Identification of Critical Issues to be Addressed In the Draft Environmental Impact Statement for The Proposed Awosting Reserve Development

Prepared for

The Shawangunk Ridge Biodiversity Partnership

Date: June 9, 2003

Prepared by:

Michael S. Batcher, M.S., A.I.C.P.
Ecologist and Environmental Planner
1907 Buskirk-West Hoosick Rd.
Buskirk, NY 12028

The Shawangunk Ridge Biodiversity Partnership

The Shawangunk Ridge Biodiversity Partnership includes Friends of the Shawangunks, Mohonk Preserve, The Nature Conservancy, the New York Natural Heritage Program, the New York State Department of Environmental Conservation, the New York State Museum, the Open Space Institute, the Palisades Interstate Park and the Office of Parks, Recreation and Historic Preservation. Although a participant in the Partnership, New York State Department of Environmental Conservation had no role in this report, as the agency has regulatory review responsibilities under SEQRA.

The Partnership was formed in 1994 to begin a coordinated ecological research and inventory program to provide the scientific underpinnings of conservation and management actions. The Partnership adopted the following vision of coordinated protection and management of the Shawangunks:

> "The Shawangunk Ridge Biodiversity Partnership will work together and with other interested organizations and landowners to maintain and, where necessary, restore natural communities and native species of the Shawangunk Mountains and the ecological processes on which they depend."

On June 18, 2003, the Partnership Steering Committee voted to accept this report and to consider the contents as representing those issues that need to be addressed in the review of the proposed Awosting Reserve development through the SEQRA process.

Table of Contents

Acknowledgements

While I was responsible for preparation of this report, most of the substance came from the many experts who provided their time and expertise to identifying potential impacts of the proposed Awosting Development. In particular, I borrowed heavily from the following memoranda:

1. Memorandum from Joe Hayes, Dan Davis, Peter Conde and Jonathan Caine to the Shawangunk Ridge Biodiversity Partnership and Save the Ridge dated April 16, 2003 regarding Awosting Reserve Proposed Development: Potential Water Related Impacts for SEQRA Scoping.

2. Memorandum from Wendy E. Harris dated April 28, 2003 on Scoping Input for Awosting Reserve EIS: Cultural Resources.

Please note that, given these were provided electronically, I used many parts of each, within this report. So, for the most part, the authors of the hydrology section are Hayes et al. and, of the cultural section, Wendy Harris. I take responsibility for any errors in transferring their knowledge to this report.

I also used information from the Shawangunk Ridge Biodiversity Partnership database, the many reports and studies prepared by the Partnership, including GIS data, the Mohonk Preserve Biodiversity Management Program, the New York Natural Heritage Program, the New York State Breeding Bird Atlas and the New York State Amphibian and Reptile Atlas Project, as well as several other plans and sources of scientific information.

Most important were the extensive contributions of a host of experts who attended a meeting on April 10, 2003 at the Mohonk Preserve and/or who have provided materials in writing. Cara Lee and Kieley Michasiow of The Nature Conservancy and Glenn Hoagland and Ellen Bennett of the Mohonk Preserve organized the April 10th meeting of experts. The science and other experts are listed in the table below:

Name	Affiliation
Spider Barbour	Botanist
Karl Beard	National Park Service
Joseph Bridges	Biologist, Mohonk Preserve Research Associate (Rudikoff Associates)
Dan Davis	Hydrologeologist, Mohonk Preserve Research Associate
DJ Evans	New York Natural Heritage Program
Ron Gill	New York State Museum
Wendy Harris	Cragsmoor Consultants
Tim Howard	New York Natural Heritage Program
Paul Huth	Mohonk Preserve Daniel Smiley Research Center
Jeff Lougee	The Nature Conservancy

Name	Affiliation
Brian Morgan	Hydrologist
Carol Rietsma	Biologist, Mohonk Preserve Research Associate (SUNY New Paltz)
Tom Sarro	Biologist, Mohonk Preserve Research Associate (Mt. St. Mary College)
Karen Schneller- MacDonald	Save The Ridge
Tim Tear	The Nature Conservancy
John Thompson	Mohonk Preserve Daniel Smiley Research Center
Troy Weldy	New York Natural Heritage Program
David Yarrow	NY Old Growth Forest Association
Experts who provided information but did not attend April 10, 2003 meeting	
Dave Clouser	David Clouser and Associates
Tom Dooley	Albany Pine Bush Preserve
Roland Kays	NYS Museum
Michael Klemens	Wildlife Conservation Society
Tim McCabe	NYS Museum
Edwin McGowan	Ecologist
Paul Rubin	HydroQuest
George Schuler	The Nature Conservancy
Shawangunk Ridge Biodiversity Partnership members attending April 10, 2003 meeting:	
Tom Cobb	Minnewaska State Park Preserve
Cara Lee	The Nature Conservancy
Glenn Hoagland	Mohonk Preserve
Hatti Grifo	Cragsmoor Association
Keith LaBudde	Friends of the Shawangunks
Heidi Wagner	The Nature Conservancy

I. Introduction

The Awosting Reserve, a limited liability corporation, has proposed construction of 349 detached residential units, an 18 hole golf course, a lodge, a beach at Tilson Lake, a post office and "Village Green," playing fields, a wastewater treatment plant, roads, and other facilities to service the development on 2,660 acres within the Towns of Gardiner, Shawangunk, and Wallkill (Lee 2003). These towns have requested the New York State Department of Environmental Conservation (NYSDEC) to serve as lead agency in the proceedings pursuant to the State Environmental Quality Review Act (SEQRA). That act provides for "scoping" or identification of issues to be addressed where a draft environmental impact statement is required.

This report summarizes issues identified by experts in the natural and cultural resources of the Shawangunks. The report has been prepared on behalf of the Shawangunk Ridge Biodiversity Partnership to assist the members as they participate in the scoping and environmental review process for the proposed Awosting Development.

Identifying these issues was accomplished primarily through a meeting of experts on the Shawangunks held at the Mohonk Preserve on April 10, 2003 and follow up consultations. In addition, there were some analyses of data from the Shawangunk Ridge Biodiversity Partnership including GIS data, the Mohonk Preserve Biodiversity Management Program, the New York Natural Heritage Program, the New York State Breeding Bird Atlas and the New York State Amphibian and Reptile Atlas Project, as well as several other plans and sources of scientific information.

This report is divided into three sections. Following this introduction, Section II briefly summarizes the significance of the Shawangunk Mountains. Section III describes potential impacts and studies needed to adequately investigate those impacts. Based on the April 10th meeting, potential impacts have been organized in the following categories:

Landscape Integrity
Hydrologic Resources
Rare Species
Cultural Resources
Recreational Resources and Visitor Experience
Fire Management
Air Quality
Construction Impacts

Finally, Section IV provides references including sources of information, plans and reports of the Shawangunk Ridge Biodiversity Partnership, experts involved in this project and other literature cited. This report does not address visual impacts, which will be significant if the project is constructed. Karl Beard (1988) has

addressed visual impacts in a report to Friends of the Shawangunks. Zoning and planning issues have been addressed in a memorandum from David Clouser (2003). Other potential impacts not addressed in this report include increased traffic on local roads, altered traffic patterns on local roads, changes in the local and regional economy, growth-inducing impacts, and impacts on local services.

II. The Significance of the Shawangunk Mountains

A. Description

The Shawangunk Mountains contain a suite of species and natural communities that give this landscape exceptional biological and cultural significance. The members of the Shawangunk Ridge Biodiversity Partnership have joined together to collect and use the best scientific information they can gather and develop to address the protection and management needs of this landscape.

The Shawangunk Mountains in New York extend from near the confluence of Rondout Creek and the Wallkill River in New York, south to the New York-New Jersey State Line. For purposes of research, inventory and conservation planning, the Shawangunk Ridge Biodiversity Partnership established a Study Area that totals approximately 153,000 acres and follows the Wallkill River and Shawangunk Kill on the east and Rondout Creek and Route 209 on the west. The Northern Shawangunks extend to just south of Sam's Point, to the valley through which Route 52 passes. The Northern Shawangunk Mountains portion of the study area is approximately 90,000 acres in area and contains a mosaic of natural communities surrounded by cultural land uses. These communities provide habitat for numerous rare and common species of plants and animals. The high quality of these communities and organisms, several of which are globally rare, make the Northern Shawangunk Mountains one of the highest priorities for biodiversity conservation in the eastern United States (The Nature Conservancy 1996).

The Southern Shawangunks extend from Route 52 to the New Jersey State Line, and contain the Bashakill Wildlife Management Area and several state forest lands managed by NYSDEC and the Neversink Preserve managed by The Nature Conservancy. The Shawangunks continue south through New Jersey as the Kittatinny Mountains and extend into Pennsylvania as the Blue Mountains (Claus 1994).

B. History of Conservation

Conservation in the Shawangunks has a long history. To date, nearly 30,000 acres have been protected with extensive, ongoing protection efforts (Map 1), with the major holdings consisting of Minnewaska State Park Preserve (12,150 acres), the Mohonk Preserve (6,498 acres) and Sam's Point Dwarf Pine Ridge Preserve (4,338 acres), and other lands owned by the New York State Department of Environmental Conservation, the Open Space Institute, the Cragsmoor Association, The Nature

Conservancy, and the Shawangunk Conservancy (Shawangunk Ridge Biodiversity Partnership in preparation). The Nature Conservancy has designated the Shawangunks one of Earth's "Last Great Places" for landscape-level biodiversity conservation. The New York State Open Space Plan (2002) identifies the Shawangunks as a "priority resource area" because of its biological and recreational values.

C. Research and Planning Efforts by the Partnership

1. Research

In 1994, the Shawangunk Ridge Biodiversity Partnership initiated a coordinated research program designed to:

- delineate and describe natural communities and rare species populations
- determine how environmental gradients influence variations in species composition and abundance within and between natural communities
- assess how historic events such as fires, windstorms, ice storms, and land use have influenced the current species composition and abundance of natural communities
- develop ecological models of specific natural communities so as to provide guidance for ecological management by land managers (Batcher 1995)

The information that has become available from this effort provides a basis for designing protection and management programs for the Shawangunk Mountains and the conservation targets that represent the components of the landscape. Specific reports prepared by the Partnership are listed in Section IV D.

2. Conservation Planning

Using this information, the Partnership identified and described six ecological systems and designated them as "conservation targets" that represent priorities for protection and management. These conservation targets contain the rare and high quality natural communities and associated rare species and represent the biodiversity of the Northern Shawangunks. Map 2 shows portions of these targets in relation to the Awosting Reserve:

- **Dwarf Pine Ridge:** Includes the globally rare dwarf pine ridge community and several associated rare communities and species.
- **Chestnut Oak Forest:** The chestnut oak forest contains numerous rare species and natural communities and provides the landscape context for the other targets, protecting the higher elevations from the affects of human uses at lower elevations.
- **Hemlock-Northern Hardwood/Mesic Oak Forest:** This conservation target contains hemlock-northern hardwood forests, northern hardwood, and

mixed oak forests, found primarily at lower elevations and more directly threatened by development and fragmentation.

- **Cliffs and Talus:** The cliff and talus communities of the Shawangunks are some of the best in the eastern United States, both from the standpoint of biodiversity and rock climbing.
- **Pitch Pine-Oak-Heath Rocky Summit:** A mosaic of pitch pine dominated communities dependent on periodic fire and shallow, low nutrient soils.
- **Lakes, Wetlands and Rivers:** The Shawangunks have five "sky lakes" and numerous wetlands that support several rare species populations. The streams are unique within both the High Allegheny Plateau and Lower New England ecoregions as defined by The Nature Conservancy.

The Partnership's research has identified the dynamic processes that either sustain or stress these community types, such as fires, storms, habitat fragmentation, deer browsing, and insect infestation and pathogens. Using this research as a basis, the Partnership completed landscape level conservation planning by establishing specific ecological goals and actions for protecting and managing these conservation targets to address specific threats as well as to maintain their long-term viability. This will require managing the landscape so that the processes and stresses that determine the extent of each conservation target are maintained or controlled. Along with programs for protection and ecological management, research and monitoring programs will be developed to help these programs adapt to changes and incorporate new information (Shawangunk Ridge Biodiversity Partnership in preparation).

III. Potential Impacts From the Proposed Awosting Reserve Development and Studies Needed to Investigate Those Impacts

The following sections address potential impacts and needed studies to address landscape integrity, hydrology, recreational uses, cultural resources, fire management, air quality and construction impacts. For each there is a brief description of the context or existing setting followed by a description of potential impacts of the proposed Awosting Reserve development and descriptions of the studies needed to address these impacts.

A. Landscape Integrity

1. Context/Existing Setting

SEQRA review focuses on impacts to specific resources and necessary mitigation of those impacts, with mitigation measures targeted to "minimizing or avoiding" those impacts. The cumulative nature of these impacts to the Shawangunk landscape need to be addressed as they can have cascade effects damaging to the ecological systems.

The Northern Shawangunks represent an intact landscape, relatively unfragmented by roads, power lines or other sources of fragmentation. The Nature Conservancy (2002) has identified over 30,000 of the 90,000-acre Northern Shawangunks as an ecoregionally significant "matrix forest block" – a relatively unfragmented, intact, expanse of forest that is large enough (> 15,000 acres) to retain critical landscape functions and processes. It is ecoregionally significant because it persists in a high-quality state – and remains important even when viewed from the very large-scale perspective of the High Allegheny Plateau ecoregion that spans 3 states (NY, NJ, and PA). This particular matrix forest block includes Minnewaska State Park Preserve, Sam's Point Dwarf Pine Ridge Preserve, parts of the Mohonk Preserve and the Awosting Reserve. Consequently, any efforts to fragment this site will have a dramatic impact on its standing as an ecoregionally significant forested area, as the impacts (both direct and indirect) of roads on biological diversity (e.g., terrestrial and aquatic species, communities, and ecosystems) are pronounced and profound (Tim Tear, personal communication).[1]

The Shawangunk Ridge Biodiversity Partnership (in preparation) has identified the Awosting Reserve as falling within one of five blocks, greater than 2,500 acres in area that without roads or trails. The Reserve would fall into a larger block if the various logging and other roads within it were not counted as permanent. The proposed development would also fall within two "protection areas" designed to conserve the dwarf pine ridge and associated communities and the extensive cliff and talus of Millbrook Mountain.

Within this landscape 30 natural communities have been mapped and documented (Thompson 1996, Thompson 1999, Biasi et al. 1998, Lougee 2000). Some of the most significant include the Dwarf Pine Ridge, a globally rare dwarf pitch pine community at Sam's Point Dwarf Pine Ridge Preserve and Minnewaska State Park Preserve; the chestnut oak forest, the second largest in New York, at over 30,000 acres and extending to the New York-New Jersey state lines; extensive pitch pine-oak-heath rocky summit; and cliff and talus communities that represent both unique habitat and recreational resources. The New York Natural Heritage Program has identified the following communities on or within the vicinity of the Awosting Reserve: chestnut oak forest (G4 S4), pitch pine-oak-heath rocky summit (G4 S3), dwarf shrub bog (G4 S3), and acidic talus slope woodland (G4? S3S4). This list does not include the hemlock-northern hardwood forest (G4G5 S4), Appalachian oak-hickory forest (G4G5 S4), or others mapped by the Partnership or the dwarf pine ridge (G1G2 S1), which is nearby.[2] However, these could also be impacted by such a large scale and intensive project, as will be described in the sections that follow.

As described above, the Shawangunk Ridge Biodiversity Partnership has identified six conservation targets that make up the biodiversity of this landscape: the Dwarf Pine Ridge, Pitch Pine-Oak-Heath Rocky Summit, Chestnut Oak Forest,

[1] Forman et al. (2002) have provided a comprehensive summary of the ecological impacts of roads.
[2] See Appendix II for an explanation of "G" and "S" ranks.

Hemlock-Northern Hardwood/Mesic Oak Forest, Cliff and Talus, and Lakes, Wetlands and Streams. Each contains a suite of species and communities dependent on the large areas covered by these conservation targets and the landscape that they represent. Development of the Awosting Reserve would significantly alter this landscape and the landscape level conservation targets identified by the Shawangunk Ridge Biodiversity Partnership (Map 2).

2. Potential Impacts

The proposed development could have a series of impacts that would negatively impact the conservation targets that occupy and define this landscape. These include the following:

1. There will be a substantial loss of area currently comprised of chestnut oak forest and other natural communities as well as associated species habitat. The total loss estimated by the applicants is 564 acres, or 21% of the project area, which will be directly lost to construction of roads, buildings, and other facilities (Full Environmental Assessment Form 2002).

2. The proposed development will fragment primarily chestnut oak forest, part of over 30,000 acres of contiguous chestnut oak forest that currently exists in the Shawangunks[3], and part of 60,000 acres of forests, barrens, wetlands, and other natural communities within the Northern Shawangunks. Fragmentation involves the creation of barriers to movement and dispersal of species. Fragmentation can alter or impede movement and dispersal of fauna and flora. Fragmentation co-occurs with the overall reduction in size of natural communities and species habitat. Fragmentation can result in alteration in light and nutrients within and along the edges of communities extending into the interior, invasion by exotic species (Brothers and Spingarn 1992, Fraver 1994), altered successional trajectories of plant communities, and loss of habitat by species adapted to specialized habitats, such as forest interiors (Villard et al. 1999, Trombulak and Frissell 2000). Roads and development are the main sources of permanent fragmentation. Along with representing barriers to dispersal, roads cause mortality from construction, mortality from collision with vehicles, modification of animal behavior, alteration in the physical environment, alteration in the chemical environment, spread of exotics and increased use of an area by humans (Trombulak and Frissell 2000). The width of the "road effect zones" of major roads may be anywhere from 100 to 1,000 meters (Forman and Deblinger 2000). Edges, created by roads and development, alter habitat used by organisms adapted to forest interiors and edge effects can extend from 50 to 500 meters into remaining interiors (Manolis et al. 2002).

2. There will be substantial alteration in species composition and structure of natural communities. This can result in changes in nutrient flow, soil temperature,

[3] The Natural Heritage Program has documented this chestnut oak forest as extending to the New Jersey State Line

and moisture, and other abiotic processes (Chen et al. 1999). Invasion by non-native species can have similar effects (Kourtev et al. 1999). In aquatic communities, including streams, lakes and wetlands, alteration in community composition and structure can affect water quantity, the timing and extent of flooding events, water temperature (e.g., from alteration of riparian vegetation) or nutrient levels from human activity (Mitsch and Gosselink 1993). Loss of component species including rare species can result from direct impacts, such as clearing, logging, construction of housing or commercial developments, expansion or realignment of roads, poaching, vegetation trampling by visitors, or insect and pathogen outbreaks, which may be facilitated by human activities. Indirect impacts include habitat loss or change that occurs adjacent or proximate to species populations.

3. The remaining, post-development natural communities will be degraded. This will likely make the remaining forest and other habitat unsuitable for supporting current species populations. Fragmentation, reduction in size and alteration in composition and structure are direct causes of habitat degradation.

4. Component species, including both common and rare species, may experience reduced recruitment. Failure of community dominants to reproduce will result in long-term and significant changes in that community over time (Keddy and Drummond 1996; Kobe et al. 1995). Forest cover and configuration are important to recruitment success of several birds (Villard et al. 1999).

5. Critically important ecological processes will be disrupted, altered, suppressed, or otherwise changes. For example, fire suppression since the middle part of the last century has effectively eliminated fire as an ecological process in the fire dependent dwarf pine ridge, pitch pine-oak-heath rocky summit, and chestnut oak systems. The result has been an increase in the height and cover of shrub layers, particularly heath species. These are highly flammable and wildfires occurring in such areas could be very intense. Efforts to reintroduce fire to these systems would be hampered by additional development in the area. Another example includes the alteration of hydrologic processes that influence wetland communities. In particular, impoundments have reduced both seasonal and long-term water level fluctuation and increased sediment accumulation. Since different species are adapted to different water level and substrate conditions, creating a uniform environment generally decreases overall diversity and may lead to increased invasion by exotics (Mitsch and Gosselink 1993). Road networks can alter the amount and timing of water flow, debris movement and sediment transport (Jones et al. 2000). These changes can have profound effects on aquatic flora and fauna. Changes in the local water budget may alter aquatic communities and species that are adapted to the current balance of water availability (Memorandum from Hayes et al. 2003). Additional development in this area would likely benefit the increasing deer populations, further intensifying herbivory on key components of these important natural vegetation communities. It is well documented that increasing deer populations are augmented by habitat fragmentation (Alverson et al. 1988).

Deer are selective of what they browse and may reduce recruitment of certain species, such as oak, allowing others to become dominant over time (Buckly et al. 1998). In some Long Island pine barrens communities and in the Albany Pine Bush, there is evidence of deer browse reducing recruitment of pitch pine (Ron Gill, New York State Museum and Greg Edinger, New York Natural Heritage Program, personal communication). In summary, additional fragmentation of the Awosting Preserve has many potential direct and indirect impacts on the conservation targets of the Shawangunk Ridge that will require thorough evaluation.

6. There will be a loss of ecosystem services provided by existing natural systems to local residents. Human welfare depends on plant productivity, soil fertility, water quality and quantity, atmospheric chemistry, and other local and global environmental conditions. These processes are controlled by composition and structure of natural communities. Human activities that modify natural communities and species populations can negatively alter the life support services that are vital to the well being of human societies (Daily et al. 1997, Naeem et al. 1999).

3. Needed Studies and Analyses

To assess these landscape level impacts, the following studies would be needed in addition to those in the succeeding sections:

1. Completion of detailed maps of natural communities, using the New York community classification (Edinger et al. 2002). This would include terrestrial, wetland and aquatic communities. Communities should be documented in terms of species composition, size, quality, number of patches, distance between patches, types of communities forming matrix, large and small patch communities, and linear communities. This analysis must encompass entire communities, which extend off-site, in order to effectively evaluate the extent and magnitude of the proposed development on this significant area and the complex suite of vegetation communities it supports.

2. An assessment of the current level of integrity of the Shawangunks landscape in terms of contiguous area, corridors within the landscape, and corridors between the Shawangunks and other landscapes, such as the Catskills is needed to understand how the proposed development will influence landscape-level processes such as dispersal and genetic exchange among populations. This should include modeling of habitat use and movement patterns of a variety of species including, but not limited to forest interior nesting birds, woodland and barrens nesting birds, predators (e.g., bear, bobcat, and fisher), amphibians and reptiles. Species that should receive attention include Timber Rattlesnakes and Peregrine Falcon. Comparisons would then be made to post-development movement and habitat use patterns. An overall analysis should be completed on the degree of fragmentation and the nature and extent of barriers to movement created by the proposed development and alternative development scenarios.

3. An assessment of species that require large areas of contiguous habitat (e.g., Black Bear, Bobcat, Fisher, Peregrine Falcon, Cooper's Hawk, and others), including forests, woodlands and barrens communities and potential impacts to those species from fragmentation, creation of edges, and loss of a significant areas of contiguous habitat.

4. An assessment of species that require specialized habitat such as cliff and talus, wetlands (including vernal pools), stream corridors, and waterfalls including adjacent spray zones.

5. A thorough review of the literature on fragmentation and edge effects and analyses of the effects of edge habitat created by the development in terms of species composition and structure.

6. An assessment of the current contribution of the Shawangunk Ridge and Awosting to local ecosystem services and how this contribution will change under the proposed development at Awosting. This should include, but not be limited to, the importance of the existing conditions on the site in supplying water resources to residential and other users, modification of local climate, such as wind patterns, and loss of the capacity of the existing forest to buffer and abate sources of noise, air and light pollution.

B. Hydrologic Resources[4]

1. Context/Existing Setting

The Northern Shawangunks are underlain by two major formations: the Shawangunk Conglomerate, formed during the Silurian (400-440 million years before present) and the Martinsburg Shale, formed during the Ordovician (440-500 million years before present). The Shawangunk Conglomerate, generally found at the higher elevations, is composed of sandstones and conglomerate, consisting of highly resistant quartz (Caine et al. 1994). The Martinsburg Formation, consisting of shale and siltstone, is more easily weathered. Groundwater is high quality, but extremely limited (Caine et al. 1994). Well yields in the Shawangunk Formation generally range from 3-5 gallons per minute (Caine et al. 1994), while those of the Martinsburg average 7 gallons per minute (Hayes et al. 2003). In addition, fractured bedrock aquifers typically exhibit heterogeneous permeabilities (that is, they vary across the landscape) so that some wells will intersect productive fractures and others will get very little water (Hayes et al. 2003).

Shallow soils create highly "flashy" streams in which there is little base flow (the portion of stream flow from ground and soil water) and extreme variation in flow following storm events (Caine et al. 1994). The aquatic systems within the

[4] Much of this section has been taken and paraphrased from the memorandum from Hayes et al. dated April 16, 2003.

Shawangunks are unique within both the High Allegheny Plateau and Lower New England ecoregions. Specifically, these streams are unique within the middle Hudson ecological drainage unit and the Lower New England ecoregion, as defined by The Nature Conservancy, due to geology, elevation, and other abiotic characteristics (George Schuler, personal communication). Soil disturbance can have major impacts on stream flow and water quality. The slopes of the Awosting Reserve include portions of watersheds of several streams including Beaver Brook, the Dwaar Kill and the Palmaghatt Kill. These in turn feed into the Shawangunk Kill and Wallkill and, in the process, recharge groundwater aquifers in the valley below.

While wetlands make up a small portion of the Shawangunks in area, they represent unique natural communities and important species habitat. These wetlands are dependent on precipitation, ground and surface waters for water input. Many are probably important to groundwater recharge as well.

2. Potential Impacts

.

Impacts and needed studies have been divided into those associated with groundwater vs. surface waters. There is obvious overlap between these two, but the nature of the impacts and studies needed differs greatly. Most of the focus is on groundwater, and the results of many of those studies will inform the evaluation of surface water impacts.

a. Groundwater Resources

Given that the source of water for the proposed development will be from groundwater, pumping could have the following impacts:

1. Since groundwater supply may be extremely limited, the development may require external sources, both for normal and peak usage and for emergencies such as fires. The source and potential impacts of these off-site supplies should be evaluated as well as methods of transmitting these supplies.

2. The development may require several hundred wells, each serving a residential unit along with wells for the lodge and any other buildings Alternatively, there may be one or more community wells. In either case, the impacts on existing wells on surrounding properties should be evaluated. These wells should be identified and mapped, and current yields assessed. Any wells that have gone dry or had limited yield during drought years should be identified by interviews with home owners. The proposed new well locations should then be evaluated for impacts to specific existing wells. This will require a baseline inventory of groundwater static water levels for an entire water year (October 1 to September 30).

3. The baseflow to streams is sustained by movement of groundwater and soil water from the surrounding watershed into the stream, and is the primary water

that sustains aquatic and riparian habitat during times of low flow and drought. Groundwater pumping may cause a decrease in groundwater levels and thus a decrease or cessation of baseflow to streams. Pumping from project wells could intercept groundwater that would discharge into the streams or induce seepage from streams back into the groundwater aquifer. Development of houses, roads and other facilities could also alter groundwater movement, affecting stream baseflow.

4. Groundwater sources feed springs, ephemeral or temporary streams, and vernal pools, which provide critical habitat for many species of plant and animal life (Paul Huth, personal communication; Barbour 1999). Groundwater use will decrease flows to springs and temporary waters. Development of houses, roads and other facilities will also alter flow into these waters.

5. The amount and patterns of groundwater flow will be altered as surface water runoff and areas of recharge are modified due to increased impervious surface.

6. Currently, groundwater is recharged through precipitation and, to some extent, from streams and wetlands. Once water is drawn up for human use and discharged into wastewater treatment facilities, there will be a net loss of groundwater from the system, as groundwater that might normally return to the local aquifer is discharged as wastewater to the treatment plant and transported out of the basin after wastewater treatment and discharge.

7. Awosting Lake and Mud Pond are underlain by fractured bedrock in direct contact with the same bedrock aquifer proposed as the project water supply. Bedrock fracture trace mapping (Caine et al., 1994) indicates that regional bedrock fracture orientation could provide a hydraulic connection between Awosting Lake, Mud Pond and any wells to the south-southeast on the Awosting Reserve. Therefore, groundwater pumping would reduce groundwater elevations in the Shawangunk fractured bedrock aquifer and could induce seepage from Mud Pond and Awosting Lake, as well as nearby wetlands. This impact could be particularly significant during drought periods.

8. Contamination of groundwater could occur from concentrated development of the Awosting Reserve from the use of road salt, pesticides, herbicides, septic systems (if used as an alternative to a treatment plan), and other waste byproducts of such a development.

b. Surface Water Resources

1. The proposed development will create road crossings of the Beaver Brook, Dwaar Kill and Palmaghatt Kill along with construction activities in close proximity to these streams at several points.

2. Increased flooding or erosion could occur from increased volume and velocity of stormwater runoff, especially due to construction or road building on steep slopes. Where stormwater is collected or water flow velocity drops, increased sedimentation will occur into streams and wetlands.

3. Point and non-point source contamination of surface and groundwater will result from maintenance of the golf course, lawns and landscaping, including the use of chemicals and fertilizers, application of road salt, and animal wastes (i.e., pets).

4. The proposed wastewater treatment plant could have significant impacts to waters receiving discharge from that plant.

5. Increased runoff from impervious surfaces will significantly impact stream channel stability by increasing the amount of discharge the channel needs to convey. This will cause erosion of banks and possibly down cutting of the stream channel to accommodate increased flows.

3. Needed Studies

a. Groundwater Resources

1. A water budget for the site should be created, including the amount of input from precipitation, surface water inflow and outflow, on-site and off-site groundwater sources, evapotranspiration, outflow (to off-site) and other parameters for existing and post-development conditions.

2. Water supply reliability should consider short-term peak delivery rates, including maximum daily demand and fire flow demands. Long term reliability should include evaluation of the water budget following development. This would compare the current water budget to changes due to consumptive use, decreased recharge, and loss of water offsite due to wastewater discharge offsite.

3. The potential loss of groundwater recharge due to impervious surface to cause long term water level decline, diminished stream or spring baseflow, groundwater overdraft, or decreases in groundwater quality should be evaluated.

4. To evaluate impacts to Awosting Lake, Mud Pond and associated and nearby wetlands, a thorough understanding of hydraulic connections within the bedrock aquifer system should be developed. This will also require evaluation of the potential for groundwater consumption to change water levels in these lakes and other surface water features and wetlands.

5. Potential impacts will include depletion of offsite water resources if water is imported to site during drought. Therefore, demonstrating the adequacy of supplies will require a description and evaluation of anticipated project water demands,

proposed well locations, and the water distribution network. Construction and performance testing of typical residential supply wells in various areas of the project should be completed. If no community water supply is planned, (that is, if each lot has an individual well) then the potential pumping impacts on some lots may be much greater than others due to the heterogeneity and potential low storage of fractured rock aquifers.

6. The cumulative groundwater consumption of the project will have a regional impact, with the greatest impact on stream baseflow or spring flow from wells near streams or springs. Differences in the spatial distribution of pumping impacts should be mapped and evaluated, and the potential for some well locations to have a disproportionate impact described.

7. Groundwater yields from bedrock wells can vary substantially. These yields can decline over time if extraction exceeds recharge and natural discharge rates. Therefore, aquifer tests should be conducted to determine the long-term reliability of bedrock wells. These pumping tests should be conducted at multiple locations, with adequate observation well measurements to evaluate potential pumping impacts on groundwater level decline, reduction in spring and stream flow and impacts on riparian habitat. Aquifer data including transmissivity, storativity, water levels, and baseline contaminants should be collected or developed from field tests. These aquifer pumping tests, including water level drawdown measurements in the pumping well and in observation wells, should be completed to evaluate the potential pumping impacts on the local area and on wells to be completed near one another in the project site. Samples should be collected in potentially impacted areas and analyzed to establish baseline water quality.

8. To properly evaluate the potential impact to stream baseflows, several streamflow measurements over the course of water year should be collected in stream channels in the project area. A map of stream reaches with sustained summer baseflow should be prepared to inventory potentially impacted stream reaches. Any proposed well locations within a well-founded buffer distance of streams should have aquifer pumping tests conducted to evaluate the potential for baseflow reductions. It should be noted from the outset that a single pumping test will not be adequate to evaluate the potential interactions between bedrock aquifers and streams, springs, seeps and vernal pools due to the spatial variability of bedrock fractures in the Shawangunks.

9. To evaluate the impact to springs, seeps and vernal pools, the locations of springs and vernal pools should be inventoried, mapped, and flow, temperature, pH, dissolved oxygen, and conductivity measurements should be collected (at a minimum). Groundwater elevation contour maps from piezometer[5] data should be prepared to evaluate the potential for groundwater level changes to reduce or eliminate groundwater flow to these areas and to determine if these features are

[5] A device for measuring the groundwater pressure (Dunne and Leopold 1978)

part of perched water tables. Extended aquifer pumping tests should be conducted in multiple bedrock well locations to evaluate the actual groundwater level changes that would occur from project pumping.

10. Current water quality parameters such as total dissolved solids, dissolved oxygen, pH, temperature range, major and trace element concentrations (with respect to State and EPA standards) should be identified in order to establish baseline data. The potential for impact to water quality and ecosystem integrity due to these and other practices should be evaluated and mitigation measures developed.

11. Potential point and diffuse sources of contamination should be identified, including pesticides, waste water effluent (from community and individual septic systems if they will be used), hydrocarbons from fuel sources, and contaminants from installation and use of utilities such as PCBs and other hydrocarbons, and potential impacts to onsite and offsite groundwater quality evaluated. The evaluation should include the fate and transport of contaminants across the site and off site.

b. Surface Waters

Many of the studies, such as development of a water budget and relationships of groundwater to surface waters described above would also be needed to evaluate impacts to surface waters.

1. Impacts to aquatic communities including fauna and flora within the streams and riparian communities should be evaluated following thorough biological surveys of these communities.

2. The overall increase in impervious area will increase stormwater runoff volume, and this impact should be evaluated.

3. Proposed treated water discharge locations need to be identified and the impacts of thermal changes and chemical constituents (e.g., phosphorous, chlorine compounds) on baseline conditions evaluated. This should include impacts to aquatic species and habitat. Impacts due to failure of the wastewater treatment plant should also be evaluated.

4. The current bankfull discharge should be identified and documented as a threshold for measuring impacts of increased runoff on stream stability. The potential to increase sediment supply during construction and the associated impacts on stream system stability and the viability of associated aquatic systems should also be evaluated. The riparian corridor is the zone of vegetation that borders a stream within the floodplain. Loss of riparian vegetation adjacent to the stream can significantly increase the likelihood of excessive bank erosion, reduce pollutant buffering capacity, and impact the thermal conditions important to cold

water habitat. This potential impact should be evaluated as well, along with the adequacy of proposed riparian buffers.

C. Rare Species

1. Context/Existing Setting

Rare species include species tracked by the New York Natural Heritage Program, species listed as special concern, threatened or endangered by the New York State Department of Environmental Conservation (6 NYCRR, Part 182), species listed as threatened or endangered under the Endangered Species Act, declining and vulnerable species, such as certain birds listed by Partners in Flight, and regionally rare species (i.e., rare within the Shawangunks). Sources of information include the records of the New York Natural Heritage Program, the New York State Amphibian and Reptile Atlas Project (2003), the New York State Breeding Bird Atlas Project (2003), the New York State Endangered Species Program (2003), Partners in Flight (2003), The Nature Conservancy Shawangunk Ridge Program and the Mohonk Preserve Daniel Smiley Research Center as well as experts consulted for this report. In addition, reports in Section IV D, E and F provide information on many rare species and natural communities.

Based on current information from the Shawangunk Ridge Biodiversity Partnership (in preparation) and the New York Natural Heritage Program, there are currently 51 rare species, tracked by the New York Natural Heritage Program in the Shawangunk Study Area. Several species that are historic to the Shawangunks are the subject of periodic inventory efforts and could still exist there. The New York Natural Heritage Program identified eight species within proximity to the Awosting Reserve project. These are listed below:

Scientific Name	Common Name	Global and State Ranks[6]	State Status
Corema conradii	Broom crowberry	G4 S1	Endangered
Crotalus horridus	Timber rattlesnake	G4 S3	Threatened
Falco peregrinus	Peregrine falcon	G4 S3B, SZN	Endangered
Juncus subcaudatus	Woods-rush	G5 S1	Endangered
Lycopodium complanatum	Northern running-pine	G5 S1	Endangered
Minuaritia glabra	Appalachian sandwort	G4 S2	Threatened
Rhododendron canadense	Rhodora	G5 S2	Threatened
Sphagnum andersonianum[7]	Sphagnum	G3? S2	

[6] See Appendix I for an explanation of G and S ranks.

[7] Two other species, *Sphagnum angermanicum* (G3? S1) and *Sphagnum cuspidatum* (G5 S4) are also found within the Palmaghatt ravine.

Other species listed in New York under 6 NYCRR, Part 182, found in the Shawangunks and potentially on or near the Awosting Reserve include the following listed as Special Concern: the Jefferson salamander (*Ambystoma jeffersonianum*), the Marbled salamander (*Ambystoma opacum*), the Wood turtle (*Clemmys insculpta), the* Eastern Box Turtle (*Terrapene Carolina*), the Whip-poor-will (*Caprimulgus vociferous),* the Sharp-shinned hawk (*Accipiter striatus*), and Cooper's Hawk (*Accipiter cooperii*). Declining birds, identified by Partners in Flight include the, Cerulean Warbler (*Dendroica cerulean)* and Golden-winged warbler (*Vermivora chrysoptera*), both of which are Special Concern species in New York, the Wood Thrush (*Hylocichla mustelina*), the Prairie Warbler (*Dendroica discolor*), Worm-eating warbler (*Helmitheros vermivorus*), and Blue-winged warbler (*Vermivora pinus*). Based on potential habitat, mountain spleenwort (*Asplenium montanum*) is very likely on the cliff faces within and adjacent to the preserve. A second rare sphagnum (*Sphagnum angermanicum*) is also present within the Palmaghatt Kill drainage, and clustered sedge (*Carex cumulata*) is found around Lake Awosting and Mud Pond.

The site also has potential habitat for the Allegheny Woodrat (*Neotoma magister*) listed as Endangered in New York, and historic in the Shawangunks. Woodrat populations were decimated by a pathogen, but there are large areas of potential habitat that have not been searched thoroughly, so this species may still be present (Ed McGowan, personal communication).

2. Potential Impacts

Potential impacts include loss of habitat, alteration of habitat (e.g., changes in light or moisture regimes) fragmentation of habitat and, therefore, of species populations, alteration of movement and dispersal patterns, disturbance to breeding, foraging or other activities of species, and death or injury caused by human interactions such as trampling, road kills, kills by pets (dogs and cats), use of herbicides and pesticides that could poison or reduce the health or reproductive success of these species, introduction of non-native competitors or other human activities.

As described in E below, the residents of the proposed development will be exposed to animal born pathogens such as West Nile virus and Lyme disease. Eradication efforts that use pesticides could impact rare species populations both on and off site.

3. Needed Studies

In order to assess these potential impacts, a series of studies are needed including:

1. Completion of a review of the above sources and other literature (e.g. Swift 1995) and knowledgeable experts on existing, historic and potentially occurring rare species in the Shawangunks to identify potential targets for field surveys.

2. Completion of seasonally appropriate field surveys for these rare species. For example, breeding birds should be surveyed during the breeding season, and rare plants when fruiting or flowering. These surveys should not be limited to the property or area being developed. Surveys should extend to areas used by wide-ranging species or species using nearby habitat. For example, amphibians may breed off-site, but use the site during some part of their life cycle. Surveys limited to the Awosting property would not identify those species. Since surveys will be needed for many taxonomic groups, surveyors should include botanists, community ecologists, ornithologists, invertebrate and vertebrate zoologists and others suitably experienced and trained. Searches should be documented with areas searched mapped and described. Occurrences should also be documented. Survey methods should be completed by qualified biologists and should be completed using methods that do not harm fauna during collection or disturb plant or animal populations.

3. Completion of reviews of the literature and surveys of experts on habitat requirements, life cycle, foraging and other behavior, buffer requirements and other needs of species found during surveys or potentially impacted from the development.

4. The impacts of artificial lighting on both rare and common species should be evaluated, both in terms of habitat, foraging and reproductive success and in encouraging use of the area by species not currently found there.

5. Development of models of population dynamics for species found during surveys on site or potentially impacted off-site. Some species exist in subpopulations that may extend off-site, and disturbance to one subpopulation could cascade through the larger population.

6. Large development projects typically have landscaping plans available prior to the start of the project. The species selected will effect the surrounding landscape. For each species selected in the landscape plan, a literature review to determine what negative impacts these species may have on the rare plants, rare animals, and significant natural communities both within and outside of the Awosting Reserve is needed to better evaluate the landscaping impacts.

7. Plans for eradicating potential sources of animal (including insect) born diseases should be developed and the impacts of implementing them evaluated in terms of impacts on rare and common species.

The methods and results of surveys, literature searches and population modeling should be incorporated into any environmental review documents.

D. Recreational Use and Visitor Experience

1. Context/Existing Setting

The Shawangunks are in close proximity to New York City and more than 20 million people in the tri-state area. More than 500,000 people are estimated to visit the Northern Shawangunks annually. Minnewaska State Park Preserve, the Mohonk Preserve and Sam's Point Dwarf Pine Ridge Preserve all have extensive recreational trails and facilities. The cliffs at the Mohonk Preserve and Minnewaska State Park Preserve provide access to some of the premier rock climbing areas in the northeastern United States. Recreational visitors come to the Shawangunks for hiking, horseback riding, climbing, mountain biking, picnicking, cross country skiing and other recreational pursuits. There is increased pressure for recreational opportunities. At present, the visitor experience is generally high, with visitors able to find numerous areas to enjoy recreational pursuits, including backcountry experiences and enjoyment of extensive scenic vistas.

The Awosting Reserve presently shares a five-mile, contiguous border with Minnewaska State Park Preserve and a 3,000-foot border with Sam's Point Dwarf Pine Ridge Preserve. Along this border are may well-known and highly scenic destination points including the Verkeerder Kill Falls, Gertrude's Nose, Hamilton Point, and Castle Point, all of which look over the currently undeveloped Awosting Reserve property.

Research on the impacts of recreational uses has been limited. According to a recent literature review (Jordan 2000), recreation uses such as hiking, jogging, horseback riding, and others can cause negative impacts to ecological communities, plants and wildlife, including trampling, soil compaction, erosion, disturbance (due to noise & motion), pollution, nutrient loading, and introduction of non-native invasive plant species. Trails and roads form corridors that cause habitat fragmentation and increase the amount of edge, which may affect resources available to some plant and animal species.

Many of natural communities found in the Shawangunks have shallow soils that are vulnerable to erosion caused by traffic and typically have slow "recovery" rates. Impacts to rare species populations, such as the broom crowberry (*Corema conradii*) population at Gertrude's Nose are increasing (Jeff Lougee, personal communication). These impacts of visitor use are increasingly challenging land managers as numbers of visitors increase. Residential development around the Shawangunks is a major source of new visitors.

2. Potential Impacts

The proposed development could impact the visitor experience by establishing a large, occupied development adjacent to what is now backcountry.

The current views from large areas within the Mohonk Preserve, Minnewaska State Park Preserve and Sam's Point Dwarf Pine Ridge Preserve, as well as views to the Shawangunks from the road network in large areas of the surrounding towns will be significantly and permanently altered (See Beard 1988 for a thorough review of impacts to visual resources. Hikers will stand on Gertrude's Nose or Margaret's Cliff and see houses, hear lawn mowers, and watch cars along the roads serving the development. Residents of the development will demand access to adjacent lands, particularly Minnewaska State Park Preserve and Sam's Point Dwarf Pine Ridge Preserve, further taxing the resources of those lands. The environmental assessment form indicates construction will continue to at least 2014, creating a long-term impact to visitor experience from construction activities. The increased visitation and new access from the proposed development to what are currently distant locations in Awosting Lake to Napanoch Point to Sam's Point triangle put extensive pressure on sensitive areas, including the dwarf pine ridge community.

3. Needed Studies

Studies needed to address these impacts include:

1 Baseline studies of visitor use of the Mohonk Preserve, Minnewaska State Park Preserve and Sam's Point Dwarf Pine Ridge Preserve should be completed to provide the number of visitors, per year, by season, on weekends (by season) and other time frames relevant for visitor and other management.

2. The potential trends in the number of visitors over the short-term (5-10 years) and long-term (10-25 years) should be projected given projections of local and regional population growth and recreational use and from the proposed development and alternative development scenarios.

3. The relationship between the number of visitors and visitation of specific destination points and clusters of points by season and for peak use periods should be evaluated and mapped.

4. Potential impacts of increased visitation on specific occurrences of rare species populations and natural communities should be evaluated.

5. Potential impacts on educational and management programs, including the ability of the land management organizations to implement ecological management including deer management, hunting, fire management and invasive species control should be evaluated.

6. Analyses of the relationship between the number and types of visitors and staffing and other resources needed to serve them at Minnewaska State Park Preserve, the Mohonk Preserve, Sam's Point Dwarf Pine Ridge Preserve and other managed areas. These analyses should evaluate the number of staff, staff training, staff activities (e.g., interpretation, enforcement, rescue, etc.), equipment and

operating expenses, and other resources needed to serve new visitors at new points of access.

7. The demographics of owners and the kinds of recreational demands they will generate should be described.

8. Noise and visual impacts on the visitor experience, both during and after construction, should be evaluated and the areas impacted mapped.

E. Invasive and Nuisance Species

1. Context Existing Setting

Invasive species, including garlic mustard (*Alliaria petiolaris*), Japanese barberry (*Berberis thunbergii*), and bush honeysuckle (*Lonicera* spp.) can outcompete native species, reduce the ability of component species to reproduce and alter habitat for fauna and flora. Purple loosestrife *(Lythrum salicaria*) has become a dominant in many of the wetlands at lower elevations in the study area (Thompson 1996). The Shawangunk Ridge Biodiversity Partnership (in preparation) has identified the following invasive species as priority threats:

Adelges tsugae	Hemlock woolly adelgid
Ailanthus altissima	Tree of heaven
Alliaria petiolata	Garlic mustard
Berberis thunbergii	Japanese barberry
Fiorinia externa	Elongated hemlock scale
Lythrum salicaria	Purple loosestrife
Microstegium viminium	Japanese stiltgrass
Phragmites australis	Common reed

Invasive species can also alter other ecological processes, such as the natural fire regime (Richards et al. 2000), nutrient flow and variation in wetlands (Bender 1987), reproductive success of fauna (Schmidt and Whelan 1999) and flora (de Winton et al. 1996) and energy budgets of ecological systems (Mack et al. 2000).

Insect/parasite infestations represent outbreaks of insects or other parasites that feed on and damage plant species within natural communities. Examples include gypsy moth (*Lymantria dispar)* and wooly adelgid (*Adelges tsugae)*. Most of these insects are nonnative. Nursery stock is one source of such pathogens (Campbell and Schlarbaum 2002). Insect infestations or outbreaks can have profound impacts on species composition and abundance. There has been significant mortality to canopy oaks as a result of gypsy moth damage, and hemlocks are suffering as a result of the hemlock woolly adelgid and elongate scale (Ecoscientific Solutions 2001, Paul Huth, personal communication). Invasive plant species could also take hold in areas where hemlock is lost.

Pathogens such as rabies and a recent fungal outbreak in amphibians can alter and reduce wildlife populations. As with insect infestations, pathogens can have a profound impact on species composition and abundance. One of the best examples of this is the chestnut blight that all but eliminated the American Chestnut in the early part of the 20th Century, significantly impacting the oak-chestnut forests of the Shawangunks. The Allegheny woodrat (*Neotoma magister*) may have been extirpated from the Shawangunks due to a pathogen. Lyme disease caused by the bacterium *Borrelia burgdorferi* carried on the tick *Ixodes scapularisis* is closely tied to populations of host species, including deer and mice. Increases in populations of these hosts will create vectors for human infection by this and other animal born diseases.

2. Potential Impacts

The creation of lawns, a golf course, and landscaped areas, along with land disturbance will create favorable habitat for many invasive plant species beyond those listed above. Roads and trails will provide pathways to the interior portions of the Shawangunks that are currently isolated. Insects and pathogens could also be brought to these interior and high elevation areas of the Shawangunks by means of the proposed development and alternative development scenarios.

Humans will bring pets including dogs and cats that could impact wildlife near to new homes (Pimentel et al. 2000). Creation of a cat colony could have much more significant impacts on wildlife. Such colonies are generally created when cats are abandoned within an area[8] and continue to be fed by humans (Roland Kays, personal communication). In addition, development of housing will create habitat and food (e.g. garbage) that will result in an increase in nuisance animals such as skunk and raccoon. Many organisms can be impacted ranging from nesting birds to roosting bats (Oehler and Litvaitis 1996). There will be significant amounts of increased edge within a currently forested site as lawns, roads and other facilities are created.

The Awosting development may also provide habitat, in the form of planted vegetation around homes and the golf course, for white-tailed deer (*Odocoileus virginicus*). In numerous studies in the eastern and central United States, high deer populations have been shown to reduce, and in some cases eliminate, recruitment of both woody and herbaceous species, including rare species (Augustine et al. 1998, Buckly et al. 1998). Along with deer, insects and rodents can significantly reduce the number of viable acorns, though deer will browse seedlings to the extent that regeneration is negligible (Lorimer, C. 1992). Deer have been documented to reduce regeneration of hemlock and oak (Stromayer and Warren 1997). As noted in Section III A above, deer browse can be significant on pitch pine, thereby representing a significant threat to successful regeneration of pitch pine. In some areas deer browse favors growth and reproduction of species not favored by deer

[8] Cats are often abandoned near public lands and have become a problem in some state parks.

(e.g., invasive plant species such as exotic honeysuckle), which would clearly alter the composition and structure of natural communities.

3. Needed Studies

Studies to assess these impacts would include:

1. Literature searches and expert surveys on the biology and ecology of invasive and nuisance species compiled for use in assessing their impacts.

2. Field surveys, both on and off-site of invasive and nuisance species to identify potential sources.

3. Modeling of pathways for invasives species to reach the interior portions of Shawangunk natural communities, via roadways and other paths created by the proposed development and alternative development scenarios.

4. Analyses of the potential for propagules of invasive and exotic species to enter from fill used in construction as well as temporary (e.g. erosion control) and permanent plantings.

5. Modeling of the movement and population dynamics of white-tailed deer and the zone of impact on native fauna and flora from altered movement patterns.

6. Modeling of movement and population dynamics of nuisance species, particularly skunk and raccoon, both pre and post development and identification of both on and off-site areas that would be impacted by changes in populations and movement patterns.

7. Estimation of the potential for nonnative pathogens to be brought to interior portions of the Shawangunks via the proposed development and alternative development scenarios.

8. Estimation of the potential for increased hazard to residents from animal born diseases.

F. Cultural Resources[9]

1. Context/Existing Setting

Human beings have inhabited the Shawangunks for over 10,000 years. The Native American presence dates to approximately 8200 B.P. (before present), and possibly as early as 11,500 B.P. Archaeological sites from the prehistoric period have been found throughout the ridge. Among the more important are the Indian

[9] This section was developed and paraphrased largely from a memorandum written by Wendy Harris.

Cave Site, located in the Minnewaska State Park Preserve, and the Mohonk Rockshelter Site, located in the Mohonk Preserve. Excavations at the Mohonk Rockshelter indicate that the ridge environment may contain repositories of archaeological information that cannot be found in other settings. Although archaeologists have long been aware that areas such as the Shawangunks contain prehistoric sites, it is only recently that they have recognized the importance of high elevation environments for understanding the development of prehistoric cultures in the eastern United States (Harris 2000, Harris 2003).

In addition to Native American archaeological sites, the Shawangunks also contain cultural resources associated with historic period Euro-American use of the ridge. Important examples include Trapps Mountain Hamlet, an 18th and 19th-century mountain community, the significance of which has been recognized by listing on the National Register of Historic Places, as well as structural remains and archaeological evidence remains of the regionally important and now vanished agricultural practice of berry picking. Other regionally significant historic period cultural resources present on the ridge are associated with 18th and 19th-century activities including millstone quarrying, charcoal making, shinglemaking, bark peeling, hoop pole production, and wintergreen distilling along with the remains of small sawmill operations and other rural hydro-powered industrial pursuits (Harris 2000, Harris 2003).

2. Potential Impacts

Impacts include the physical destruction of artifacts and sites during the development and through increased visitation from residents. The Area of Potential Effect (APE) for this undertaking is defined as all terrain where physical impacts will occur. Within the Awosting Reserve, potential impacts include any resulting from construction and grading. Thus the applicant must consider building lots in their entirety (for residences and as well as other structures), roads, the golf course, parking lots, picnic areas, pools, sewage treatment facilities, playing fields, all walkways, new trails, staging areas, and all construction access roads.

Since increased access by residents and visitors to cultural resources will also impact cultural resources, all areas within Reserve defined as archaeologically sensitive should be considered part of the APE. This would include any open or buffer areas determined to be archaeologically sensitive as defined in 3 below.

Lands located adjacent to the Awosting Preserve (including the Minnewaska State Park Preserve and Sam's Point Preserve) will also now become accessible to large numbers of people as a result of this undertaking. Therefore the boundaries of the APE should be extended beyond the Awosting Preserve's boundaries to include areas of known archaeological sensitivity a zone defined by potential direct impacts and increased visitation as defined in 3 below.

3. Needed Studies

For the proposed Awosting Preserve Development, studies conducted as part of cultural resource compliance under SEQR would include Phase I and Phase II archaeological surveys of the APE. State law governing cultural resources is Section 14.09 of NY State Parks, Recreation, and Historic Preservation Law. If any wetlands on the property are under the jurisdiction of the US Army Corps of Engineers, federal involvement may also be necessary. If there is federal involvement, the Advisory Council on Historic Preservation's regulations, "Protection of Historic and Cultural Properties" 36 CFR 800 require that the federal agency initiate Section 106 consultation with the State Historic Preservation Officer (SHPO).

The New York State Office of Parks, Recreation and Historic Preservation Historic Preservation Field Service's archaeology staff should determine the types and extent of surveys needed to address the potential impacts of this development. The potential cultural resources to be surveyed should include Native American and Historic Euro-American archaeological sites, structural remains, and landscape features. As stated above, in addition to the portions of the Awosting Preserve that are to be developed, the areas investigated should also include all archaeologically sensitive terrain located in areas of the Preserve set aside as "open" or "buffer" land, as well as adjoining portions of Minnewaska State Park Preserve and Sam's Point Preserve. Areas that should be considered especially sensitive include areas surrounding wetlands, areas surrounding Mud Pond and Lake Awosting, corridors adjoining waterways or adjoining the locations of known prehistoric/historic period trails, areas likely to contain rockshelter sites such as the escarpments that overlook the Awosting Preserve's northern boundary or any other rock ledge overhangs, and all areas of slope of less than 12%. Many of the historic period Euro-American resources are associated with extractive activities and are apt to be located within terrain not typically considered sensitive.

a. Phase I Surveys

The purpose of Phase I surveys is to identify all known and previously unknown archaeological and historic properties. The Historic Preservation Field Service staff should approve the scope-of-work for all surveys.

1). Phase Ia

The Phase Ia survey should include a thorough literature review. In addition to reviewing OPRHP and State Museum files, this review should include records and information at the Daniel Smiley Research Center, the Elting Memorial Library, and the Ellenville Public Library. Documents that must be reviewed include the Minnewaska State Park Preserve and Sam's Point Preserve Master Plans and all past issues of the Shawangunk Watch that deal with the region's cultural history. Knowledgeable experts should also be interviewed. A model should also be

developed that contains a delineation of all archaeologically sensitive areas within the APE. The Phase Ia should also include complete pedestrian reconnaissance of the entire APE.

2). Phase Ib

The Phase Ib survey should involve intensive field-testing and evaluation of all archaeologically sensitive areas. All final reports should be reviewed and commented upon by the Historic Preservation Field Service staff and included, along with these reviews, in any environmental review documents.

b. Phase II Surveys

More intensive Phase II investigations should be undertaken in order to evaluate the National Register-eligibility of each property. Again, the Historic Preservation Field Service's staff should review and approve any scopes-of-work developed by the applicant for all Phase II investigations. All archaeological work undertaken for the EIS should meet the requirements set by OPRHP and according to its recommended standards. For all properties determined to be potentially eligible, the consulting archaeologist should develop mitigation strategies for dealing with impacts. Again, all final reports should be reviewed and commented upon by the Historic Preservation Field Service staff and included, along with these reviews, in any environmental review documents.

G. Fire Management

1. Context/Existing Setting

There is a long history of fire in the Shawangunks. Laing (1994) showed that fires and fire dependent vegetation were found in the Sam's Point area and the Badlands at least 9,000 years before present. Native Americans may have used fire for land clearing and it is likely that some fires escaped. European settlers used fire for clearing and after logging (Russell 2001). Frequent fires resulted from berry pickers up to the end of the second World War. Since then, fires have been suppressed with a significant decline in the size of wildfires (Hubbs 1995; Batcher 2000).

Altered fire regime can negatively impact those species and natural communities dependent on fire for recruitment and regeneration and where fire is necessary to maintain habitat structure and composition. The lack of fire and fire suppression have resulted in increases in fuels, primarily in the form of extensive shrub layers of highly flammable heath layers (e.g., huckleberry, blueberry, mountain laurel, sheep laurel, etc.) within the dwarf pine ridge, the pitch pine-oak-heath rocky summit and the chestnut oak forest. Shrubs have increased in height, and therefore, in their contribution to fuel loads. Rees (1997) noted significantly less shrub cover

within sparse pitch pine-oak-heath rocky summit communities subjected to historic wildfires than those that had not burned. High fuel loads have increased the potential for large, intense, and fast moving wildfires.

Absent fire, it appears that significant areas of the pitch pine-oak-heath rocky summit and dwarf pine ridge have transitioned to other community types. At this stage, most of that is reversible through the appropriate application of fire and mechanical treatments. However, these trends will continue to a point where reversing them would become difficult and expensive. At that point, the conservation targets would no longer be considered viable (Shawangunk Ridge Biodiversity Partnership in preparation).

2. Potential Impacts

The proposed development could alter fire regimes in two ways. First, both during and after construction, the development could be a source of ignitions. During construction, there will be removal of vegetation, movement of rock and soil, some blasting, use of power tools and an increase in human activity, all of which could lead to potential wildfires. Following construction, the use of outdoor grills, woodstoves, burning of leaves and yard waste, campfires (including potential illegal camping and campfires on adjacent managed areas by residents of the proposed development) and other human activities that could lead to ignition of wildfires.

Second, plans to use fire for ecological management could be hampered by the existence of the proposed development. The Awosting Reserve is north and east of Sam's Point Dwarf Pine Ridge Preserve and south and east of Minnewaska State Park Preserve. Smoke from fires from those locations could move toward the proposed development following southerly and westerly winds, which are prevalent during the spring, summer and fall when wildfires are likely or prescribed burns most appropriately scheduled (Batcher 1998; Shawangunk Ridge Biodiversity Partnership in preparation). Residents of the proposed development would be impacted by smoke and would likely oppose the use of fire that they would feel threatening to their property.

3. Needed Studies

To address these impacts, several studies are needed including the following:

1. Identification of potential sources of wildfire, both on and off-site that could start within and/or impact the proposed development and alternative development scenarios.

2. An evaluation and analysis of the response times of local fire departments, adequacy of fire department equipment and training to protect the proposed development from both structural and wildland fires, and adequacy and

appropriateness of the proposed road system for providing adequate ingress and egress by fire and emergency vehicles.

3. A description of construction materials and the potential to use nonflammable materials in the development, given the potential for wildland fire and adequacy of local fire departments to protect the proposed development.

4. A description of proposed landscaping in terms of effects on fire behavior and structure protection.

5. An economic analysis of the effects of a catastrophic wildfire impacting the proposed development.

6. Identification and mapping of both natural and human created features, both on and off-site, that could be used as fire breaks and the needed actions to enhance them to appropriately limit such wildfires.

7. Modeling of fire behavior using appropriate software such as BEHAVE (Andrews et al. 2001) and FARSITE (Finney and Ryan 1995, Finney 1998) to determine potential wildfire behavior during the spring, summer and fall given wildfires either starting within or potentially impacting the proposed development and alternative development scenarios.

8. Modeling of potential smoke behavior from prescribed burns or wildfires and how smoke could impact the proposed development and alternative development scenarios. These models should be capable of addressing smoke from both small and large (>1,000 acre) fires in the dormant and growing seasons.

9. Assessments of current and post-development fuels on the Awosting Reserve and surrounding properties and how fuels would be managed to provide defensible space around proposed structures.

10. Development of a wildfire contingency plan for the proposed development and alternative development scenarios including incident command, equipment required, sources of water, fire breaks, evacuation procedures and other information for addressing such an emergency.

11. Identification of measures to maintain fire dependent communities on the site, following development.

12. Identification of natural communities and species populations that may be impacted through fire suppression on the site and within the area impacted by the proposed development and alternative development scenarios, if fire is suppressed to limit and avoid impacts to the development.

H. Air Quality

1. Context/Existing Setting

Air quality is generally good in the Shawangunks. However, the Shawangunks are impacted by air pollution from distant sources, such as sources of acid precipitation, atmospheric deposition of nitrogen, and ozone and particulates from the Hudson River valley. Locally generated pollution sources are increasing, primarily from increased traffic as developments in the valleys proliferate.

2. Potential Impacts

Air pollution from both nearby and distant sources (e.g. smoke stacks, automobiles, house heating systems, wood stoves, etc.) can deposit toxic chemicals, metals, nutrients (NO_x) and acidic precipitation. The Shawangunks have an extensive lichen flora (Dirig 1994). Lichens and mosses are directly impacted, while other species may be affected as habitat is altered through reduced recruitment. The increased use of automobiles, small engines (e.g., lawn mowers, snow blowers, snowmobiles, ATVs, etc) and heating systems are long-term sources of air pollution.

3. Needed Studies

Studies to address these potential impacts include:

1. An assessment of ambient air quality on the site and surrounding lands compared with post development air quality in terms of particulates.

2. The components of particulate pollutants from the anticipated sources within the development, including cars, trucks, motorcycles, power tools and power lawn equipment, construction equipment, wood stoves, heating systems, etc.

3. An assessment on potential impacts to the lichen and moss flora, both on and proximate to the site.

I. Construction Impacts

Many of the impacts and studies discussed above should cover construction related impacts. The following represent those not covered above.

1. Context/Existing Setting

The site is currently undeveloped.

2. Potential Impacts

During construction, there will be increased noise, dust and pollutants from construction activities and vehicles. There will also be increased traffic, erosion, low quality runoff and blasting (see Sections III B Hydrologic Resources and III D Recreational use and Visitor Experience). Cuts and fills, stream crossing culvert locations, building pads and roadways will cause significant impacts to surface water quality as will blasting and grading. Landsliding or slope failures from construction activities on steep slopes will increase sediment loading in streams and wetlands even with erosion control measures in place.

3. Needed Studies

Studies to address these include those for listed under the above topic areas and the following additions:

1. Impacts of construction, grading, blasting and other construction activities on both ground and surface water flows and on nearby wells.

2. Impacts of construction activities on the movement, foraging and reproductive success of wildlife.

IV. References

References are divided into sources of information, including web sites, studies completed by the Shawangunk Ridge Biodiversity Partnership, experts consulted for this report, and other literature cited.

A. Experts Providing Consultation

Name	Affiliation	Address
Spider Barbour	Botanist	5 Fish Creek Rd., Saugerties, NY 12477
Karl Beard	National Parks Service	4097 Albany Post Road Hyde Park, NY 12538
Joseph Bridges	Biologist, Mohonk Preserve Research Associate (Rudikoff Associates)	11 Beekman St., Beacon, NY 12503
Dave Clouser	David Clouser and Associates	Times Square Professional Building, Suite 103A 652 Route 299, Highland, NY 12528
Tom Cobb	Minnewaska State Park and Preserve	PO Box 893, New Paltz, NY 12561
Dan Davis	Hydrologeologist, Mohonk Preserve Research Associate	74 Lawrence Hill Road, Accord, NY 12404
Tom Dooley	Albany Pine Bush Preserve	Albany Pine Bush, 108 Wade Road, Latham, NY 12201
DJ Evans	New York Natural Heritage Program	625 Broadway, Albany, NY 12233-4757
Ron Gill	New York State Museum	New York State Museum, CEC 3140, Albany, NY 12230
Wendy Harris	Cragsmoor Consultants	P.O. Box 327, Circle Rd., Cragsmoor, NY 12420
Tim Howard	New York Natural Heritage Program	625 Broadway, Albany, NY 12233-4757
Paul Huth	Mohonk Preserve Daniel Smiley Research Center	Daniel Smiley Research Center, Mohonk Preserve, PO Box 715, New Paltz, NY 12561
Roland Kays	NYS Museum	New York State Museum, CEC 3140, Albany, NY 12230
Michael Klemens	Wildlife Conservation Society	Metropolitan Conservation Alliance Wildlife Conservation Society
Jeff Lougee	The Nature Conservancy	PO Box 310, North Conway, NH 03860
Tim McCabe	NYS Museum	New York State Museum, CEC 3140, Albany, NY 12230
Edwin McGowan	Ecologist	PO Box 204, Ft. Montgomery, NY 10922
Brian Morgan	Hydrologist	PO Box 387, Stone Ridge, NY 12484
Carol Rietsma	Biologist, Mohonk Preserve Research Associate (SUNY New Paltz)	16 Ferris Lane, New Paltz, NY 12561
Paul Rubin	Hydroquest	PO Box 387, Stone Ridge, NY 12484
Tom Sarro	Biologist, Mohonk Preserve Research Associate (Mt St Mary College)	330 Powell Ave, Newburgh, NY 12550
Karen Schneller- MacDonald	Save The Ridge	25 Carriage Dr., Red Hook, NY 12571
George Schuler	The Nature Conservancy	Neversink River Program, P.O. Box 617,Cuddebackville, NY 12729

Name	Affiliation	Address
Tim Tear	The Nature Conservancy	200 Broadway., 3rd Floor, Troy, NY 12180
John Thompson	Mohonk Preserve Daniel Smiley Research Center	Daniel Smiley Research Center, Mohonk Preserve, PO Box 715, New Paltz, NY 12561
Troy Weldy	New York Natural Heritage Program	625 Broadway, Albany, NY 12233-4757
David Yarrow	NY Old Growth Forest Association	44 Gilligan Rd., East Greenbush, NY 12160

B. Materials Submitted by Experts Cited in This Report

Beard, K. 1988. Critical values of the Awosting Reserve and its proposed addition to the Minnewaska State Park, Ulster County, NY. Report prepared for the Friends of the Shawangunks.

Memorandum from Spider Barbour on Awosting Reserve Ecological Issues dated April 10, 2003

Memorandum from Joseph Bridges entitled Awosting Reserve/Scope Outline Items for Consideration dated April 10, 2003.

Memorandum from David Clouser and Associates regarding the Awosting Reserve Proposed Subdivision: Evaluation of Allowable Use dated March 17, 2003.

Memorandum from Joe Hayes, Dan Davis, Peter Conde and Jonathan Caine to the Shawangunk Ridge Biodiversity Partnership and Save the Ridge dated April 16, 2003 regarding Awosting Reserve Proposed Development: Potential Water Related Impacts for SEQRA Scoping.

Memorandum from Wendy E. Harris dated April 28, 2003 on Scoping Input for Awosting Reserve EIS: Cultural Resources.

Letter from Michael Klemens, Wildlife Conservation Society dated April 1, 2003.

Memorandum from Cara Lee dated January 9, 2003 and entitled Awosting Reserve Application Summary.

Letter from Heidi J. Krahling, New York Natural Heritage Program to Ron Gautreau, Evans Associates dated February 20, 2003, regarding rare species and natural communities on or in the vicinity of the proposed development.

Memorandum from Paul Rubin of HydroQuest dated January 15, 2003.

C. Application Materials

Full Environmental Assessment Form (EAF) prepared for the Awosting Reserve LLC and dated December 3, 2002.

D. Sources of Information

Daniel Smiley Research Center, Paul Huth, Director of Research, The Mohonk Preserve, 1000 Mountain Rest Road, New Paltz, NY 12561.[10]

New York Natural Heritage Program. 2003. New York Natural Heritage Program, David VanLuven, Director, 625 Broadway, 5th Floor, Albany, NY 12233-4757. Available from: http://www.dec.state.ny.us/website/dfwmr/heritage/

New York State Amphibian and Reptile Atlas Project: 1990-1999. 2003. NYS Herp Atlas Project, NYSDEC, 625 Broadway, Albany, NY 12233-4754. Available from: http://www.dec.state.ny.us/website/dfwmr/wildlife/herp/

New York State Breeding Bird Atlas: 2000 – 2004. 2003. Breeding Bird Atlas 2000 Project Coordinator, 625 Broadway, Albany, NY 12233-4754
Available from: http://www.dec.state.ny.us/website/dfwmr/wildlife/bba/

New York State Endangered Species Program. 2003. Peter Nye, Program Coordinator, Endangered Species Unit, NYSDEC, 625 Broadway, Albany, NY 12233-4754. Available from: http://www.dec.state.ny.us/website/dfwmr/wildlife/endspec/

New York State Open Space Conservation Plan. 2002. Division of Lands & Forests, C/O Francis Sheehan, 625 Broadway, 5th Floor, Albany, NY 12233-4250. Available at: http://www.dec.state.ny.us/website/opensp/

Partners in Flight. 2003. Available from: http://www.partnersinflight.org/

The Nature Conservancy, Shawangunk Ridge Program, Cara Lee, Program Director, 108 Main Street, New Paltz, NY 12561.

E. Reports and Studies Completed by the Shawangunk Ridge Biodiversity Partnership

Barbour, S. 1999. Northern Shawangunks vernal pools inventory. Final report to the Shawangunk Ridge Biodiversity Partnership.

Batcher, M. 2000. Ecological Processes and Natural Communities of the Northern Shawangunk Mountains, report prepared for the Shawangunk Ridge Biodiversity Partnership.

Batcher, M. 1998. Draft fire management plan for Minnewaska State Park Preserve. Report prepared for the Palisades Interstate Park Commission.

[10] The Daniel Smiley Research Center has an ongoing research program, maintains the Biodiversity Management Program, a database of biological observations and records for the Shawangunks and has extensive collections, a library, and research results.

Batcher, M.S. 1995. Shawangunks ecosystem research program: research needs and work program. Report to the Shawangunk Ridge Biodiversity Partnership.

Batcher, M.; T. Hall; and R. Bartgis. 1997. Ecological processes in rock outcrop pine barrens and associated natural communities. Draft report to The Nature Conservancy, Arlington, VA.

Biasi, F.; D. Morse; J. Thompson; and M. Batcher. 1998. Geospatial database for the Northern Shawangunks of New York. Eastern Conservation Science, The Nature Conservancy, Boston, MA.

Caine, J. S., Coates, D. R., Timoffeef N. P., Davis, W. D., 1994, Hydrogeology of the Northern Shawangunk Mountains: New York State Geological Survey Open File Report #1g806, 72 p. and maps.

Claus, R. 1994. Protection planning for the Shawangunk Ridge: a planning resource inventory, report prepared for the Eastern New York Chapter of The Nature Conservancy, Troy, NY.

Cobb, T. 1998. A multi-purpose trails plan for the footpath and carriageway system of Minnewaska State Park Preserve, draft report of the Palisades Interstate Park Commission, Bear Mountain, NY.

Hubbs, K. 1995. Fire history of the northern Shawangunks. The Nature Conservancy, New York Regional Office, Troy, NY.

Laing, C. 1994. Vegetation and fire history of the dwarf pine ridges, Shawangunk Mountains, New York, University of Massachusetts, Department of Forestry and Wildlife Management, Amherst, MA.

Lougee, J. 2000. Sam's Point Dwarf Pine Ridge Preserve cliff community survey. The Nature Conservancy, Eastern New York Chapter, Troy, NY.

Rees, C. 1997. Fire and Pinus rigida rock outcrop communities of the northern Shawangunk Mountains. graduate thesis submitted to Bard College, Annandale-on-Hudson, NY.

Russell, E. 2001. Three centuries of vegetational change in the Shawangunk Mountains. report to The Nature Conservancy, Eastern New York Chapter, Troy, NY. Prepared by the Department of Biological Sciences, Rutgers University, Newark, NJ.

Russell, E. 2000. Factors contributing to forest diversity of the Shawangunk Mountains. Presentation at New York Natural History Conference, New York State Museum, April 26-28, 2000, Albany, NY.

Shawangunk Ridge Biodiversity Partnership (in preparation) Protection and management guidelines for the Shawangunk Mountains of New York: Vision, Goals, Strategies and Actions for Conservation of the Shawangunk Mountains, prepared by the Shawangunk Ridge Biodiversity Partnership.

Swift, Lauren, 1995. Historical and current records of rare plants and animals and significant natural communities of the Shawangunk Ridge Bioreserve report to the Eastern New York Chapter of The Nature Conservancy.

The Nature Conservancy 2002. High Allegheny Plateau Ecoregional Plan: final draft report, first iteration July 2002, edited October 2002. Conservation Science Support, Boston, MA.

Thompson, J. 1999. Cliff and talus survey of the Mohonk Preserve. Daniel Smiley Research Center, New Paltz, NY.

Thompson, J. 1996. Northern Shawangunk Ridge Vegetation Study. Report to the Shawangunk Ridge Biodiversity Partnership.

F. Plans

Lougee, J. and S. Gifford. 2001. Sam's Point dwarf pine ridge preserve master plan. Report of The Nature Conservancy, Eastern New York Chapter, Troy, NY.

Mohonk Preserve 2000. Mohonk Preserve land management plan. Report prepared by the Mohonk Preserve, New Paltz, NY.

Palisades Interstate Park Commission (PIPC) 1993. Minnewaska state park final master plan and environmental impact statement, prepared by Parsons, Brinckerhoff, Quade and Douglas, Inc.; Wallace Roberts and Todd, Inc.; Historical Perspectives, Inc.; and PIPC and NYSOPRHP staff.

The Nature Conservancy 1996. Draft strategic plan for the Shawangunk Ridge biodiversity conservation program: 1995-2000. Report prepared by the Eastern New York Chapter of The Nature Conservancy, Troy, NY.

G. Other Literature Cited

Alverson, W.S., D.M. Waller, and S.L. Solheim. 1988. Forests too deer: edge effects in northern Wisconsin. *Conservation Biology* 2 (4): 348-358.

Andrews, P., C.D. Bevins, D. Carlton and M. Hunter. 2001. BehavePlus version 1.0, available at http://fire.org/cgi-bin/nav.cgi?pages=behave&mode=1

Bender, J. 1987 (updated by J. Randall 2000). Element stewardship abstract for *Lythrum salicaria* (purple loosestrife), prepared by The Nature Conservancy, Wildland

Weeds Management and Research Program, available from: http://tncweeds.ucdavis.edu/index.html.

Buckley, D. S., T.L. Sharik, and J.G. Isebrands. 1998. Regeneration of northern red oak: positive and negative effects of competitor removal. *Ecology* 79 (1): 65-78.

Campbell, F.T. and S.E. Schlarbaum. 2002. Fading forests II: trading away North America's natural heritage. Healing Stones Foundation in cooperation with the American Lands Alliance and University of Tennessee, Knoxville, TN.

Chen, J.; S.C. Saunders; T.R. Crow; R.J. Naiman; K.D. Brosofske; G.D. Mroz; B.L. Brookshire; J.F. Franklin. 1999. Microclimate in forest ecosystem and landscape ecology: variations in local climate can be used to monitor and compare the effects of different management regimes. *Bioscience* 49 (4): 288-300.

Daily, G.C., S. Alexander, P.R. Ehrlich, L. Goulder, J. Lubchenco, P.A. Matson, H.A. Mooney, S. Postel, S.H. Schneider, D. Tilman, and G.M. Woodwell. 1997. Ecosystem services: benefits supplied to human societies by natural ecosystems. *Issues in Ecology* Number 2, Fall 1999. Ecological Society of America. Washington, DC.

de Winton, M.D., and J.S. Clayton 1996. The impact of invasive submerged weed species on seed banks in lake sediments. *Aquatic Botany* 53(1-2): 31-45.

Dirig, R. 1994. Lichens of pine barrens, dwarf pine plains, and "ice cave" habitats in the Shawangunk Mountains, New York. *Mycotaxon* 52(2): 523-558.

Dunne, T. and L.B. Leopold 1978. *Water in Environmental Planning*. W.H. Freeman and Co., New York, New York USA.

Ecoscientific Solutions. 2002. Hemlock health and the hemlock woolly adelgid in the northern Shawangunks Mountains. Report prepared for The Nature Conservancy on behalf of the Shawangunk Ridge Biodiversity Partnership. Ecoscientific Solutions, Scranton, PA.

Finney, M.A. 1998. *FARSITE*: Fire Area Simulator-- Model Development and Evaluation. USDA Forest Service Research Paper RMRS-RP-4.

Finney, M.A. and K.C. Ryan. 1995. Use of the *FARSITE* fire growth model for fire prediction in US National Parks. Proc. The International Emergency Mgt. and Engineering Conf. May 1995 Sofia Antipolis, France.

Forman, R.T.T., D. Sperling, J.A. Bissonette, A.P. Clevenger, and J.A. Jones. 2002. Road ecology: science and solutions. Washington, DC: Island Press,

Forman, R.T.T. and R.D. Deblinger. 2000. The ecological road-effect zone of a Massachusetts (U.S.A.) suburban highway. *Conservation Biology* 14 (1): 36-46.

Harris, W.E. 2000 Protecting Cultural Resources in the Sam's Point Preserve, Parts I and II *Shawangunk Watch* Volume 6, #1: 4-7, #2: 3-5.

Harris, W.E. 2003 The Story of the Shawangunk Mountain Region. Draft report prepared for the Shawangunk Mountains Scenic Byway Steering Committee.

Kourtev, P.S., W.Z. Huang, and J.G. Ehrenfeld. 1999. Differences in earthworm densities and nitrogen dynamics in soils under native and exotic plant species. *Biological Invasions* 1: 237-245.

Mack, R.N., D. Simberloff, W.M. Lonsdale, H. Evans, M. Clout, and F. Bazzaz. 2000. Biotic invasions: causes, epidemiology, global consequences and control. *Issues in Ecology* No. 5, Spring 2000, Ecological Society of America, Washington, D.C.

Manolis, J.C., D.E. Andersen, and F.J. Cuthbert. 2002. Edge effect of ground nesting birds near regenerating clearcuts in a forest-dominated landscape. *The Auk* 119 (4): 955-970.

Mitsch, W.J. and J.G. Gosselink. 1993. *Wetlands.* Van Nostrand, New York, New York USA.

Naeem, S., F.S. Chapin III, R. Costanza, P.R. Ehrlich, F. B. Golley, D. U. Hooper, J.H. Lawton, R.V. O'Neill, H.A. Mooney, O.E. Sala, A.J. Symstad, and D.Tilman. 1999. Biodiversity and Ecosystem Functioning: Maintaining Natural Life Support Processes. *Issues in Ecology* Number 4, Fall 1999. Ecological Society of America. Washington, DC.

Oehler, J. D. and J.A. Litvaitis. 2996. The role of spatial scale in understanding responses of medium-sized carnivores to forest fragmentation. Canadian Journal of Zoology, 74(11): 2070-2079.

Ostfeld, R.S. 1997. The ecology of Lyme-disease risk. *American Scientist* 85: 338-446.

Pimentel, D., L. Lach, and R. Zuniga. 2000. Environmental and economic costs of nonindigenous species in the United States. *BioScience* 50 (1): 53-65.

Schmidt, K.A. and C.J. Whelan. 1999. Effects of exotic Lonicera and Rhamnus on songbird nest predation. *Conservation Biology* 13(6): 1502-1506.

Sparks, D.W., M.T. Simmons, C.L. Gummer, and J.E. Duchamp. 2003. Disturbance of roosting bats by woodpeckers and raccoons. *Northeast Naturalist* 10 (1): 105-108.

Trombulak, S.C. and C.A. Frissell. 2000. Review of the ecological effects of roads on terrestrial and aquatic communities. *Conservation Biology* 14 (1): 18-30.

Villard, M; M.K. Trzcinski; and G. Merriam. 1999. Fragmentation effects on forest birds: relative influence of woodland cover and configuration on landscape occupancy. *Conservation Biology* 13 (4): 774-783.

Appendix I. Global and state ranks for rare species and natural communities. Source: New York Natural Heritage Program web site: http://www.dec.state.ny.us/website/dfwmr/heritage/

GLOBAL RANK (GRANK) AND STATE RANK (SRANK)

The network of Natural Heritage Programs and Conservation Data Centers--which currently consists of installations in all 50 states, several Canadian provinces, and several Latin American and Caribbean countries--ranks the rangewide (GRANK or global rank) and state (SRANK or state rank) status of plants, animals, and plant communities on a scale of 1 to 5. The rank is primarily based on the number of known occurrences, but other factors such as habitat quality, estimated number of individuals, narrowness of range of habitat, trends in populations and habitat, threats to the element, and other factors are also considered. The ranking system is meant to exist alongside national and state rare species lists because these lists often include additional criteria (e.g., recovery potential, depth of knowledge) that go beyond assessing threats to extinction.

COMPONENTS OF RANKS:

G = Global rank indicator; denotes rank based on rangewide status.
T = Trinomial rank indicator; denotes rangewide status of infraspecific taxa.
S = State rank indicator; denotes rank based on status within Idaho.

1 = Critically imperiled because of extreme rarity or because some factor of its biology makes it especially vulnerable to extinction (typically 5 or fewer occurrences).
2 = Imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction (typically 6 to 20 occurrences).
3 = Rare or uncommon but not imperiled (typically 21 to100 occurrences).
4 = Not rare and apparently secure, but with cause for long-term concern (usually more than 100 occurrences).
5 = Demonstrably widespread, abundant, and secure.

E = Exotic or introduced.
U = Unknown.
H = Historical occurrence (i.e., formerly part of the native biota with the implied expectation that it might be rediscovered).
X = Presumed extinct or extirpated.
Q = Indicates uncertainty about taxonomic status.
? = Not yet ranked.

STATE RANKS SPECIFIC TO LONG DISTANCE MIGRANTS (BATS AND BIRDS):

A = Accidental (occurring only once or a few times) or casual (occurring more regularly although not every year) in Idaho; a few of these species might have bred on one or more of the occasions when they were recorded.
Z = Only applies when migrant occurs in an irregular, transitory, and dispersed manner. Occurrences cannot be defined from year-to-year.
B = Breeding population.
N = Nonbreeding population.