “feedback loop”

maintains pine barrens vegetation, and prevents succession to hardwood forests (Mutch 1970, Latham and Johnson 1993). If fire is suppressed, given enough time (hundreds of years) even coarse Carver-Plymouth sands may accumulate enough organic matter and nutrients to support oak forests, or even more mesic beech-maple forest types.

From 1938 to the present the average sizes of fires have significantly decreased, and the average area burned per year had generally declined, with the 1995 Sunrise Wildfire being a notable exception. Barrens community types (dwarf pine plains, pitch pine-scrub oak woodland, pitch pine health and scrub oak shrubland) declined over a 12,000 acre study area from 90% of total vegetation cover in 1938 to an estimated 44% of vegetation cover in 1994 (Jordan, Windisch, Patterson 2003).

The most important vegetation changes between 1938 and 1996 were a 5,598 acre loss of pitch pine-oak-heath woodland, a 1,118 acre loss of dwarf pine plains, a 2,619 acre gain of pitch pine-oak forest, and an overall 1,168 acre gain in scrub oak shrubland. Barrens loss was due to conversion to pitch pine oak forest or to development; gains were due to succession and creation by wildfire. Predictions for the next 50 years, if trends remain unchanged, are a continued loss of dwarf pine plains, pitch pine scrub oak woodland, and scrub oak shrubland, with a continued gradual increase of pitch pine-heath, and very little change in pitch pine-oak forest

III. Site

Goal

The ultimate goal of the project is to accomplish fuel reduction and ecological restoration in the Central Pine Barrens while demonstrating proven techniques for restoring the role of fire in Pine Barrens vegetation types at an appropriate scale.

Site Selection and Description

After review of vegetation maps, aerial photography, and field visits, the Sarnoff Preserve, east of County Route 104/105 has been selected as the site for implementation of this project (see attached maps). The site is located in Suffolk County, in the eastern portion of the Central Pine Barrens, south of Riverhead and north of Sunrise Highway. The preserve is located on both the east and west sides of Routes 104/105. Treatments will be contained to an area on the east side approximately 350 acres in size. This site contains representative examples of most vegetation community types and successional stages found throughout Sarnoff Preserve and the greater Central Pine Barrens.

Vegetation

Six community types can describe most of the vegetation composition and structure within the project boundaries. Vegetation communities represented include Pitch pine Scrub oak Woodlands, Tree oak Pitch pine Scrub oak Woodlands, Pitch pine Scrub oak Forest, Pitch pine Tree oak Forest, Tree oak Pitch pine Forest, and Pitch pine Forest as described below.

Pitch Pine Scrub oak Woodlands are found on approximately 107 acres of the site. These stands can be defined by widely spaced or small groups of uneven aged pitch pine trees. Occasional oak trees may also be a component of the overstory. Between the tree species exists a continuous mat of mature scrub oak ranging from 4-15 feet in height. Below the scrub oak, surface fuels are found including huckleberry, blueberry, leaf and needle litter. These stands in their current condition have a high potential for a high intensity active crown fire.

Tree oak Pitch Pine Scrub oak Woodlands are found on approximately 17 acres of the site. These stands are very similar in structure and composition to the Pitch pine Scrub oak Woodlands. The majority of the tree species in this open woodland are black and scarlet oaks with a smaller component of Pitch pine trees. Below the scrub oak, surface fuels include huckleberry, blueberry, leaf and needle litter. These stands in their current condition also have a high potential for a high intensity active crown fire.

Pitch pine Scrub Oak Forests are found on approximately 97 acres of the site. These stands consist of a high density of mature Pitch pine trees. The majority of these are even aged and posses a closed canopy. There are widely spaced larger diameter trees with less vigorous smaller diameter groups of "dog-hair" trees between. Occasional tree oaks may be found. The understory has a range of vigorous mature scrub oak in continuous patches to less vigorous patches limited by available resources. Additional components of the understory include huckleberry, blueberry, needle and leaf litter. In the current condition these stands have a very high potential for a high intensity active crown fire.

Pitch pine Tree oak Forests are found on approximately 33 acres of the site. These stands can be defined by a majority of even aged mature Pitch pine trees and a smaller component of even aged mature Black and Scarlet oak trees. Huckleberry, blueberry, needle litter and leaf litter dominate the understory with occasional patches of scrub oak found throughout. In the current condition these stands have a high potential for high intensity surface fire, with pockets of crown fire behavior.

Tree oak Pitch Pine Forests are found on approximately 50 acres of the site. These stands consist of a majority of even aged mature Black and Scarlet tree oaks and a smaller component of even aged mature Pitch pine trees. The majority of the understory consists of huckleberry, blueberry and leaf litter. In the current condition these stands have a potential for high intensity surface fire.

Pitch pine Forests are found on approximately 14 acres of the site. These forests are a product of previous soil disturbance. These stands contain almost 100% mature pitch pine trees and a general lack of vigor and diversity of typical pine barrens species in the understory. Bearberry and needle litter comprise the majority of the understory with occasional patches of scrub oak appearing. There is a potential for moderate surface fire behavior and if fire were to reach the canopy, a high potential for active crown fire.

These are all fire adapted communities that require fire to successfully reproduce and maintain critical pine-barrens wildlife habitat. In the absence of fire, fuels (both live and dead vegetation) build up and habitat degrades. In 2001 a high intensity crown fire occurred within the site, and numerous other fire scars in the immediate area demonstrate the potential for extreme fire behavior within this area under dry and windy conditions.

Soils

Three primary soil types exist in the project location: CpA (Carver and Plymoth Sands) 0-3% slopes, CpC Carver and Plymouth Sands 3-15% slope, and PIB Plymouth Loamy Sand 3-8% slope. There is a sliver of At (Atsion) sand in the northwest corner of the site.

Carver series consists of deep, excessively drained, coarse textured soils. Slopes range from 0-35%. Native vegetation includes white oak, black oak, scrub oak, and pitch pine. In a representative profile a thin layer of leaf litter and partly decayed organic matter is found on the surface. Permeability is rapid. The root zone is mainly in the uppermost 30-40 inches. Severe limitations exist on the creation of paths and trails due to sandy surface layer.

CpA=Carver and Plymouth Sands, 0-3% slopes, 58% of project area. The hazard of erosion is slight on the soils in this unit. These soils are droughty. Natural fertility is low and not well suited to crops commonly grown in county. The site index is 50-60. There is a slight limitation on equipment and a slight erosion hazard. Moderate seedling mortality potential exists and there is a slight risk from windthrow. Species suitability includes white pine, pitch pine, red oak, white oak.

CpC=Carver and Plymouth Sands, 3-15% slopes, 23% of project area. The hazard for erosion is slight to moderate on soils in this unit. These soils are droughty. Natural fertility is low and not well suited to crops commonly grown in county. The site index is 50-60. There is a slight limitation on equipment and a slight erosion hazard. Moderate seedling mortality potential exists and there is a slight risk from windthrow. Species suitability includes white pine, pitch pine, red oak, white oak.

PIB=Plymouth Loamy Sand, 3-8%slope, 18.5% of project area. Soils in this series are deep, excessively drained, and nearly level to moderately sloping. Site index 60-70. A slight limitation of erosion hazard and slight limitation on equipment exist. Seedlings may be subject to a moderate rate of mortality. There is slight hardwood competition but moderate conifer competition. Species may include white pine, red maple, blackgum, white oak, red oak. Plymouth soils have low to very low available moisture capacity. Natural fertility is low. The root zone is confined mainly to the upper 25-30 inches. Internal drainage is good. Permeability is rapid. There are moderate limitations on paths and trails due to sandy surface layer.

At=Atsion sand, 0.5% of project area. Deep, nearly level, somewhat poorly drained to poorly drained, coarse textured soils. Adjacent to ponds, creeks, tidal inlets. The native vegetation consists of red maple, pitch pine, white oak, and highbush blueberries. In a representative profile about 4 inches of organic matter is on the surface. The upper 2

inches is leaves and partly decomposed organic matter, the lower 2 inches is decomposed organic matter. These soils have a seasonal high water table. Depth to water table ranges from 6-18 inches. Permeability is rapid and available moisture capacity is low. Natural fertility is low. The root zone is 15-20 inches thick. The hazard of erosion is slight. Limitations for creating paths and trails are moderate due to the relatively high water table. Site Index is 60-70. There is a severe limitation to equipment, seedling mortality, and windthrow.

Topography: Slopes range from nearly flat to upward of 20% on a few of the rolling hills.

Wetlands: Units are at least 200 feet away from wetland boundaries which is 100 feet beyond the regulatory jurisdiction of ECL Article 24 – the Freshwater Wetlands Act.

Access: The proposed location has access via a gated paved road off of Route 104/105, ending in a staging area that can be used by prescribed fire crews or mechanical treatment contractors. Several trails already exist providing for interior access and anchor points for operations. After project implementation these trails can also serve as access for interpreting the results of the demonstration site to natural resource professionals, firefighters, government officials, and the public alike.

Proposed Treatment

Site treatments will accomplish fuel reduction and ecological restoration by mechanical means, by mechanical treatments followed by prescribed fire, and by prescribed fire alone. Mechanical treatments may include the creation of shaded fuel breaks where separation in continuous crown closure will be accomplished by select tree removal with ladder fuels pruned or removed. Mechanical treatments may also include cutting/mowing of shrub species. Prescribed fire will include objectives of reducing dead down surface fuels, removing or elevating ladder fuels, and potentially breaking areas of continuous crown closure. Treatment season (growing vs. dormant) will also be varied to highlight differences. Both mechanical treatments and prescribed fire treatments will be distributed throughout the calendar year as long as fuels and weather conditions contained within the approved burn plan prescriptions are met.

One of the most important goals of this project is to demonstrate to a variety of audiences different methods, tools and effects of forest management. The majority of treatments will use proven and recommended forest management techniques, employing both specific types of mechanical equipment and specific timing of mechanical and prescribed fire treatments. Smaller areas will be treated for comparison purposes to demonstrate alternative methods that have proven to be less successful in meeting the objectives of ecosystem restoration and fuel reduction. Interpretive materials will be developed as part of this project following the completion of unit treatments in order to translate the effects of various treatments to intended audiences.

Specific Treatments for each type of community typed are discussed in more detail below:

Pitch pine Scrub oak Woodlands and Tree oak Pitch pine Scrub Oak Woodlands: Treatment of the majority of these areas will include the mowing of understory shrubs targeting scrub oak. Occasional small diameter trees will also be cut or mowed in order to create greater separation between canopy fuels. Clumps of unmowed scrub oak may remain to retain diverse habitat structures, especially below pine trees targeted for retention. For maximum restoration effect, mowing should occur early in the growing season but any time during the growing season may be adequate. After mowing, scrub oak should be allowed 1-2 weeks to resprout from cut stumps before prescribed fire is conducted. Prescribed fire should occur within the same growing season as mowing. Secondary demonstration treatments may include mowing scrub oak during the first growing season but waiting until the next growing season for prescribed fire, leaving scrub oak patches unmowed and then burning them either during the growing season or during the dormant season, and "control" areas left untreated either by mechanical or prescribed fire.

Pitch pine Scrub oak Forests and Pitch Pine Forests: Treatment of the majority of these areas will include select canopy tree removal and mowing of understory vegetation. Select canopy tree removal will target suppressed low diameter trees in order to separate groups of canopy fuels. Occasional larger diameter trees may also be targeted to achieve necessary fuel reduction and separation. Mowing treatments will target small diameter trees as well as scrub oak and other understory components. Cutting of canopy trees is not limited in season. Mowing of understory should focus on growing season. After mowing, the scrub oak should be allowed 1-2 weeks to resprout from cut stumps before prescribed fire is conducted. Prescribed fire should occur within the same growing season. Secondary demonstration treatments may include cutting and mowing during the first growing season but waiting until the next growing season for prescribed fire, conducting prescribed fire during the dormant season, and "control" areas left untreated either by mechanical or prescribed fire. These areas will be the most labor intensive and costly for ecosystem restoration and fuel reduction.

Pitch pine Tree oak Forests: Treatment of the majority of these areas will be focused on prescribed fire. Patches of scrub oak in the understory and occasional small diameter trees will be targeted for mowing. Mowing treatment should occur early in the growing season but any time during the growing season may be adequate. After mowing, scrub oak should be allowed 1-2 weeks to resprout from cut stumps before prescribed fire is conducted. Prescribed fire should be conducted during the same growing season. Secondary demonstration treatments may include mowing scrub oak during the first growing season but waiting until the next growing season for prescribed fire, leaving scrub oak patches unmowed and then burning them either during the growing season or during the dormant season, and "control" areas left untreated either by mechanical or prescribed fire.

Tree oak Pitch Pine Forests: Treatment of the majority of these areas will require no mechanical treatments aside from the creation of control lines. The majority of these areas will be targeted for dormant season prescribed fire. Growing season prescribed fire may also be conducted over a considerable portion of the areas.

The proposed site will be divided into treatment and burn units. Each unit will have a specific treatment identified. If prescribed burning is part of that treatment plan, a burn plan will be developed and approved prior to implementation. Permits and notifications will be made as required in the burn plan. Control lines will be identified in burn plans. Construction of control lines will take place around all burn units and may include cutting, mowing, raking, or hand tool removal of vegetation, in some areas down to mineral soil.

Small White Snakeroot (Agerotinia aromatica var. aromatica) is a rare vascular plant last observed in 1952 in dry woods in the general vicinity. It is ranked G5, S1. The project may consider potential beneficial impacts the project has in regard to reintroduction/reappearance of this species.

Treatment units will be marked. A contractor may be hired to accomplish the majority of mechanical treatments and supervised by project staff (Department of Environmental Conservation/The Nature Conservancy). Heavy equipment and machinery such as a brush-hog, hydro-axe, feller-buncher, skidder, chainsaws, etc. may be used to accomplish mechanical treatment and control line construction. Specific equipment will be identified as part of each treatment plan. Equipment may be stored temporarily on project site.

This site is a small representation of widespread species and communities found throughout the pine barrens. Pine barrens species are adapted to a disturbance regime; therefore, no significant adverse impacts are anticipated.

After initial mechanical and prescribed fire treatments are accomplished, units will be assessed and scheduled for a rotation of maintenance treatments.

Wildlife Species of Concern

Birds

Whip-poor-will (*Caprimulgus vociferous)*: State listed Species of Special Concern. The demonstration site location within the pine barrens supports breeding populations of Whip-poor-will. Whip-poor-wills are dependent on pine barrens habitat and are widespread in areas of pitch pine-scrub oak barrens. They need the areas of pine forest for nesting and the more open scrub oak areas for foraging. Lower intensity fires that reduce the scrub oak density and height while allowing the larger pine and oak trees to survive, should have no negative effects on these populations, and in fact may allow the population to increase.

Lepidoptera

The demonstration site contains extensive areas of scrub oak, *Quercus illicifolia* which provides important habitat for many rare, threatened or endangered species of lepidoptera (moths and butterflies). The list below details some species of lepidoptera known to

occur in shrubland habitats of the Central Pine Barrens, identifies which require or prefer scrub oak as a food plant, and indicates protection status in New York State. Species which prefer scrub oak as a food plant often prefer leaves of younger scrub oak stems (Tim Simmons - Massachusetts Natural heritage Program, Neil Gifford – Albany Pine Bush Preserve, Consult Paul Novak NYNHP?)perhaps due to increased nutritional content or general palatability. One of the primary restoration objectives of this demonstration site is to create significant areas of young scrub oak regrowth to benefit lepidoptera populations in the area.

Lepidoptera species with New York Natural Heritage Program (NYNHP)records in the general vicinity (several miles) of the Demonstration site are as follows:

- Coastal Barrens Buckmoth, *Hemileuca maia SSP5,*1995G5 S2, Unprotected, species of special concern. (a scrub oak feeder).
- Packard's Lichen Moth *Cisthen Packardii* 1995, G5 SU, Unprotected. (a lichen feeder)
- Edwards Hairstreak, *Satyrium Edwardsii*, 1995 G4 S4S3 Unprotected. (a Scrub oak feeder)
- Herodia or Pine Barrens Underwing, *Catocala herodias gerhadi*, G3 S2S3, unprotected special concern 1995. (a scrub oak feeder)
- Doll's Merolonche (Merolonche dolli), G3G4, SH, Unprotected, EO Rank H (historical with no recent information, last observed in area in 1931, in New York State not seen in last 15 to 20 years)
- Richard's Fungus Moth (Metalectra richardsi), 1995, SU (Status Unknown), G4, Unprotected

Additional sampling is needed in the Demonstration site area to determine what other species of lepidoptera might benefit from scrub oak restoration.

The following discussion contains some pertinent information regarding these species (information was obtained from the NatureServe Website and NYNHP and information for other lepidoptera is available as well):

Coastal Barrens Buckmoth (*Hemileuca mai)*

This specie is listed as SSP5,1995G5 S2(S2 indicating that there are typically 6 to 20 occurrences of this species in New York State with either few remaining individuals, acres or some factor in its biology making it especially vulnerable in New York State), Unprotected and, State species of special concern. It is a scrub oak feeder and is known to occur near the area of proposed project.

Terrestrial habitats in which this species is found are shrubland/chaparral, woodland – conifer and woodland – mixed. This species is restricted to pitch

pine-scrub oak barrens, including the Long Island Dwarf Pine Plains, on deep xeric sands and portions of the Nantucket heathlands with a lot of scrub oak. The species is tolerant of either sparse canopy or no canopy.

Adults do not feed. Larvae are herbivorous and are virtually restricted to consuming scrub oak (Quercus ilicifolia) as its primary foodplant. A single report of oviposition on Prunus serotina is known. Larvae will readily eat most other oaks, willows, aspens and Prunus serotina like other strains of Hemileuca maia. In nature older larvae do disperse and do use willows, Prunus serotina and other oaks occasionally if they encounter them. Young larvae eat new spring leaves whereas older larvae eat mature leaves.

Diurnal activity patterns are typical for the species with adults mating in morning or early afternoon and males seldom flying at other times. Activity is strongly suppressed by cloudy skies or temperatures below 11 degrees Celsius. Due to the maritime climate eggs hatch late, usually in late May or even occasionally early June. Larvae mature relatively quickly for this species and almost all enter the soil for pupation in mid or late July. Adults fly later than inland populations of this species, starting about October 5 in Massachusetts and generally finished by October 25. As with all strains of H. maia some pupae do not hatch the first fall but overwinter one to very rarely three times before coming out the next fall.

There are about 20 total Element Occurrences (EOs with elements being the individual species) ranked A through C by the NYNHP in terms of the status and/or relative quality of specific occurrence of the element, with A being excellent, B being good and C being fair., Several of these are not in immediate jeopardy. However, no EOs have adequate long term management plans actually functioning. Unprotected Eos, such as the Coastal Barrens Buckmoth which does not have the protection granted by Threatened or Endangered status, are very vulnerable to fire suppression and development.

In regard to the estimated number of Element Occurrences there are several EOs in the Cape Cod-Plymouth region and on the offshore islands in Massachusetts. About two or three Element Occurrences in Rhode Island are of C rank at best. There are perhaps ten Element Occurrences on Long Island New York ranging in rank from A-D

In regard to its Global Status, it was recommended that the few remaining potential sites which have not yet been checked be field inspected within the species range. Most of these are mostly scattered barrens remnants on Long Island.

Degree of Threat:
Threats to this species which were identified include fire suppression,

development and , sometimes tree planting. Fire suppression may become a problem after several decades.

In regard to Fragility, it was noted that population numbers can fluctuate. Therefore, it is recommended that a reserve of diapausing pupae be maintained in soil enabling population to survive fires.

Other Considerations noted were that if gypsy moth spraying were ever resumed this species would be vulnerable to the spray and that fire management plans which account for the needs of this species were not yet implemented.

Herodia or Pine Barrens Underwing (Catocala herodias gerhadi)

This specie is listed as G3 S2S3, unprotected and special concern 1995 (S2S3 indicating that there are typically 6 to 100 occurrences of this species in New York State with either few remaining individuals, acres or some factor in its biology making it especially vulnerable in New York State), Unprotected and, State species of special concern. It is a scrub oak feeder and is not known to occur near the area of proposed project site.

In and north of New Jersey, the habitat of this species is almost exclusively high quality, extensive, open canopied pine barren oak scrub dominated by various mixtures of blackjack and scrub oak, usually on sterile white sand. A few isolated ridgetop populations are known in southeastern New York and western Massachusetts. Trees are normally scattered pitch pines, sometimes with a bit of post or other oaks; or trees may be absent or extremely stunted (dwarf pine plains). The species is rare or absent in more closed canopy pitch pine-oak woods. Appalachian habitats are poorly understood, but probably are ridgetop pine-scrub oak areas. In general closed canopy oak-pitch pine-heath forest should not be regarded as suitable habitat for these moths.

Adults food sources for this species are unclear. Since the flight season is short and adults do not usually come to bait, they may not feed much other than taking water, but this is speculative. The larvae feed on the new growth of scrub oak (Quercus ilicifolia) and probably shrub forms of blackjack oak (Quercus marilandica) and usually begin to feed on the catkins. Catkins may be essential for normal development. Larvae must complete feeding quickly before the leaves harden.

In most of the range, including New Jersey, adults occur mainly in July straggling into August. Larvae occur in spring and complete feeding by late May or early June. Eggs occur from July to late April or May.

Occurrences ranked higher than C should generally be greater than 1000 hectares if only one patch or at least two patches of 400 hectares each.

Richard's Fungus Moth (Metalectra richardsi)

Although the status of this species is unknown and it is Unprotected, NYNHP does list the species as it was believed to be rare and it is indicated as being in the general vicinity of the project site. The species is now known to be fairly well distributed and is known to be rather common in southern New Jersey with the exception of the New Jersey Pinelands. The species is also found in common woodlands in other parts of New Jersey, Pennsylvania and Virginia. . There are no apparent threats to this species as its populations may be increasing perhaps due to prior killing of oak trees by gypsy moths.

This species appears to occur mostly in rather ordinary dry-mesic to swampy hardwood forests. It may be more common in areas with a large number of dead oaks. Larvae of this genus are believed to feed on fungi, such as bracket fungi, on trees.

In southern New Jersey there are two broods of adults year, about the end of May through most of June and again in August. Thus larvae are present in at least September-early October and in late June-July. Presumably pupae hibernate.

Doll's Merolonche

As this Noctuid moth has not been observed in the area since 1931, it is possible the species has been extirpated from the area. Also, globally the species is considered not imperiled. However, it may be uncommon to rare in parts of its range and much of its life history is poorly known.

The species apparently feeds on oaks and ericaceous shrubs. It has been found in dwarf pine plains in New Jersey, bogs, various pine-oak communities and other community types. Regardless, the project may assist in re-creating habitat that allows the species to re-colonize or to be re-introduced.

Reptiles and Amphibians

*Tiger Salamander***(***Ambystoma tigrinum)*:

This specie is listed as Endangered in New York State and is found only on Long Island.

Fire impacts on Tiger Salamanders are likely to be less as the intensity of fire decreases. Tiger Salamanders spend most of the year outside the breeding season in subterranean burrows or in moist duff layers. Furthermore, they are nocturnal and therefore would no generally be on the surface during the daytime when fire treatments would be conducted. In addition, tiger salamanders are usually prompted to leave burrows by precipitation events. Fires that are not hot enough to penetrate deeply into the soil layers are not likely to have an impact on the

salamanders. Soil compaction by equipment being used for mechanical treatments may have some impact on the salamanders.

The New York Natural Heritage Program records indicate Tiger Salamanders have bred in a wetland complex to the Northeast – completely outside of the demonstration site area. The population was first identified in 1983 and last observed occupying the site on March 25, 1998. No tiger salamanders or egg masses were observed on March 08, 2002 or on March 30, 2005. Of the demonstration site, 26.7 acres fall somewhere within an area between 200 to1,000 feet of the boundary of that wetland complex. Because the 26.7 acres represent a small fraction of the total upland dispersal area for the tiger salamander population in this area and in light of the tiger salamander's life history, periodic fire and mechanical treatments are not expected to have a significant adverse impact on Tiger Salamander populations in the area.

Eastern Hognose Snake (Heterodon platyrhincos)

This specie is listed by New York State as a Species of Special Concern.

Hognose snakes may occur in the project area. The effects of fire on hognose snakes are not known, but a highly mobile animal like a snake should be able to avoid direct impacts and the increased prey base following a fire should be beneficial. Most prescribed fires would be expected to have no significant impact on populations of hognose snakes.

Eastern Box Turtle (Terrapene carolina)

This specie is listed by New York State as a Species of Special Concern.

Box turtles occur in the demonstration area. They are diurnal.

Habitats utilized by this species include cropland/hedgerow, conifer forests, hardwood forest, mixed forest, forest-brush, forest-field ecotones, marshy meadows and grasslands and other herbaceous communities

This species burrows in or uses soil and fallen logs and debris. When inactive, this species burrows into loose soil, debris, mud, old stump holes or under leaf litter.

This species hibernates in winter. Mating and courtship occurs throughout the warm season, with a peak in fall. Eggs are laid in sandy or loamy soil in open areas. Eggs usually hatch in August, September, or October and hatchlings may overwinter in nest. Adults and juveniles consume fruit, plants and invertebrates but young are mostly invertivorous

Young are primarily (not noted in North Carolina; Stuart and Miller 1987); adults are opportunistic omnivores, eating various plants (including fruits), fungi, snails and other invertebrates, carrion, and rarely small vertebrates.

While fire intensity and speed will determine the level of direct impacts on this species, the overall impact on the population can be expected to be positive. The removal of dense interwined layers of underbrush should allow the turtles to move around the area more easily, and the flush of new growth low to the ground will provide increased foraging opportunities. Fire treatments in areas of high turtle population density may be planned to avoid time periods when the species is most active aboveground when it would be more likely to be caught unawares in a fire.

Aesthetic Resources

The project will result in the creation of broader vistas to the north and east along County Route 104. These vistas will provide excellent views of typical early successional Pine Barrens habitats. However, because of public unfamiliarity with ecological restoration and forest fuel reduction techniques, initial mowing treatments may appear similar to the initial steps of land clearing for development and pose a concern to the general public. Several options exist for mitigating public reactions including advanced earned media campaign to inform and educate the public as well as signage on site. Due to property boundaries restrictions a screen of vegetation may be left in place along the road way that may limit the publics view during the period of initial restoration (1-2 years) during which impacts will be most pronounced.

Recreation/ User Impacts

The project will have impacts to user groups of the site, both short-term and long term. In the short term, trails in the area will be closed during times when mechanized equipment is active and/ or prescribed fire is being conducted. This will impact user groups such as hikers, birders, and depending on the season, hunters. Ample opportunities are available to user groups to enjoy their preferred choice of recreation on the west side of County Route 104, where the majority of recreational trails are present.

The treatment(s) will provide positive long-term benefits to the recreational community. By creating a more diverse age class structure in the vegetation that now exists, the site will provide habitat for a greater variety of flora and fauna. This will provide benefits to the birding community. By reducing the thick vegetation, particularly in the scrub oak woodland, the aesthetic appeal to users will increase vastly because of the ability to see further into the woods, as opposed to looking at a “wall” of vegetation.

As discussed in the impacts to flora and fauna section, opening up these stands will increase forage for local wildlife, such as small game, deer, and possibly turkey. The combination of an increase in forage and an increase in the accessibility to the scrub oak woodlands, will provide more opportunities for the hunting community to enjoy their pastime.

Notification

Notification to emergency services and specific agencies will be made prior to ignition of prescribed fires. In addition local fire districts, state and local police and dispatch, neighboring agency landowners and other stakeholders will be notified in order to appropriately address public phone calls or respond to contingency plans, if the need to be activated arises. Contact information for each agency requiring notification will be listed in the Public Notification Plan section of each burn plan.

Partner agencies, essential to conducting prescribed fire activities, will be contacted as soon as an appropriate burn window is apparent. These agencies include but are not limited to: New York State DEC, US Fish and Wildlife Service, National Weather Service, Suffolk County Department of Parks, The Nature Conservancy, and local fire department and fire marshal offices.

The burn boss is responsible for ensuring that all notifications have been made prior to ignition as outlined in the public notification plan.

Monitoring:

Pre and post treatment monitoring is being developed to measure the fuel reduction and ecological restoration results. Specifically the following approach to monitoring and research is being undertaken:

1. Using satellite or aerial imagery, changes in vegetation cover across the entire demonstration site will be measured through periodic updates of a vegetation cover map most recently updated in 2003.
2. Invitations will be sent to academic researchers offering the site for experimental research in disciplines such as soils, flora, fauna.
3. Vegetation and photographic data will be collected to measure change in composition and structure.
4. Fire behavior data collected will include:
    - Burn day weather (Rh, temp, cloud cover, wind, etc.)
    - Fuel conditions

Projected Outcomes:

1. Reduced fuel loading.
2. Reduced potential for crown fire due to break in continuity of canopy fuels.
3. Reduced ladder fuels.
4. Reduced hazards to communities on the north and east sides of Sarnoff preserve
5. Reduced likelihood of severe impacts to air quality during a wildfire event.
6. Improved habitat and increased nutrition and palatability of vegetation for pine barrens wildlife species including but not limited to lepidoptera, deer, and turkeys. Improved ecological health of the various vegetational communities being treated with concomitant increases in biodiversity.

7. Increased training and experience of Long Island interagency prescribed fire and wildfire suppression crew.
8. Improved safety for firefighters during future wildfire events.
9. Interpretive site to study and learn from a variety of fuels management treatments.