

HIGHLANDS ECOSYSTEM RESEARCH SYMPOSIA PROCEEDINGS

**Symposium I
Extant Data, Research Needs and Priorities
April 12, 1996**

**Symposium II
Applying Ecological Knowledge to Land Use Decision Making
June 14, 1996**

Sponsors

**New Jersey Department of Environmental Protection
New Jersey Ecological Research Partnership
Ramapo College of New Jersey
Regional Plan Association
Rutgers University Ecopolicy Center
USDA Forest Service**

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I. INTRODUCTION

Noted as a landscape of national significance, the Highlands physiographic province stretches from Reading, Pennsylvania across New Jersey, to the Hudson River and beyond into Connecticut (see Figure 1). The Highlands forest resources provide high quality surface and ground water for agriculture, recreation, wildlife habitat, industry, and drinking water for over 3.8 million residents of New Jersey and New York. The 1992 USDA Forest Service *New York-New Jersey Highlands Regional Study* found that 1 in 12 Americans live within a one- to two-hour drive of the Highlands and that, because of its significant water supply and wildlife habitat, the Highlands ecosystem is critical to the long-term health of the region.

Recognizing that the Highlands region is a unique and critical ecosystem, the New Jersey Ecological Research Partnership joined with Regional Plan Association and the USDA Forest Service to sponsor two companion symposia on the Highlands Ecosystem. The first, held at Ramapo College of New Jersey on April 12, 1996, focused on extant data, research needs and priorities through the eyes of scientists, researchers, data gatherers, and persons knowledgeable about the Highlands ecosystem. The second symposium, held on June 14, 1996 also at Ramapo College, brought together municipal officials, developers, planners, open space managers, and citizen activists to discuss how scientific data and understanding about habitat conservation and water resource management can be translated into better land use management and development decisions in the Highlands region. Recommendations developed during the first meeting were used as a basis for discussion at the second symposium.

This document reports the findings of both Highlands Research Symposia. It contains a brief summary of the recommendations developed by participants as well as the complete reports of each of the individual workshops held at either event. A list of participants is included as well.

The recommendations that follow reflect the best thinking of over 100 scientists and land use practitioners that attended the sessions. These experts have suggested the data and research needs, the educational initiatives, and the policy changes that must be undertaken if the Highlands ecosystems and their associated benefits are to be managed successfully. Implementing these findings is not impossible. Also included is a list of some of the success stories from the Highlands and elsewhere in New Jersey that demonstrate how scientific understanding can be linked to innovative public policy and good private land use practices.

These findings are directed toward the variety of public and private actors that are the stewards of the Highlands. It is the intent of Regional Plan Association, the New Jersey Ecological Research Partnership, and the USDA Forest Service to explore how these recommendations can be implemented.

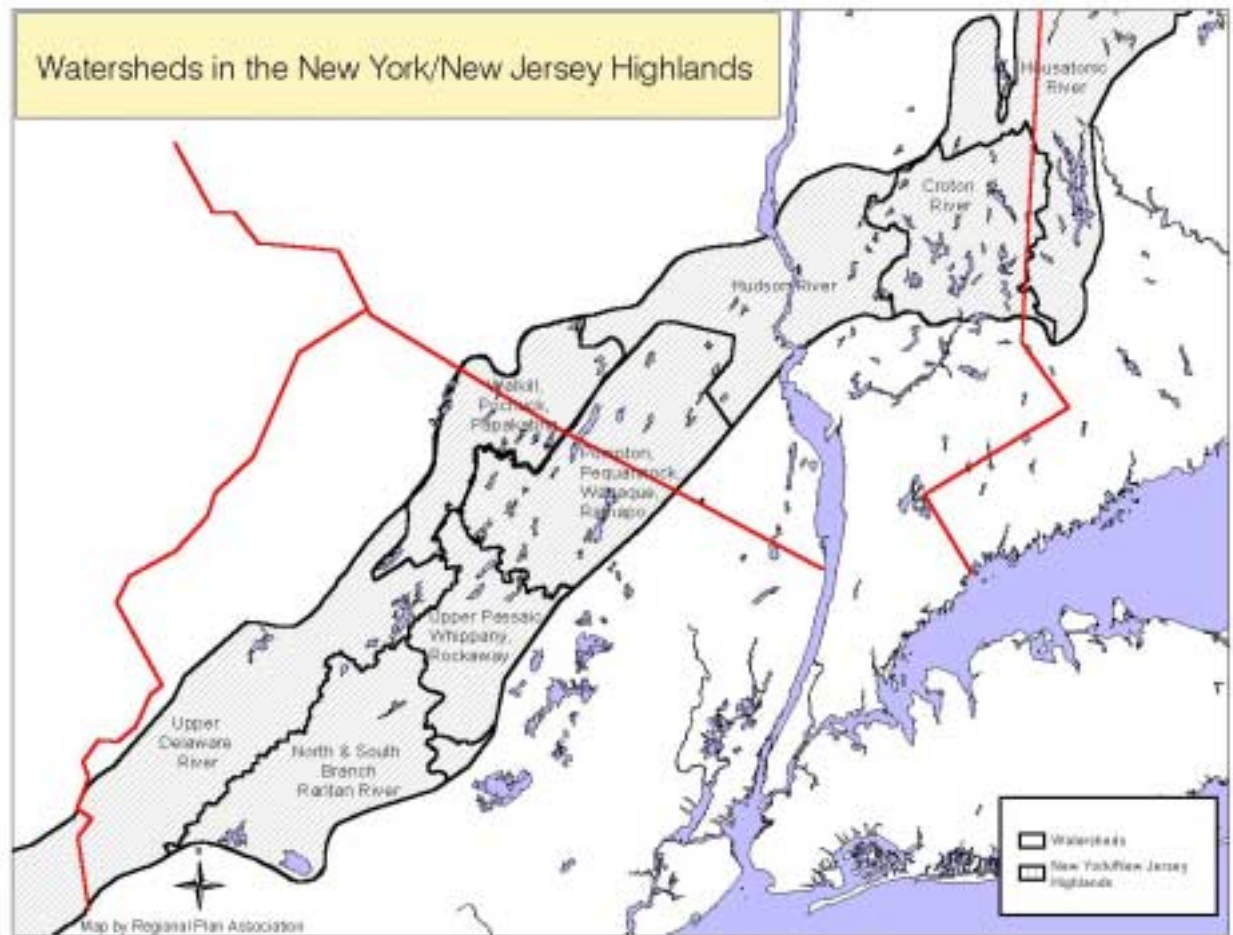
This document is also available electronically through the New Jersey Department of Environmental Protection, Division of Science, Research, and Technology at www.state.nj.us/dep/dsr as well as through the Regional Plan Association at www.rpa.org and is the second in a series of symposia on New Jersey ecosystems and environmental issues specific to New Jersey and related

areas centering on research, data gathering, information exchange, and collaborations.

In May of 1995, the New Jersey Ecological Research Partnership sponsored a similar symposium on Outer Coastal Plain/Pinelands research. An *Outer Coastal Plain/Pinelands Research Symposium Monograph* and companion *Outer Coastal Plain/Pinelands Research Symposium Sourcebook* are available electronically through the Richard Stockton College of New Jersey at: <http://loki.stockton.edu/~coastal>.

In the years following these symposia, the work of the New Jersey Ecological Research Partnership has been assumed through the New Jersey Center for Environmental Indicators (NJCEI). Research to meet critical data needs cited through these ecosystem symposia has moved forward through NJCEI partners which include the New Jersey Department of Environmental Protection, Rutgers University's Cook College and Environmental and Occupational Health Sciences Institute. For more information see the NJCEI website <http://eohsi.rutgers.edu/cei/index.html>.

FIGURE 1



II. SUMMARY RECOMMENDATIONS: HIGHLANDS ECOSYSTEM RESEARCH SYMPOSIUM I AND II

These recommendations are a synthesis of the findings made by symposia participants. The party or parties that might be responsible for taking action have not been identified.

The overriding recommendation of the symposia was establishment of a Highlands Research Experiment Station and/or Research Consortium to study the biotic and abiotic resources of the Highlands and the impacts of urbanization. A key role of the station/consortium would be to aggregate existing data, especially on habitat and forest fragmentation, and make it available in forms easily accessible for decision makers, possibly in the form of environmental indicators. Another function of station/consortium would be to serve as a conduit between state and local data sources.

Subsequent to these symposia some key activities have taken place in New Jersey that have begun to address some of the priority issues identified. As mentioned already, the New Jersey Center for Environmental Indicators (NJCEI) has been established as a partnership among the New Jersey Department of Environmental Protection, Cook College, and the Rutgers University-UMDNJ Environmental and Occupational Health Sciences Institute (EOHSI). Research to meet key needs and expand scientific rigor as New Jersey implements the National Environmental Performance Partnership System (NEPPS) has been facilitated through this Center and its relationship with the NJDEP Division of Science, Research and Technology. This research has already begun to help New Jersey better measure and report environmental status and trends. Again, further information can be found at the following websites:
www.state.nj.us/dep/dsr and <http://eohsi.rutgers.edu/cei/index.html>.

In addition, NJDEP has established a Division of Watershed Management (www.state.nj.us/dep/watershedmgt) to improve protection of New Jersey's surface and ground water resources through integrated holistic management of water resources and environmental programs. Key features include comprehensive resource-based planning; broad-based stakeholder partnerships; action-oriented approaches to address nonpoint sources of pollution; integration of related strategies, such as open space preservation, and management of forest, wetlands, fisheries and wildlife resources; and use of indicators to evaluate performance over time and foster continued improvement. Watershed-based characterization and assessment (facilitated between NJDEP's Division of Watershed Management and Division of Science, Research and Technology) has begun to integrate some of the priority data sets identified by symposia participants (www.state.nj.us/dep/dsr/watershed/waterteam.htm)

For additional information, see NJDEP's main website (www.state.nj.us/dep) which includes the first NJDEP Strategic Plan. There are also links to NJDEP's Geographic Information System (GIS) which will integrate place-based data through the ENDEX program and contains digital downloads of many geographic data sets for New Jersey.

PRIORITY ISSUES

Priority issues identified by the symposia participants (for the station/consortium or other, existing entities) include:

Water Resources

- Water resources data reflecting baseline (current) conditions. This should be collected at a scale sufficient for watershed based management of water supply and water quality.
- The economic utility of water resources using different time scales and user perspectives. Specific issues include the inter-generational costs, non-monetary costs, and the disparate effects of costs and benefits on different interests (such as host municipalities and downstream users of surface water supplies).
- The fate and transport of ground water and groundwater supply in the Highlands bedrock aquifers.

Habitat

- Habitat needs of Highlands fauna. A compilation of existing information is missing. While some information exists, it is often scattered through a variety of sources. In addition, Highlands specific research on the needs of lesser-studied species and defining “high-quality” habitat for all species.
- The impacts of forest/habitat fragmentation. Baseline data is needed on the extent of current forest cover in the Highlands. In addition research on the impact of fragmentation on Highlands flora and fauna (especially on species besides birds); community/ecosystem processes such as disturbance, exotic plant invasions, and nutrient cycling; the cumulative impacts of habitat and forest fragmentation; and how to alleviate the impacts of fragmentation, including research on the success of wildlife bridges, tunnels, corridors to connect habitat.
- Habitat mapping and monitoring. A number of mapping efforts are now underway. These assessments need to be continually monitored and updated to be effective. In addition, there could be a better integration of terrestrial, wetland, and aquatic mapping and monitoring programs.

Land Use, Economics and Infrastructure

- Up-to-date GIS land use/land cover information . Use high-spatial resolution satellite imagery as an alternative to the currently used (and expensive) aerial photos. (Both of these efforts are now underway in New Jersey).
- Parcel and Property Tax Information. This data could be gathered by combining a statewide effort to establish minimum standards for mapping combined with GIS establishment at the

municipal and county level. This effort could also incorporate digital CAD files produced as part of the development process.

- The economics of transfer of development rights programs. Research is needed on the potential value of development rights.
- The infrastructure and natural resources capacity of the Highlands for additional development.
- Travel and tourism data related to eco-tourism, specifically economic impact data, baseline information on the quality and character of the resources, and monitoring and impact assessments for the resources and the business community.

III. PROCEEDINGS: APRIL 12, 1996 HIGHLANDS ECOSYSTEM RESEARCH SYMPOSIUM I EXTANT DATA, RESEARCH, NEEDS AND PRIORITIES

OVERVIEW

On April 12, 1996 scientists, data gatherers, decision makers, and other interested parties came together at Ramapo College of New Jersey for a symposium to discuss research and data related to the Highlands Ecosystem. The meeting was sponsored by the New Jersey Department of Environmental Protection (NJDEP), Ramapo College of New Jersey, Regional Plan Association, Rutgers University Ecopolicy Center, and the USDA Forest Service, under the auspices of the New Jersey Ecological Research Partnership.

This meeting was the second in a series of symposia on New Jersey ecosystems and environmental issues specific to New Jersey and related areas centering on research, data gathering, information exchange, and collaborations. In May of 1995, the Partnership sponsored a similar symposium on Outer Coastal Plain/Pinelands research. An *Outer Coastal Plain/Pinelands Research Symposium Monograph* and companion *Outer Coastal Plain/Pinelands Research Symposium Sourcebook* are available via Richard Stockton College of New Jersey at: <http://loki.stockton.edu/~coastal>.

Welcoming remarks were given by Dr. Robert K. Tucker, Director of Rutgers University Ecopolicy Center and convener of the New Jersey Ecological Research Partnership and Dr. Angela Cristini, Professor, Ramapo College of New Jersey.

The following four focus areas were the basis for discussion: Water Resources; Biodiversity, Species and Census Data; Habitat and Forest Fragmentation; and Land Use, Economics, and Infrastructure Planning Data. Overviews of these four focus areas were given by the facilitators prior to concurrent breakout sessions: Dr. Daniel Van Abs, NJ Department of Environmental Protection (Water Resources); Dr. Edmund Stiles, Rutgers University, Professor of Biological Sciences (Biodiversity, Species and Census Data); Dr. Richard Lathrop, Rutgers University, Associate Professor of Environmental Monitoring (Habitat and Forest Fragmentation); and Robert Pirani, Regional Plan Association, Director of Environmental Projects (Land Use, Economics, and Infrastructure Planning Data).

Discussions in breakout sessions centered on current knowledge, needs, priorities, possible collaborations, and recommendations in each of the focus areas. Upon reconvening two presentations were made to all participants: Hank Garie (NJ Department of Environmental Protection=s Office of Information Resource Management) provided an overview of data layers on New Jersey's Geographic Information System and Craig Coutros (NJ Department of Environmental Protection, Forestry Services) provided an overview of the New Jersey EcoMap Project. Facilitators then reported on their individual group discussions followed by an open forum.

CONFERENCE PROGRAM

9:00 Welcome

Robert K. Tucker, Director, Rutgers Ecopolicy Center

9:30 Plenary Panel Presentation:
Highlands Ecosystem Research Symposium: Extant Data, Research Needs and Priorities

Daniel Van Abs, Jr., New Jersey Department of Environmental Protection
Edmund Stiles, Rutgers University
Richard Lathrop, Rutgers University
Rob Pirani, Regional Plan Association

10:45 Concurrent Workshops

12:15 Lunch Break

1:15 GIS Demonstration, Hank Garie, New Jersey Department of Environmental Protection

1:30 Highlands Ecomap Project, Craig Coutros, New Jersey Department of Environmental Protection

1:45 Report of Breakout Workshops to Conference/Next Steps

Robert K. Tucker, Director, Rutgers Ecopolicy Center

3:30 Adjournment

The Workshops and Facilitators were:

Water Resources, Daniel Van Abs, Jr., New Jersey Department of Environmental Protection
Biodiversity/Species and Census Data, Edmund Stiles, Rutgers University
Habitat/Forest Fragmentation, Richard Lathrop, Rutgers University
Land Use/Economics/Infrastructure Planning Data, Rob Pirani, Regional Plan Association

SUMMARY OF PLENARY PANEL

Daniel Van Abs, Assistant Administrator, Office of Environmental Planning, New Jersey Department of Environmental Protection provided an overview of water resources issues in the Highlands. Dr. Van Abs discussed the reoccurrence of watershed management activities in New Jersey that began with basin management in the 1950's and the Clean Water Act 208 and 303 programs in the 1970's. Today, one can be optimistic about watershed management because the technical tools (models and GIS) can be brought together with social will to use extant data for watershed management, recognizing there are insufficiencies in some of the data. The Highlands region with its geologic faulted and folded formations is a major surface water resource containing the largest surface water reservoirs in New Jersey, in contrast to the ground water resources of Southern New Jersey. From a local perspective, however, ground water resources are quite significant in the Highlands region because much of the surface water present in the Highlands is used as a remote water resource for residents in New Jersey cities and towns. Historically, growth in the Highlands itself has relied on ground water for local residents. Changes in water quality indicate the need to focus on both ground water and surface water resources. In the 1980's water quality improvements in many New Jersey streams were attributed to wastewater infrastructure improvements, while at the same time a similar number of streams showed declining water quality. Two-thirds of water supply feeder streams that had been relatively pristine were located in newly suburbanizing areas.

Dr. Van Abs noted that with watershed planning and management, New Jersey can begin to pull together information on both ground water and surface water quality and supply. Data sources include surface water flow data and flow models (Passaic-Hackensack and Raritan systems); surface water quality monitoring (government and private industry) and reach-specific water quality models; and ground water data including regional models, aquifer recharge areas, geologic mapping, and site-specific contaminant studies (spill fund sites, underground storage tank sites, Superfund sites).

Edmund Stiles, Professor of Biological Sciences, Rutgers University defined biodiversity as the myriad of plants and animals that inhabit the globe. An understanding of this diversity has been attempted by examining it at different levels of complexity. One division of the complexity, presented by The Nature Conservancy, is a division into genetic diversity, taxonomic diversity, community diversity and landscape diversity. Landscapes are made up of communities, communities are aggregations of taxa, and the phenotypes of taxa are the result of and interaction between genetic makeup and environmental conditions. Dr. Stiles explained that the loss of a species results in the elimination of all of the genotypes of that species and emphasized that even a small number of individuals can have great genetic diversity. Human interference can result in the loss of materials that are important for biological interactions that may not be apparent to non-scientists. One example of a community-level interaction is that between bayberry (a plant found throughout New Jersey, including the Highlands) and various nonrandom species. Bayberry fruit is covered with a high-melting point wax that was used by early settlers for candlemaking. Although humans no longer use bayberries for candlemaking and the waxy fruit cannot be digested by humans, species such as woodpeckers, tree swallows and warblers can use the fruit as a high energy source at times when insects are unavailable to them.

Therefore, to attempt to understand how we can cohabit the earth with the biodiversity around us, we must make efforts to determine what the nature of this biodiversity is, and what processes allow its persistence in the face of changing environments. To help preserve the biodiversity of the earth we need to study the genetic diversity of plants and animals and the varied interactions among them that has created the myriad of adaptations that allow them to survive. This will bring the large public concern over disappearing open spaces and threatened species into focus.

Why save biodiversity? Dr. Stiles mentioned the economic reasons, for example, the top 10 drugs used in New Jersey are natural products. In addition to economics, biodiversity is something humans have an affinity with; it provides us with something special. Unless we study biodiversity and have basic data about species and community and landscape level interactions we may never fully recognize the intrinsic value of sustaining such resources. Dr. Stiles posed the challenge of using species and biodiversity data to inform decision making.

Richard Lathrop, Associate Professor of Environmental Monitoring, Rutgers University presented data on forest habitat in the Highlands. Dr. Lathrop cited the fact that increasingly larger scale approaches at the level of the ecosystem or landscape are being advocated to conserve biological diversity (Noss, 1983; Norse et al., 1986; Franklin, 1993). At the regional landscape level, there appears to be a strong connection between landscape structure and biodiversity due in part to the impacts of habitat fragmentation. A recent decline in the breeding populations of migratory passerine songbirds has been linked to the effects of fragmentation of their temperate forest breeding habitat (Bohning-gaese et al., 1993; Robinson et al., 1995). Research has shown that fragmentation has lead to isolation and diminution of interior forest habitat (Whitcomb, 1977; Butcher et al., 1981; Blake and Karr, 1984; Lynch and Whigham, 1984; Askins et al., 1987) and increased pressure by nest predators (Wilcove, 1985) and brood parasitism by cowbirds (Brittingham and Temple, 1983; Robinson et al., 1995).

To ensure the maintenance of area-sensitive bird species requiring large home ranges or undisturbed interior forest habitat, preserving large contiguous blocks of forest is critical. Whitcomb (1977) states that thousands of contiguous acres may be required to assure the long-term survival of forest-interior bird species. Robbins et al. (1989) in their study on the habitat area requirements of breeding forest birds of the Middle Atlantic states, suggested that 3000 ha is the minimum area needed to retain all species of area-sensitive forest-breeding birds. Askins et al. (1987) found that the diversity and density of forest-interior birds is higher in large forest tracts that are within a heavily forested matrix, suggesting that the dispersal of birds from other forests may be important in maintaining populations. These large, unfragmented forest areas may further serve as reproductive "source" populations to help restock "sink" populations in neighboring fragmented landscapes (Robinson et al., 1995). As interior forest habitat is becoming increasingly rare throughout the eastern United States (Robbins et al., 1989), the preservation of large unbroken tracts of interior forest habitat is becoming a major biodiversity conservation issue.

In the latter half of the 20th century, forest areas at the edge of major urban metropolises have increasingly undergone fragmentation due to suburban and exurban development. The New York-

New Jersey Highlands region is an example of this trend. Though comparatively close to New York City and associated New Jersey urban centers, the Highlands Region was largely spared the effects of 20th century suburban expansion until quite recently. The distinct possibility that piecemeal development will overwhelm the Highlands has instigated intense concern and interest in trying to conserve the region's natural values and wildlife (Michaels et al., 1992; Mitchell, 1992).

The New Jersey Highlands is a region of moderate relief with maximum elevations from 1000 to 1300 feet. The geology consists of a complex series of folded and faulted metamorphic schist, granite and gneiss bedrock. Exposed rock outcroppings are common and soils are generally rocky and shallow. The effects of the Wisconsin glaciation is evident in the number of glacially gouged depressions that have filled to create lakes/ponds and wetlands. The NY-NJ Highlands physiographic province is floristically diverse showing the influence of the southern Appalachian Oak-Hickory, the northern Appalachian Hemlock-Pine-Northern Hardwood, and the Atlantic Coastal Plain vegetation associations (Collins and Anderson, 1994). The present vegetation composition and landscape pattern in the Highlands reflects past human and natural disturbances. As a result of past mining, timber harvesting, limited farming/ pasturing, fire and disease/insect pests, the Highlands' forests of today are entirely of second growth. For a good review of Highlands natural vegetation communities and associated wildlife, see Mitchell (1992).

The NY-NJ Highlands are host to a number of so-called area-sensitive faunal species that depend on large tracts of interior forest habitat to maintain viable breeding populations (Mitchell, 1992). Forest interior nesting bird species including a diverse array of neotropical migrating songbirds as well as threatened raptors such as the red-shouldered hawk and barred owl. Timber rattlesnakes, listed as a threatened species in both New York and New Jersey, are susceptible to human disturbance and are increasingly restricted to remote woodlands (Brown, 1988). Two of the larger far-ranging mammals found in the Highlands region, black bear and bobcat, require comparatively large home ranges of relatively intact forest area.

As part of the Plenary Session, Dr. Lathrop reviewed some of the ongoing work at the Rutgers University Center for Remote Sensing and Spatial Analysis on monitoring Highlands forest systems. Satellite remote sensing and geographic information systems (GIS) provided the basis for a systematic inventory of forest habitat (both edge and interior) and assessment of forest fragmentation in the NY-NJ Highlands region (Lathrop, 1995). A primary objective of this study was to identify and map large blocks of forest land to provide a comparative assessment of large forest tracts. The widespread decline of hemlock forest (*Tsuga canadensis*) due to the infestation of wooly adelgid and scale insects was assessed using satellite remotely-sensed change detection techniques. A comparison of 1984 to 1994 Landsat Thematic Mapper imagery shows that over 50% of the hemlock forests in the northern New Jersey Highlands have been affected by hemlock decline to some degree (Royle, 1996).

Robert Pirani, Director, Environmental Projects, Regional Plan Association discussed urban planning information (data on land use, infrastructure needs, and economics) related to natural resource management in the Highlands. Over the past thirty years, towns in the Appalachian Highlands of New York and New Jersey grew by 90%, a rate of growth that far exceeds the overall

regional increase of 13% in the same 30-year period. Based on population projections developed by Regional Plan Association, these areas are likely to grow by about 20% over the next 20 years if current policies and trends continue. This could result in another 220,000 people and the roads, homes, and commercial activities needed to support them located in the hillsides and valleys of Highlands communities.

The ecological impacts of this growth are clear in terms of:

Land use change. US Forest Service projected forest losses of between 20 to 60% for the counties in the New York/New Jersey Highlands in the next 25 years, primarily due to increases in residential uses.

Parcelization of habitat. US Forest Service found that only 1% of the land area consisted of forest patches larger than 5,000 acres. Only 5% consists of patches larger than 500 acres. Seventy-one percent of the land area in the Highlands (one of the most undeveloped areas in the region) was in forest patches of less than 50 acres.

Placing biodiversity at risk. There are more than 500 Highlands sites listed in the Natural Heritage Program data bases of New York and New Jersey; 469 in New Jersey alone. Posing challenges for watershed managers -- the channelization of riparian corridors, wetland impacts, and the conversion of forests to impervious surfaces will degrade water resources and impair downstream uses.

These impacts suggest several important areas where research needs to be done, or needs to be better disseminated, if we are to improve our ability to manage this process of land use. Examples include better data on land use, especially the rates of change and where that change is occurring. Is the problem of the first 5% of growth causing 90% of the problem? This is certainly true in terms of visual impact and fragmentation of habitat. Other data needs include: quantification of the value of green vegetation and natural hydrologic systems as infrastructure. Such data may help decision makers make better judgments about the costs and benefits of development. For example, riparian buffers may cost more in short term but researchers have found that trees add a 12 to 15% market premium for adjacent homes. At the regional level, this same concept would relate to translating the cost to downstream consumers of increased development from upstream decision makers.

Mr. Pirani also explained that we need to develop land uses and land regulatory systems that are desirable from an economic viewpoint and from an ecological viewpoint. This ranges from understanding the true potential of ecotourism to quantifying the viability of transfer of development rights schemes. We need to help communities understand and utilize sustainable fiscal practices so that they do not have to engage in a ratables chase in order to balance their accounts. We need to understand the carrying capacity of Highlands infrastructure in terms of people and natural resources. A specific example is understanding the trade-offs of center-oriented development in terms of sewage treatment and non-point source pollution.

SUMMARY OF CONCURRENT WORKSHOPS

Water Resources Breakout Session

Facilitator: Dr. Daniel Van Abs, Assistant Administrator, Office of Environmental Planning, New Jersey Department of Environmental Protection

Breakout Session Discussion Summary

Six people participated in the break-out session on water resources. Three were from the NJDEP (NJ Geologic Survey), one from the US Geological Survey, and two were from non-profit organizations (Regional Plan Association and Passaic River Coalition). The session focused on several fundamental research and data issues regarding Highlands water resources. First, the need for better resolution and density in water resources data for the Highlands, sufficient for watershed management purposes. Second, the need for a detailed understanding of how the many water resources issues relate to each other and to various forms and densities of land use management. Third, the need for a better understanding, framework and terminology regarding the economic values (short and long term, monetary and social utility) of water resources, including their quality, allocation and protection.

The session participants focused on major components of water resources data and research, identifying where information gaps existed. These gaps then became the basis for the recommendations listed above. The first two topics are fairly well developed. The later topics are not developed due to the lack of session time.

INFORMATION USES AND NEEDS	AVAILABILITY OF INFORMATION
<p>1. WATER SUPPLY AVAILABILITY (Multiple Uses and Needs)</p> <p>1. Geologic Mapping</p> <p>2. Stream Flow and Base Flow Data</p> <p>3. Aquifer Recharge (Spatial Variations and Rates)</p> <p>4. Water Quality (Precipitation; Surface Water, Ground Water)</p> <p>5. Distribution of Water Availability</p> <p>6. Distribution of Allocations</p> <p>7. Aquifer Characteristics</p> <p>2. LAND DEVELOPMENT VS. PRESERVATION: WATER RESOURCES IMPLICATIONS, COSTS, BENEFITS (Short Term and Inter-generational)</p> <p>8. Local and Regional WQ Impacts</p> <p>9. Local and Regional Water Use Impacts</p>	<p>Yes -- State Geologic Map Stations exist, but questions about extrapolations. Is the existing network sufficient? Under development at NJDEP</p> <p>NAWQA (USGS project) measuring precipitation quality. Ambient quality data insufficient for detailed watershed characterization, management efforts, modeling</p> <p>Good information for surface water, only relative information for ground water with limited spatial accuracy</p> <p>NJDEP Water Allocation Permits</p> <p>Very good information for priority aquifers. Limited for other aquifers</p> <p>Issue posed by session: How can we show the value of using alternative development patterns based on water resources costs and benefits?</p> <p>Insufficient Highlands data, though NJDEP is assessing in Piedmont and Coastal Plain. Applicable?</p> <p>Data exist, but need to be collected and assessed at Highlands level</p>

INFORMATION USES AND NEEDS	AVAILABILITY OF INFORMATION
<p>10. Water Resources Value (Supply and Quality) of National Land Forms and Ecosystems</p> <p>11. Common Frames of Reference for Measuring Impacts and Costs</p> <p>12. Private Vs ASocial Utility≅ Values and Options Over Various Time Frames</p> <p>13. Taxation Impacts On and From Development Options</p>	<p>Not available</p> <p>Not available. Session believes that a major problem is the use of different referents and measures when assessing costs and benefits</p> <p>Not available</p> <p>Limited information exists and all of it is controversial</p>
<p>3. INTERCONNECTIONS AND PROCESSES AMONG WATER RESOURCES AND HUMAN ACTION COMPONENTS OF WATERSHEDS</p>	<p>What are the connections between land use, pollutant inputs, riparian and wetlands quality, water withdrawals, etc., from a holistic and integrated perspective (instead of issue by issue)?</p>
<p>4. POLLUTANT SOURCES, FATES AND TRANSPORT (E.G., NONPOINT SOURCE POLLUTANTS) IN THE HIGHLANDS</p>	<p>Highlands geology (fractured bedrock) is different from the most common research focus for ground water pollutant fate and transport (sand aquifers). Nonpoint pollutant sources, fate and transport are poorly understood compared to point sources</p>
<p>5. IMPROVED SURFACE WATER CLASSIFICATIONS (Especially to Address the Protection of Warm Water Fisheries)</p>	<p>Current system focuses on trout as an indicator and protected species. High quality warm water fisheries do not receive the same recognition in the NJ Surface Water Quality Standards</p>
<p>6. IMPACTS OF RIPARIAN LAND AND LAND USES ON AQUATIC ECOSYSTEMS</p>	<p>To what extent is the condition of the aquatic ecosystem dependent on riparian habitat quality and riparian land uses, (assuming that pollutant loadings are otherwise equal)?</p>

Recommendations

The break-out session on water resources research and data needs developed the following major recommendations (not in priority order):

- X Water resources data reflecting baseline (current) conditions should be collected at a scale sufficient for watershed-based management of water supply and water quality. The utility of data at the municipal and sub-watershed level is important.
- X Improved information is needed on the economic utility of water resources using different time scales and perspectives. Inter-generational costs and benefits are not easily addressed through standard economics (which tends to weight near-term costs and benefits more than long-term). Non-monetary costs and benefits also tend to be ignored by standard economics. There is also little recognition of the disparate effects of costs and benefits on different interests.
- X A unified framework for water resource functions is needed. It should be watershed-based and cover the full spectrum of water issues. Current frameworks have limited scope, focusing usually on single issues (e.g., water quality, flooding).
- X Research is needed on the fate and transport of ground water and ground water pollutants in Highlands geology. Most such research tends to focus on porous media, such as sand and gravel aquifers.
- ∃ A better understanding is needed of the value of clean, potable water for urban users of remote supplies (e.g., the Pequannock and Wanaque watersheds), and the costs and benefits of A providing those supplies to the host municipalities.

Biodiversity, Species and Census Data Session

Facilitator: Dr. Edmund Stiles, Professor, Biological Sciences, Rutgers University.

Breakout Session Discussion Summary

The Biodiversity Focus Group began with the question: 1. Should we save some biodiversity and 2. if so, then how much is Asome \equiv ? This began a discussion in which the group focused on the following remaining questions: 3. Is targeting rare species for protection enough?; 4. If our goal is to preserve large, contiguous natural areas, what data sets will achieve our goal? and 5. How should we approach decision-makers with our accumulated data? These questions can also be used to stimulate further discussion for additional symposia and informal discussion groups.

Considerable discussion was generated and information shared about current data gathering efforts to better characterize the Highlands. The *Metropolitan Flora Project*, undertaken by the Brooklyn Botanical Garden, is gathering basic plant species distribution data within the Metropolitan NY area, including counties in the Highlands. Participants felt that by developing preservation efforts based upon landscape level analyses, species dependent upon that landscape would be preserved, which would include all species, not just rare species. Participants also felt that the need to preserve genetic diversity is important which is why decisions to preserve lands should strive for large contiguous areas. Data gathering, species inventories, species trend lines and indicators, as well as data cataloguing are all necessary to inform the public and decision makers about the value of biodiversity in their communities.

Recommendations

- X **Aggregate data.** Our first recommendation was to aggregate data. The ability to make informed decisions in the management of our biodiversity is dependent on the quality of the information available to the decision-makers. In some circumstances new data must be gathered, but in many situations, existing information must be made available in forms easily accessible to a wide variety of users. Both continued collection of information and the efforts to make the information available in useful forms must be pursued.

- X **Develop advocates in primary and secondary schools.** Our second recommendation was to develop advocates at the primary and secondary school levels. The citizens of New Jersey and the world form their opinions and develop their attitudes relatively early in life. We must be sure that the options involving the preservation or loss of our biodiversity and the consequences for our quality of life be presented to students at an early stage in their education. All individuals should have the opportunity to make decisions on environmental quality using the highest quality information available. The decisions that are made today will influence the quality of life of the youth who will live in the environment created by those decisions.

- X **Preserve large contiguous areas and corridors.** Our third recommendation was to preserve large contiguous areas and connecting corridors. Large contiguous areas serve to

minimize the influence of the edge effect. Influences from surrounding habitats impact the integrity of a patch that has been deemed worthy of preservation. Smaller patches have proportionately smaller core areas that are little influenced by the species and physical conditions of the surrounding habitats. In a forest patch, for example, light penetration into the understory, movement of wind, seeds and animals into the edge are but a few of the many influences that change the preserved patch into an environment that has many of the characteristics of the surrounding habitat and fewer of the characteristics unique to the habitat we wish to preserve. The connection of these large patches via corridors not only facilitates the genetic communication between these patches, but also serves as a network of similar habitat that facilitates the movement of organisms into the backyards of the citizens of the State. The corridors may be small and be affected by local extinctions, but these extinctions may be recolonized from the large contiguous areas and the quality of life for people living in the region will be enhanced. In addition, the corridors may serve as public rights-of-way for people to access the larger patches and to enjoy the natural heritage of New Jersey.

- X **Preserve open space.** Our fourth recommendation was to preserve as much open space as possible, but we, reluctantly, recognize that this must be done within the practical limits of available funds and innovative land preservation techniques. New Jersey is an urban State with a great need for open space for the preservation of the natural heritage of the State and for the passive recreational opportunities needed by the people of the State. We have not preserved anywhere near enough open space needed to maintain the quality of life we enjoy. We must work toward a much higher goal of greater than 50% preserved land.
- X **Link data with public process.** Our fifth recommendation was to link the data with the public process. This is related to our first recommendation in that data by itself does not change policy. Presentation of information relevant to management policy and governmental decision-making is critical if we wish to influence the patterns of land use in the State. The linkage of researchers with policy makers is a clear need in the development of this information transfer process.

Habitat and Forest Fragmentation Session

Facilitator: Dr. Richard Lathrop, Associate Professor, Environmental Monitoring, Rutgers University.

Breakout Session Discussion Summary

The Habitat and Forest Fragmentation Session first identified current habitat mapping, monitoring, and research efforts. Next, the group identified research and data gaps with respect to habitat and forest fragmentation issues in the Highlands. Finally, conclusions and recommendations related to current and future habitat and forest fragmentation needs were developed by the participants.

Initial discussion centered on ongoing habitat mapping, monitoring and research efforts in the Highlands region that are being conducted by various federal, state, and local agencies. These various efforts will be summarized below.

Gap Analysis/Natural Community Classification of natural vegetation communities of the Highlands and other New Jersey physiographic provinces, with rarity status and examples of exemplary sites. The present mapping program is a cooperative effort between the state governments of New Jersey, Delaware, and Maryland and the U.S. Fish & Wildlife Service (coordinated by Ann Rasberry, Maryland Dept. of Fish and Game). Digital map data will not be available for another 3 to 4 years. Local contact: Tom Breden, Natural Heritage Program, NJDEP.

ECOMAP. Vegetation/land type association mapping coordinated nationwide by the U.S. Forest Service. The Highlands region will be mapped and available in digital form. Local contact: Craig Coutros, N.J. Department of Environmental Protection, Parks and Forestry.

U.S. Forest Service Forest Health Monitoring Program. Long-term forest inventory plots to monitor forest status and health nationwide. Local contact: George Koeck, N.J. Department of Environmental Protection, Parks and Forestry.

U.S. Fish & Wildlife Service Significant Habitat Study for New York Bight. Compilation of environmental data of the Highland region, much of this is available in digital form. Contact: USF&WS, Rhode Island.

AMNET. Systematic sampling of benthic macroinvertebrates from a number of Highlands stream/river systems, conducted by the NJ DEP. Contact: Al Korndoerfer, NJDEP, Water Monitoring Management.

Hemlock Decline Study. Satellite remotely sensed change detection of hemlock decline in northern New Jersey. Contact: Rick Lathrop or Denise Royle, Center for Remote Sensing & Spatial Analysis, Rutgers University.

Highlands Land Cover Mapping/Forest Fragmentation Study. Satellite remotely sensed

mapping of land cover and inventory of contiguous forest blocks in the New Jersey Highlands. Contact: Rick Lathrop, Center for Remote Sensing & Spatial Analysis, Rutgers University.

Breakout Session Data Gaps

Habitat needs of Highlands fauna. Information on the habitat needs of Highlands fauna exists for many species but is often scattered through a variety of sources. There is a great need for the literature review and compilation of existing information. Additional research (specific to the Highlands) on the habitat needs of lesser studied species as well as what qualifies as high quality habitat for all faunal species is needed.

Cumulative impacts of habitat/forest fragmentation on Highlands flora and fauna. Greatest information on interior forest nesting birds, however most of this information is derived from research conducted elsewhere. Information on many other species (e.g., reptiles and amphibians) are lacking.

Community/Ecosystem levels of impacts of fragmentation. Additional research on the effect of fragmentation and increasing edge on community/ ecosystem level processes such as disturbance, succession, exotic plant invasions, disease transmission, nutrient cycling, productivity.

Alleviating impacts of fragmentation. Research is needed on alleviating the impacts of development and fragmentation on Highlands fauna. Specifically, the success of wildlife bridges/tunnels/corridors to ensure connectivity of wildlife habitat and the long-term sustainability of Highlands biodiversity is unquantified.

Integration of terrestrial and aquatic mapping/monitoring efforts. There needs to be better integration of terrestrial, wetland and aquatic ecological mapping and monitoring efforts.

Recommendations

- X **Finish existing habitat mapping efforts followed by continued monitoring efforts.** A number of habitat mapping efforts are presently in the works and should provide us with a better picture of the Highlands vegetation communities and landscape in the near future. However, the Highlands are a dynamic system affected by a variety of natural and anthropogenic influences and these ecological systems need to be continually monitored and updated.
- X **Further research on the cumulative impacts of habitat/forest fragmentation.** Research on the cumulative impacts on habitat/forest fragmentation and how to alleviate these impacts needs to be conducted that is specifically relevant to the Highlands landscape and Highlands flora and fauna.
- X **Making information on habitat mapping and forest fragmentation readily available.**

Relevant information on Highlands habitat and the impacts of forest fragmentation needs to be available to decision-makers at all levels (i.e., federal, state and local). As most land use decisions are made at the local level, information must be made available to local groups in an understandable format and timely manner. Maps of habitat should be made available in digital format wherever feasible due to the increasing use and availability of geographic information systems for environmental analysis.

- X **Increasing the visibility of the Highlands as a region.** The visibility of the Highlands as a unique and coherent region, as a landscape of meaning, needs to be increased and brought to the attention of the New Jersey populace, as well as the entire Mid-Atlantic region. The New Jersey Pine Barrens region provides a similar model and the feasibility of establishing a Highlands National Reserve should be explored.

Land Use, Economics and Infrastructure Planning Data Session

Facilitator: Rob Pirani, Regional Plan Association

Breakout Session Discussion Summary

The group's discussion revolved around two inter-related sets of data and research needs: Land use economics and land use. The recommendations highlighted the links between land use decisions and fiscal health and the inadequacy of the large lot subdivision as the development template for the Highlands.

Land Use Economics. There were several studies/data sets mentioned as being useful starting points for future research on the question of land use economics and the fiscal impact of development. These included property tax/school finance information available from the State Board of Education, data available from the Center for Urban Policy and Research at Rutgers on land values by municipality dating back to the 1950s, an analysis of a cluster development proposal on the Copperas Ridge tract in Rockaway Township by the New Jersey Green Acres Program, and studies by the American Farmland Trust in Massachusetts and the Trust for Public Land in Connecticut.

The discussion of data/research/application needs revolved around the fiscal impact of different land uses. Two related issues that were mentioned were the desire of municipalities to identify and attract uses that do not add additional school children and the need for decisionmakers to be able to fully understand the fiscal implications of development, in particular, the relationship of short-term and long-term costs and benefits (i.e. immediate tax revenue versus service demand in the future). It was noted that EIS and other planning studies typically do not measure natural resource information in monetary terms.

Land Use. Many people spoke of the need to improve the quality and availability of natural resource information for local decision makers and land owners. "Carrying capacity" studies were suggested as one means of relating natural resource information to land use decision making. One suggestion was to develop biological indicators that could be used to gauge the impact of development decisions. Macroinvertebrate stream populations was a specific example.

Another concern was keeping data sources current and available. It was stated that there could be better links between state and local information sources; both as a means of providing localities with information and to keep state-level databases current. One particular set of data that was recognized as rarely being shared on a regional basis are the environmental impact statements filed for individual projects.

The group discussed the need to develop zoning and other local regulatory tools based on such natural resource information. It was suggested that in many cases a small amount of the development causes most of the ecological impact, impacts that could be easily mitigated if proper care was taken.

Much of the discussion centered on the need to develop alternatives to 5 acre, large lot zoning as the

principal means for managing growth. It was suggested that developing the information/planning base for developing these alternatives requires a better understanding of the trade-off between cluster and sprawl developments. It was stated that planning board analysis of subdivision proposals could be done in a way that was more accessible to the public. Also needed is a clarification of what uses are viable on land that might be considered as "sending areas" in transfer of development rights programs.

Several people in the group raised the problem of "selling" the public and the market place on higher density housing. It was suggested the computer aided design might be a useful tool for doing that. Improving the design of cluster and other high density development was one other recommendation.

Recommendations

Data/Research Needs

- X Assemble a State- or Highlands- wide GIS of parcel and property tax information that could be used for fiscal impact (and other) analyses.
- X Improve local ability to conduct fiscal impact analyses of both conservation and development, including disseminating existing studies and information on fiscal cost/benefit studies and techniques.
- X Develop a better understanding of the land use economics underlying transfer of development programs, including the potential value of the development rights (i.e. the value of being able to build at higher densities in receiving areas) and the value and potential uses of "residual land" where the development rights have been transferred (i.e. the "sending areas).
- X Develop design and regulatory alternatives to large lot zoning.
- X Develop a better understanding of the infrastructure and natural resource capacity of the Highlands for additional development.

Organizational Needs

- X Establish better links between local and state data sources.
- X Encourage the use of data for inter-municipal decision making.
- X Educate the public, local officials, and developers on the fiscal and ecological trade-off's between land uses.

SYMPOSIUM I: COLLECTIVE RECOMMENDATIONS

The following needs and recommendations were developed within each of the four focus area breakout sessions (water resources; biodiversity/species and census data; habitat/forest fragmentation; and land use/economics/infrastructure planning) and during the final open discussion session at the April 12th symposium. The recommendations are not listed in any priority order.

Water Resources

- X **Water resources data reflecting baseline (current) conditions should be collected at a scale sufficient for watershed-based management of water supply and water quality.** The utility of data at the municipal and sub-watershed level is important.
- X **Improved information is needed on the economic utility of water resources using different time scales and perspectives.** Inter-generational costs and benefits are not easily addressed through standard economics (which tends to weight near-term costs and benefits more than long-term). Non-monetary costs and benefits also tend to be ignored by standard economics. There is also little recognition of the disparate effects of costs and benefits on different interests.
- X **A unified framework for water resource functions is needed.** It should be watershed-based and cover the full spectrum of water issues. Current frameworks have limited scope, focusing usually on single issues (e.g., water quality, flooding).
- X **Research is needed on the fate and transport of ground water and ground water pollutants in Highlands geology.** Most such research tends to focus on porous media, such as sand and gravel aquifers.
- X **A better understanding is needed of the value of clean, potable water for urban users of remote supplies (e.g., the Pequannock and Wanaque watersheds), and the costs and benefits of providing those supplies to the host municipalities.**

Biodiversity/Species and Census Data

- X **Aggregate data.** The ability to make informed decisions in the management of our biodiversity is dependent on the quality of the information available to the decision-makers. In some circumstances new data must be gathered, but in many situations, existing information must be made available in forms easily accessible to a wide variety of users. Both continued collection of information and the efforts to make the information available in useful forms must be pursued.
- X **Develop advocates at the primary and secondary school levels.** The citizens of New Jersey and the world form their opinions and develop their attitudes relatively early in life. We must be sure that the options involving the preservation or loss of our biodiversity and the consequences for our quality of life be presented to students at an early stage in their education. All individuals

should have the opportunity to make decisions on environmental quality using the highest quality information available. The decisions that are made today will influence the quality of life of the youth who will live in the environment created by those decisions.

- X **Preserve large contiguous areas and connecting corridors.** Large contiguous areas serve to minimize the influence of the edge effect. Influences from surrounding habitats impact the integrity of a patch that has been deemed worthy of preservation. The connection of these large patches via corridors not only facilitates the genetic communication between these patches, but also serves as a network of similar habitat that facilitates the movement of organisms into the backyards of the citizens of the State. The corridors may be small and be affected by local extinctions, but these extinctions may be recolonized from the large contiguous areas and the quality of life for people living in the region will be enhanced. In addition, the corridors may serve as public rights-of-way for people to access the larger patches and to enjoy the natural heritage of New Jersey.
- X **Preserve as much open space as possible, recognizing that this must be done within the practical limits of available funds and innovative land preservation techniques.** New Jersey is an urban State with a great need for open space for the preservation of the natural heritage of the State and for the passive recreational opportunities needed by the people of the State. We have not preserved anywhere near enough open space needed to maintain the quality of life we enjoy. We must work toward a much higher goal of greater than 50% preserved land.
- X **Link data with the public process.** This is related to our first recommendation in that data by itself does not change policy. Presentation of information relevant to management policy and governmental decision-making is critical if we wish to influence the patterns of land use in the State. The linkage of researchers with policy makers is a clear need in the development of this information transfer process.

Habitat/Forest Fragmentation

- X **Habitat needs of Highlands fauna.** Information on the habitat needs of Highlands fauna exists for many species but is often scattered through a variety of sources. There is a great need for the literature review and compilation of existing information. Additional research (specific to the Highlands) on the habitat needs of lesser studied species as well as what qualifies as high quality habitat for all faunal species is needed.
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- X **Community/Ecosystem levels of impacts of fragmentation.** Additional research on the effect of fragmentation and increasing edge on community/ ecosystem level processes such as disturbance, succession, exotic plant invasions, disease transmission, nutrient cycling,

productivity.

- X **Alleviating impacts of fragmentation.** Research is needed on alleviating the impacts of development and fragmentation on Highlands fauna. Specifically, the success of wildlife bridges/tunnels/corridors to ensure connectivity of wildlife habitat and the long-term sustainability of Highlands biodiversity is unquantified.
- X **Integration of terrestrial and aquatic mapping/monitoring efforts.** There needs to be better integration of terrestrial, wetland and aquatic ecological mapping and monitoring efforts.
- X **Finish existing habitat mapping efforts followed by continued monitoring efforts.** A number of habitat mapping efforts are presently in the works and should provide us with a better picture of the Highlands vegetation communities and landscape in the near future. However, the Highlands are a dynamic system affected by a variety of natural and anthropogenic influences and these ecological systems need to be continually monitored and updated.
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- X **Make information on habitat mapping and forest fragmentation readily available.** Relevant information on Highlands habitat and the impacts of forest fragmentation needs to be available to decision-makers at all levels (i.e., federal, state and local). As most land use decisions are made at the local level, information must be made available to local groups in an understandable format and timely manner. Maps of habitat should be made available in digital format wherever feasible due to the increasing use and availability of geographic information systems for environmental analysis.
- X **Increase the visibility of the Highlands as a region.** The visibility of the Highlands as a unique and coherent region, as a landscape of meaning, needs to be increased and brought to the attention of the New Jersey populace, as well as the entire Mid-Atlantic region. The New Jersey Pine Barrens region provides a similar model and the feasibility of establishing a Highlands National Reserve should be explored.

Land Use/Economics/Infrastructure Planning

- X **Assemble a State- or Highlands- wide GIS of parcel and property tax information that could be used for fiscal impact (and other) analyses.**
- X **Improve local ability to conduct fiscal impact analyses** of both conservation and development, including disseminating existing studies and information on fiscal cost/benefit studies and techniques.

- X **Develop a better understanding of the land use economics underlying transfer of development programs**, including the potential value of the development rights (i.e. the value of being able to build at higher densities in receiving areas) and the value and potential uses of "residual land" where the development rights have been transferred (i.e. the "sending areas).
- X **Develop design and regulatory alternatives to large lot zoning.**
- X **Develop a better understanding of the infrastructure and natural resource capacity of the Highlands for additional development.**
- X **Establish better links between local and state data sources.**
- X **Encourage the use of data for inter-municipal decision making.**
- X **Educate the public, local officials, and developers on the fiscal and ecological trade-off's between land uses.**

Additional Recommendations During Open Discussion

- X **Identify areas as low density zoning rather than large lots to provide greater flexibility.**
- X **Establish statewide program to encourage municipalities to prepare tax maps on a standardized data base**, geo-referenced to a statewide base map, that would enable regional/cross-boundary analysis.
- X **Highlands groups (including the real estate community) could work together, share digitization and develop a parcel base map.**
- X **Develop a Highlands Research Experiment Station and/or Research Consortium** to study the biotic and abiotic resources of the Highlands and the impacts of urban and suburban stressors on these resources. Focus could also include public use and public health impacts and could include development of environmental indicators for the Highlands region.

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IV. PROCEEDINGS: JUNE 12, 1996
HIGHLANDS RESEARCH SYMPOSIUM II
APPLYING ECOLOGICAL KNOWLEDGE TO LAND USE DECISION MAKING

OVERVIEW

Managing the ecological processes of the Highlands is the stewardship responsibility of land owners, builders, planners and natural resource managers in the private and public sectors. Unfortunately, these people do not always have the most current information or planning tools available to them when they are making decisions. At the same time, scientists and data managers in academia and government that are charged with assembling this information are not always aware of the needs of land owners and land use professionals.

On June 14, 1996, the second symposium of the two-part series was convened at Ramapo College in Mahwah, NJ. As with the first conference on April 12th, the overall goal was to improve the extent, quality, and use of information about Highland resources. The June 14th session specifically sought to assess how scientific data and understanding about habitat conservation and water resource management can be most effectively translated into better land use management and development decisions in the Highlands. 81 municipal officials, landscape architects, planners, open space managers and concerned citizens gathered to discuss the state of the science in habitat protection and land management, to build collaboration and connections for practical and technical knowledge exchange, and to discuss specific information needs and how ecological information can be better used in land use decision making.

The day started with a panel presentation and group discussion on applying ecological knowledge to land use decision making. Featuring Randall Arendt of the Natural Lands Trust in Pennsylvania, Elizabeth Brabec from LandEthics in Maryland, and Richard Lathrop of Rutgers University, and moderated by Robert Yaro of Regional Plan Association, this panel of experts presented the concepts of landscape ecology and looked at some innovative ways these concepts can be address at the site and municipal level.

The symposium then divided into workshops where specific resource management issues and planning techniques were addressed in detail by both speakers and symposium participants. The workshop presenters and facilitators are listed in the program. Workshop participants were asked to specifically answer three questions in each session.

1. Identify the five most important information or knowledge gaps that exist for the specific workshop topic. The following are examples of the type of response that was sought from participants:
 - A lack of knowledge/understanding of the natural resources in question (e.g. the habitat needs of specific species);
 - A lack of data (e.g. where the species are present);

- A lack of awareness/implementation of management tools for the Highlands region (e.g. mapping of open space, migration corridors, etc.);
2. Identify a key barrier to addressing the issue for each of five information or knowledge gaps identified above; and
 3. Identify at least two success stories where science/ecological concepts were integrated with planning/design and successfully applied to resolve these gaps.

The entire conference reconvened to hear the reports from the individual workshops and participate in a summary discussion led by Robert Tucker from the New Jersey Ecological Research Partnership.

CONFERENCE PROGRAM

9:30 Welcome

Robert D. Yaro, Executive Director, Regional Plan Association

9:45 Plenary Panel Presentation and Discussion:
Applying Ecological Knowledge to Land Use Decision Making

Richard G. Lathrop, Associate Professor, Rutgers University
Randall Arendt, Vice-President for Conservation Planning, Natural Lands Trust
Elizabeth Brabec, President, LandEthics

11:15 Break

11:30 Concurrent Workshops

12:30 Lunch Break

1:15 Concurrent Workshops Continue

2:15 Report of Breakout Workshops to Conference/Next Steps

Robert Tucker, Director, EcoPolicy Center, Rutgers University

3:00 Adjournment

The workshops and key participants were:

- Wetlands and Stormwater Management/Riparian Corridors

Facilitator: Rick Cooksey, USDA Forest Service; Sally Dudley, Association of New Jersey Environmental Commissions

Presenters: Gene McColligan, New Jersey Department of Environmental Protection; John Thonet, Thonet Associates; Al Todd, USDA Forest Service

- Habitat Protection

Facilitator: Richard Kane, New Jersey Audubon

Presenters: Larry Niles, New Jersey Department of Environmental Protection; Larry Torok, New Jersey Department of Environmental Protection

- Local Open Space Protection and TDR's: Tools and Barriers

Facilitator: Eileen Banyra, EFB Associates/Association of New Jersey Environmental Commissions

Presenters: Randall Arendt, Natural Lands Trust;
John Carlton, Carlton Design

- Ecotourism Development

Facilitator: Kerri Ratcliffe, New Jersey Department of Environmental Protection

Presenters: Stephen Kehs, Cumberland County Planning and Development;
James Sciascia, New Jersey Department of Environmental Protection

- Geographic Information Systems

Facilitator: Richard Lathrop, Rutgers University

Presenters: Barbara Plunkett, New Jersey Department of Environmental Protection;
Dave Peifer, South Branch Raritan Watershed Association

SUMMARY OF PLENARY PANEL

Richard G. Lathrop, Associate Professor at Rutgers University provided a primer on the state of the science in landscape-scale ecological processes. It included definitions and discussion of some key concepts such as the edge effect, biological diversity, forest fragmentation, and wildlife corridors. He concluded his remarks by presenting a four-part program for preserving the Highland's biological legacy: Establish large forest reserves throughout the Highlands to maintain forest interior wildlife; Protect lake, river, stream, and wetland systems through riparian buffer zones; Create greenway corridors between reserves to facilitate movement/migration of flora and fauna; and Maintain tree/shrub cover in residential areas to "soften" the intervening matrix and maintain landscape connectivity.

Elizabeth Brabec, the President of LandEthics, Inc., a planning consultant based in Annapolis, Maryland, outlined several examples of alternative development proposals in the Chesapeake Bay area that her firm has created that both protect landscape values and water resources, while realizing the number of building lots that would be possible under conventional development scenarios. These development examples utilized shallower building setbacks, narrower streets, and smaller lots to lower building costs, provide community character, and to allow for the conservation of significant tracts of community open spaces and other amenities. Ms. Brabec further described how these development scenarios helped protect water quality by minimizing the amount of land disturbance, grading, and impervious surface. In one example, the amount of non-point surface loading of phosphorus from the alternative development scenarios was 60% of that which would be expected from a typical development.

Randall Arendt is Vice-President for Conservation Planning at the Natural Lands Trust, a non-profit conservation organization in Pennsylvania. Mr. Arendt's presentation described how local and regional planners can create open space networks by linking municipal comprehensive plans with new provisions for local zoning and subdivision ordinances. Drawing on his book Conservation Design for Subdivisions, Mr. Arendt showed how planners and developers can create subdivisions whose central organizing principle is that of resource conservation. The process starts by limiting "as-of-right" density in sensitive landscapes but allowing developers to proceed with higher density developments that include minimum open space set-asides in areas designated by the comprehensive plan. The traditional site analysis for a subdivision is redefined, with the identification of conservation features, road layout, and location of house sites occurring first, and the drawing of lot lines, which is usually the first or second step in the process, the last issue to be resolved. Mr. Arendt suggested that such subdivisions not only result in better conservation practices, but more marketable homes as new owners will enjoy being adjacent to preserved land and the greater privacy afforded by the alternative alignments.

SUMMARY OF CONCURRENT WORKSHOPS

Wetlands and Stormwater Management/Riparian Corridors

Facilitators: Rick Cooksey, USDA Forest Service; Sally Dudley, Association of New Jersey Environmental Commissions

Presentations

Three speakers participated in this workshop. Each discussed a topic segment and then all answered questions regarding development design and current innovative approaches that include the important functions of wetlands and riparian areas to protect water quality and sensitive living resource habitats into comprehensive land use planning. The speakers included:

Gene McColligan, New Jersey Department of Environment Protection - Gene provided a summary of functions and values of wetlands, and highlighted the current NJ DEP regulations on wetlands.

John Thonet, Thonet Associates - John gave a presentation on an innovative approach to stormwater management called “No Net Increase.” The philosophy is to create no net increase in rates or volumes of stormwater runoff and non-point source pollution associated with runoff. It is a policy that seeks to preserve healthy stream corridors, while managing to accommodate a reasonable degree of land development.

Al Todd, U.S. Forest Service, State & Private Forestry - Al presented the function, values, and importance of riparian forest buffers, or streamside forests, to the protection of stream corridors for water quality and habitat. He highlighted case studies of local governments that have ordinances in place to retain riparian buffers and require the integration of this natural feature in land use planning.

Facilitated Listening Session -- Responses

Knowledge/Information Gaps

- Support for cluster development, conservation design and “New Urbanism”
- Communication of where to find GIS information and its accessibility. Particularly useful would be GIS layers about special environmental areas and natural features.
- Information to estimate calculations of gross densities to be used for implementing innovative approaches to site design.
- Forest cover data and maps

- Information on integrating natural systems such as wetlands and riparian corridor protection into development site design that local government officials can use and understand.
- Economic analysis of stormwater management alternatives which highlight cost comparisons between alternatives and the benefits of different approaches.
- “How to” publications to protecting water quality at the hamlet, township level and that encourage development into centers.
- Increase professional knowledge through certification and training on integrating natural systems into stormwater and development planning.
- Information on appropriate use and placement of septic systems in development infrastructure.
- Information about wetlands and riparian corridor trouble spots and how to treat them.
- Information on which watershed land is contributing to water sources (surface and ground) and the capacity of those lands to accommodate development.

Barriers Toward Addressing the Issues

- Local governments need to understand what it means to “cluster development” and that it will not be detrimental to their locality.
- State stormwater guidelines that encourage or support integrating natural systems into stormwater treatment facilities are not being distributed from the state to the local level.
- There is a lack of suitable incentives to employ innovative approaches to development and stormwater management.
- There is too much emphasis on satisfying self-interests. There needs to be ways to maintain equity between compensating the development community and protecting important environmental assets.
- Fear of litigation is a constraint on local government official’s willingness to try alternatives strategies.

Success Stories

- Lafayette Township, Sussex County which has used a gross density calculation and local carrying capacity analysis as well as establishing local riparian corridor protection
- Harding Township, Morris County on integration of natural systems into stormwater management
- Statewide NJ DEP guidelines on riparian buffer and wetland setbacks.

Habitat Protection

Facilitator: Richard Kane, New Jersey Audubon

Presentations

Larry Niles, New Jersey Department of Environmental Protection, Endangered and Non-Game Species Program described the difficulties in identifying habitat areas to be protected:

- There is a lack of knowledge about species location and habitat needs. While some species have been favored for investigation such as the bald eagle, very little has been done about species such as bobcats, amphibians, invertebrates, and owls.
- Even when information is available, the practical result for managers is a "mishmash of species with conflicting needs." For example, favoring species of the interior forests puts grassland birds at a disadvantage.
- Habitat-level data is limited to the degree to which we have identified such habitats and understand them. There are some habitats which only now are gaining currency as important - such as vernal pools.
- The result of this lack of information is that developers are presented with confusing facts from the preservation community. This may develop into an adversarial relationship. Developers may stay outside of the area completely because they do not want to deal with uncertain regulations whose interpretation may change. When people do develop land, they "develop the hell out of it."

The NJ Endangered and Non-Game Species Program is addressing some of these concerns by delineating key habitats critical to biodiversity through its Highlands Landscape Project. By identifying where all species are found, using sources such as the Bird Atlas created by the Audubon Society, and then incorporating this information into a GIS, the program will delineate what the critical land areas in the Highlands are. The final management decision may not be land acquisition, but an attempt to get the information to the planning boards, land management officials and state regulators.

Steps that can be taken to assist land management professionals are to develop a predictable system of state regulation that goes beyond protection of individual sites to identifying entire areas where, for example, an area would be subject to the maximum wetland buffers. Working groups could be created among land managers; often the various parties in land management only interact when there is a conflict. Land use planners should be supplied with information about the sites.

Larry Torok of the NJ DEP Wetlands and Land Use Regulatory Program pointed out that New Jersey, like most of the northeastern states, does not have a comprehensive system designed to protect habitats. Instead, several different pieces of legislation, taken together, partially address habitat protection issues.

The Freshwater Wetlands Protection Act, for example, protects wetland habitat by identifying the location of wetland-dependent species and then limiting development within a certain distance from that areas. For example, once a red-shouldered hawk nesting site is identified, a one-mile radius area around that location is noted in the Department's GIS system. This boundary is used to target areas for development review or wetland delineation. The program's effectiveness is constrained by limited amount of information gathered, and by the fact that it cannot protect migration routes or the genetic variability of metapopulations. The success of this and other regulatory programs is also limited by their site-by-site basis, the artificial boundaries imposed by political jurisdictions, and the fact that findings and recommendations are highly subject to legal interpretations.

Facilitated Listening Session -- Responses

Knowledge/Information Gaps

- Species distribution
- Critical areas of biodiversity
- Locations of regulated species
- Guidance on endangered species protection for the regulated public and users
- Data to create useable indicators of healthy ecosystems at municipal or watershed level, Such as:
 - % forest cover, current and build-out;
 - % impervious surfaces, current and build-out; and
 - species, current and build-out.
- Changes in habitat due to climate change, development, and exotics, and their effect on species over time

Barriers Toward Addressing the Issues

- Political resistance at the municipal and economic level to take natural resources as the basis for decisionmaking
- Zoning density
- Rateable chase/taxes based on potential for development
- Lack of open space planning at municipal and regional levels
- Education of public of importance of ecosystem protection
- Urban flight
- Lack of resistance to regional development mechanism
- Fragmented planning
- Abdication of responsibility by planners

Success Stories

- Newark's passive watershed management program
- Pinelands

- Greenacres protection of watershed lands owned by Jersey City
- Preservation of Wanaque Reservoir watershed lands
- Greenacres acquisition in Highlands

Local Open Space Protection and TDR's: Tools and Barriers

Facilitator: Eileen Banyra, EFB Associates/Association of New Jersey
Environmental Commissions

Presentations

John Carlton, ASLA, of Carlton Design gave a TDR primer illustrating how development occurs in a “swiss cheese” fashion. John gave local examples from his experiences working for the Newark Watershed Corporation and discussed the challenges of addressing “home rule” when seeking to protect resources that exist beyond municipal boundaries. The presentation stressed that the key difficulty in implementing creative land use controls in communities is understanding the resource and maintaining its critical and contiguous mass.

Randal Arendt of the Natural Lands Trust spoke of identifying and working with a community's existing natural and cultural features. Randal's slide presentation addressed creative land development techniques as well as examples of greenways, sensitive higher density housing and waste disposal. He described a four-step process to design within the presentation: 1. Identify resources; 2. Locate houses; 3. Connect the houses with greenbelts; 4. Draw lot lines.

The speakers and moderator all emphasized the importance of using a sketch plat or concept review process for a community. A discussion followed on how higher density can be attractively designed and fit into the landscape with participants emphasizing the use of appropriately trained professionals with an understanding of design and the environment to address land use decisions (“to show how beautiful density can be”). Typically this job is left to engineers who are not trained as site designers and do not necessarily understand the complexities of natural systems. Participants also emphasized the need to develop a community vision based on an analysis of environmental constraints. Creating such a vision and including it in the master or general plan of the community is the only means of preserving contiguous open space resources that traverse several properties. This vision should also include ways of designing the balance of the community.

Facilitated Listening Session -- Responses

Knowledge/Information Gaps

Lack of understanding of the cost of development. Fiscal analysis isn't understood by communities i.e. open space vs. development costs.

Planning education isn't required of local boards or land use decision makers. Knowledge greatly varies among boards, local officials and board attorneys.

Local planning is inadequate when addressing natural systems that cross multiple local and/or county boundaries.

There is a lack of coordinated regional or inter-municipal planning.

Communities need demonstration models to better understand the difference between PDR/TDR, density vs. lot size, master planning, wastewater systems and managing common open space.

Barriers Toward Addressing the Issues and Suggested Solutions

Strong public perception that all development will improve tax base.
Little to no funding is available for local planning studies or education.

Suggested Solutions:

Mandatory education of all elected and appointed officials

Ineffective local planning.
Lack of authority for regional planning efforts and no leadership.
Lay people with no training in decision-making positions.
Decisions are based on political rather than environmental information.

Suggested Solutions

Required education.
State Plan with the M.O.U. between DEP, OSP & COAH.
State Plan with additional regulatory powers.

DEP regulations do not permit some of the ideas that Randal espoused ie. alternative septic systems, community or shared systems.
Communities afraid of law suits.
No funding for planning solutions that can be replicated.

Suggested Solutions

More flexibility/innovation at NJDEP.
Mandatory continuing education of professionals.
Funding of planning efforts as identified in the NJ State Plan.

Success Stories

- | | |
|---|--|
| 1. Readington Township, NJ; Pilesgrove, NJ in Salem Co. | Communities with mandated cluster ordinances. |
| 2. Alexandria, NJ in Hunterdon Co. | Greenway plan and community worked with 3 contiguous land owners to cluster development on to one property. |
| 3. Cranbury, NJ in Mercer Co. | Lot averaging plan in village to match existing historic village, preserve open space and viewsheds. |
| 4. Washington, NJ in Morris Co. | Community dedicated to preserving open space and have protected tracts in Long Valley. |
| 5. Washington, NJ in Mercer Co. | The Conservation Plan element of the Master Plan identifies property to be preserved, offers a variety of methods for preservation, attempts to form contiguous open space and prioritizes properties. |
| 6. Pinelands Commission and Pinelands Development Credit Bank | Successful TDR program in NJ |

Ecotourism Development

Facilitator: Kerri Ratcliffe, New Jersey Department of Environmental Protection

Presentations

Stephen Kehs, Executive Director, Cumberland County Planning and Development, discussed Cumberland County's Ecotourism Plan. The Plan developed a strategy to preserve outstanding natural resources while also promoting jobs and a healthier economy in Cumberland County. The Plan focuses on six nature-related themes and designates unique destinations. The Plan identifies specific opportunities for moving an ecotourism program forward. This Plan was developed and will be implemented with significant participation from the general public, local governments and private sector.

Jim Sciascia, Principal Zoologist, NJ Department of Environmental Protection, discussed the forthcoming publication of the New Jersey Wildlife Viewing Guide. A product of a partnership with the Defenders of Wildlife and Falcon Press, this guide will provide information on 90 wildlife viewing areas around the state and will feature several wildlife diversity tours of the state's ecoregions.

Facilitated Listening Session -- Responses

Knowledge/Information Gaps

- Inadequate travel and tourism data related to ecotourism; particularly economic impact data.
- Transportation and public infrastructure planning does not contemplate ecotourism.
- Lack of education/involvement of local interests can result in local governments and citizens viewing “tourism” in a negative light
- Lack of comprehensive and user-friendly listings of nature-related attractions either by region or for state.
- Need for monitoring and impact assessments as ecotourism is developed for both the natural/cultural resources and for the economic/business sector. Need baseline information on quality and character of the resources.
- Lack of sufficient technical/financial assistance to communities to develop ecotourism plans.

Barriers Toward Addressing the Issues

- Potential for conflict between and among residents, interest groups, travelers, businesses, user groups.
- Potential for overuse or inappropriate use of the resources.
- Funding for public parks and recreation organizations has been strained and interpretive programming and events have declined dramatically, creating a less appealing visitor experience at parks and cultural sites.
- Pressure on large tract landowners (including agricultural) to sell properties - need incentives to help landowners keep open lands in undeveloped state.
- Zoning and other regulations can discourage ecotourism related enterprises such as campgrounds, bed & breakfasts.
- Liability - fear of litigation is a constraint for both public and private recreation providers, cost of insurance and structure of liability insurance coverage is problematic.

Suggested Solutions

- Cumberland County is a success story in the making. County planning effort brought together a broad spectrum of private and public interests to develop an ecotourism plan.
- State Wildlife Diversity Tours will make link between wildlife viewing and tourism development. Need to develop local constituent groups to “adopt” wildlife viewing sites for monitoring/maintenance/interpretive enhancements of sites.
- DOT needs an ecotourism/cultural tourism coordinator to review and implement appropriate transportation planning and guidance for local communities - including ability to use “rustic” or other appropriate signage.
- All local/county planning agencies should incorporate tourism planning and related needs into routine planning activities.
- State/local governments need some model zoning ordinances to review to foster both a

“tourism-friendly” atmosphere and to protect the natural and cultural resources from degradation - examples of cultural overlay zoning and open space/cluster zoning.

- Both public and private groups can create eco-friendly tourism opportunities. For example, NJ Audubon has been providing excellent birding and outdoor education experiences - bringing tourists to more rural areas of the state.
- In-lieu tax payment programs for open space should be reviewed for possible revamp.
- Support for Intermodal Surface Transportation Efficiency Act (ISTEA) reauthorization to allow for grants for trails/recreational transportation development.
- Make changes or additions to state travel and tourism data collection and surveys to give targeted focus to eco and cultural tourism.

Geographic Information Systems

Facilitator: Richard Lathrop, Rutgers University

Presentations

Barbara Plunkett from the Bureau of Geographic Information Analysis at the NJ Department of Environmental Protection discussed NJDEP's development and application of GIS for environmental protection efforts, including the availability of low-cost GIS data that the NJDEP is making available on CD-ROM.

David Piefer from the Upper Raritan Watershed Association discussed the Upper Raritan watershed Association's involvement with GIS for grass roots environmental planning, including actual case studies of the use of GIS.

Facilitated Listening Session -- Responses

Knowledge/Information Gaps

Uncertainty about the what GIS is and the appropriate uses for the technology?

Barriers Toward Addressing the Issues and Suggested Solutions

Ignorance. Normal time lag for adaptation of new technology. Steep learning curve.

Suggested Solutions:

Continued education through short courses, workshops, etc.

Data availability in general. Particular problem layers include:

- parcels/zoning;
- public open space/easement;
- detailed site level data.

Large initial expense in data creation. Lack of standards across administrative units. Narrow perspective at municipal level.

Suggested Solutions:

Statewide effort to establish minimum standards for land use mapping combined with GIS establishment at the municipal and county level. This should include a push to map ownership parcels and zoning in a standardized fashion. Leadership from state government is needed to coerce cooperation at local level. This is envisioned as a long term process as municipalities update their existing maps.

Make sure that the digital CAD (Computer Aided Design) files that are part of most detailed development site plans public records, available for incorporation into municipal level GIS's.

Enhance the sharing of digital data to reduce duplicative data creation efforts. Make greater efforts to make GIS users aware of existing GIS data sets that are available on CD-ROM or the Internet.

Keeping GIS data up-to-date, especially on two particularly problematic layers:

- land use/cover
- digital orthophotography

Large expense in keeping GIS current due to heavy reliance on aerial photography.

Suggested Solutions:

Greater reliance on high spatial resolution satellite remotely sensed imagery and digital image processing to update land use/cover.

- Confusion about what level of software/hardware is needed for varying levels of GIS application

Wide range of GIS software/hardware available with large range in price. Fully functioning system can be costly in terms of initial expense and upkeep.

Suggested Solutions:

Low cost ARC-VIEW systems will bring GIS to many users but there are limitations that initial users should be made aware of.

Not all municipalities may need a fully functioning GIS. Pooling of resources (regionalization) through cooperation at county level should be investigated.

- Problems integrating GIS into the day-to-day decisionmaking, as well as long-range pro-active planning, at the county and municipal level

A lack of well thought out planning for the proper integration of GIS into the day-to-day operations and general organizational dysfunction.

Suggested Solutions:

Careful planning and consultation when instituting GIS that includes review of the literature for GIS case studies.

Start any initial GIS implementation small and build from success. Keep overambitious goals in check.

Success Stories

Development of statewide GIS data bases of environmental data. NJ DEP and Rutgers University Center for Remote Sensing & Spatial Analysis have greatly facilitated the adoption of GIS for land use planning state/county/municipal governments and nonprofits in the state of New Jersey through their efforts to provide:

- GIS data, e.g., NJDEP CD-ROM, Rutgers NJ Environmental Information System on INTERNET;
- Low cost software, e.g., ESRI/NJDEP ARC-VIEW software grants, Rutgers distribution of GRASS software;
- education/training, e.g., Rutgers professional educational program, GIS certificate, DEP

- training of county personnel; and
- technical support.

Application of GIS at local level in the NJ Highlands region through efforts of groups such as the Upper Raritan Watershed Association and the Township of West Milford. The Upper Raritan Watershed Association (URWA) serves as a model of GIS application for watershed-level planning by nonprofit organizations. URWA got its initial funding through a negotiated Clean-water Act legal settlement. The Rutgers University Center for Remote Sensing & Spatial Analysis created the initial GIS data base, provided software, training and technical support. The Township of West Milford is an outgrowth of a county level GIS demonstration project supported by Senator Bradley's Urban Forestry Initiative. The Rutgers University Center for Remote Sensing & Spatial Analysis created the initial GIS data base, provided software, training and technical support.

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