

FINAL VERSION – JANUARY 2002

A Vision for Enhanced Use and Development of The Arnot Teaching and Research Forest

A Strategic Plan for Improving the Contribution of the Arnot Forest to the Mission of
Cornell University and the Department of Natural Resources

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Executive Summary

The Arnot Teaching and Research Forest, the "Arnot" is 4075 acres of private property owned by Cornell University and managed by the Department of Natural Resources. The property consists of approximately 3800 acres of managed second-growth forest, 200+ acres of open fields and young forests, 10 ponds, and a 20 acre field campus with associated buildings and structures. The Arnot Forest was established initially by a gift of 1600 acres in the 1920's, and has expanded through gifts and acquisition to its current size. The Arnot Forest, like its home department, embraces a conservation ethic through support of research and education that addresses the balance between sustainable production and the maintenance of ecological function.

Rural land use patterns in much of New York and the Northeast are reflected in the Arnot Forest. Privately owned and managed lands dominate the Northeast. However, many landowners don't recognize the benefits of sustainable management practices that complement conservation needs. The Arnot's greatest strength is the opportunity to access a working forest landscape that is integrated with a field campus. Utilization of this strength will ultimately benefit the entire region. As such, the Arnot is well suited to a mission to "document and disseminate the ecological and economic functions of a managed hardwood forest that support societal benefits and conservation values". The Arnot can achieve this mission with commitments to and investments in infrastructure, staff, and programs that provide research, extension, and teaching experiences.

This document describes a 3-year strategic plan that targets specific objectives related to the Arnot Forest mission. With an underlying purpose to serve the department, college, and university, the Arnot will implement the following goals:

1. Maintain the long-term capacity of the Arnot to serve as a facility that supports education and research of natural resource conservation values
2. Develop new research programs and expand the undergraduate field research intern program
3. Develop new and enhance existing extension opportunities and increase use by extension audiences
4. Increase student activity through classes, independent study, and special events
5. Document and plan for the continued sustainable utilization of natural resources

The following strategies will help achieve these goals. They will serve to focus energy and budgets for the Arnot Forest and guide decisions about the allocation of resources and personnel.

- Expand the breadth and diversity of talents on the Arnot committee [goal 1, 2, 3, 4]
- Facilitate research opportunities for faculty and graduate students [goal 2,5]

- Encourage increased research activity, especially through the development of an undergraduate internship program [goal 2, 4]
- Enhance road infrastructure to allow vehicular access on the existing road network for research and education purposes [goal 1, 2, 3, 4, 5]
- Modernize and upgrade the field campus facilities to accommodate user groups with safe and reasonably comfortable conditions as a four-season facility [goal 2, 3, 4]
- Serve as a working educational model for the production and sale of low-grade timber and specialty forest products as a supplement to traditional income sources [goal 1, 5]
- Expand the number of demonstration areas [goal 1, 3, 4]
- Encourage greater use by the university community and public organizations linked to natural resource management [goal 1, 3]

Achieving these objectives will require the following changes. A primary need will be recognition of the Arnot Forest by college administration as an important academic resource. This may lead to their investment in core infrastructure (e.g., roads, buildings) that allows other activities to occur. An enhanced marketing strategy will be necessary to increase stakeholder awareness of opportunities. Many of the desired outcomes currently exist at the Arnot, but the target audiences (e.g., other departments, timber buyers, extension audiences) are unaware of the opportunity. Achieving the full potential of the Arnot will require increasing the awareness and use of property resources by faculty and staff.

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Overview of the Arnot Forest

Historical Background and Regional Context

The Cornell University Arnot Forest "began" following the 1926 death of Matthias Arnot and the donation of 1,641.23 acres in 1927 to the Department of Forestry at Cornell¹. During the next several decades, additional parcels of 50 to 100 acres were purchased from the county or neighbors. The largest addition came to Cornell University in 1954 during the Federal Resettlement when 2092 acres on the west and north side of the forest, first as a 99 year lease and then permanently. In 1995 a 50-acre parcel was obtained on the eastern boundary, and in 2001 the Arnot is in the process of acquiring 125 acres from a neighboring estate on the southeastern corner of the property. Total near future property size is 4200 acres.

The Arnot Forest is a 4075-acre property, privately owned by Cornell University and managed through the Department of Natural Resources within the College of Agriculture and Life Sciences. The property is 98% forested, though when acquired many acres were in transition from abandoned agricultural production to field and forest. Even the mature forests of the central basin were likely logged repeatedly during the late 1850's to supply a hemlock and pine sawmill in nearby Smartwood, NY and a fuel wood steam mill located in Banfield Hollow². The history and prior use of the Arnot Forest parallels the land use patterns in much of New York and throughout the mid-Atlantic and Northeast. Timber or firewood cutting has occurred on virtually all acres during the last 100 years, although approximately 75 acres have been set aside for long-term research projects. A primary strength of the Arnot is to function in documenting the effects of various rural land management practices and sharing that knowledge with students and citizens.

The Arnot Forest has served the Department of Natural Resources (originally the Department of Forestry) for summer field camp, academic courses, youth and landowner education, and research related to rural land and forest management and conservation. Use during the previous five years has included: extension activity for youth, landowners, and extension educators; academic course activities in forest ecology, woodlot management, forest pathology, field biology, agricultural economics, and others; and research including long-term forest dynamics, deer impacts on forest vegetation, conservation ecology of amphibians and reptiles, earthworm ecology, breeding bird habitat use, and a variety of agroforestry projects.

Resource management (e.g., timber, maple syrup) and field campus use provide the financial basis for the Arnot's annual operating budget. Since the mid 1980's, Arnot has sustained a positive cash flow through sale of timber, maple syrup, and rental fees for field campus use. These activities provide critical revenue for infrastructure maintenance, but also provide educational and research opportunities. Forest

¹ Adapted from: AL Odell, JP Lassoie, and RR Morrow. 1980. A History of Cornell University's Arnot Forest. Department of Natural Resources Research and Extension Series No. 14. 53 pages.

² Adapted from: LS Hamilton and MM Fischer. 1970. The Arnot Forest: A Natural Resources Research and Teaching Area. NYS Coll. Agric. Extension Bulletin #1207. 30 pages.

management activities and associated rural land uses are consistent with and support Arnot's role in the department, they reflect a common use in the region, and are an essential part of academic programs.

Mission

The purpose for maintaining and managing the Arnot Forest landscape is to contribute research, extension, and teaching opportunities on the property towards the natural resource conservation objectives of the Department and within the university community. The objectives and strategies described below are presented in this context, and proposed strategies to enhance the Arnot (e.g., increased revenue, expanded infrastructure) will more adequately support departmental and university missions.

The vision of the Arnot Forest is to serve as a regional facility that documents the effects of conservation-based forest and rural land use practices on ecological and economic conditions of the Northeast and to share the knowledge of these effects.

The mission of the Arnot Forest:

**To Document and Disseminate the Ecological and
Economic Functions of a Managed Hardwood
Forest that Support Societal Benefits and
Conservation Goals**

Characteristics of the Property

The Arnot Forest includes the majority of the Banfield Creek watershed that has seven first-order streams and one second-order stream combining into Banfield Creek. The property drains into the Susquehanna River and the Chesapeake Bay Watershed. Elevations range from 2030 to 1150. Soils are generally acidic, medium-textured to fine-textured silt loams of glacial till and typically shallow to bedrock resulting in poor drainage. Soils are primarily of the Lordstown-Mardin-Volusia association. Average annual precipitation is 35 inches.

The forests are primarily mixed northern hardwoods or mixed oak on the drier western and southern slopes. Sugar maple, red maple, white ash, and northern red oak are common overstory species, while the sapling layer in forests not recently farmed is dominated by beech and striped maple. Advance regeneration is infrequent, likely due to a combination of overly abundant deer and/or dense interfering plants such as beech, striped maple, or fern. Understory flora is diverse and typical of mixed hardwood forests of the region.

Several useful features exist on the property and are used in education and/or research programs. Near the south gate, the Arnot maintains a 40 acre, 2500 tap sugar bush which produces an average of 500 gallons of syrup per year. The sugar bush is managed for dominance by healthy sugar maple, excluding diseased trees and trees of other species. Near the north gate the Arnot has a multi-faceted woodland/wildlife demonstration area. The demonstration area includes three sections representing management practices in mature forests, pole timber stands, and successional fields reverting to woodland. Three agroforestry demonstration plots exist in the central basin

and a fourth on the upper ridge along Irish Hill Road. These plots are used for applied research and also illustrate practices for production of ginseng, golden seal and gourmet mushrooms. Near the west-central section of the Arnot is a chain of ponds developed between 1947 and 1950 for farm pond fisheries research. Other features such as the former Soil Conservation Service research buildings, picturesque overlooks, and historic markers are scattered throughout the forest.

The historic use of Arnot lands is one of aggressive and exploitive practices that removed all forest cover in much of the forest or cut heavily in areas not suitable for farming during the mid to late 1800's. Other than approximately 100 acres of open grassland and brush in the west-central section of the forest, the entire property is in some stage of forest re-growth. Approximately half the acres are classified as sawtimber³.

Facilities and Administration

Building and Road Infrastructure

The Arnot Forest includes a four-mile gravel road from the north to south gate including sections of Irish Hill Rd and the former Banfield Road. The main road is open for day use between May 15 and December 15, but closed evenings and during the winter to protect the road and interior areas from abuse. In addition, closed roads include Loop Road, Station Road, Plantation Road, Overlook Road, Recknagel Road, Magazine Road, Aspen Road, Birch Road, McCleary Road, and the Auger Hole Road. Of the closed roads, one mile of Recknagel is passable by truck/van during 3 seasons, and Loop (2 miles), Plantation (0.25 miles), Overlook (0.25 miles), and sections of McCleary Road (0.5 miles) are passable by 4 WD vehicle.

The Arnot Field Campus is located in the southeast corner of the property, and thus effectively juxtaposed to the managed and controlled forest property to facilitate educational programs. The Arnot Field Campus includes (1) a three-season lodge with a 110 person capacity for meals or lectures, plus one heated break-out room, an institutional kitchen, and a small four-season kitchen; (2) a heated bathhouse/sanitary building with restroom and shower facilities; (3) 5 heated cabins that each sleep 8 people; (4) 8 unheated cabins that each sleep 8 people; (5) a shop/maintenance building with work area and vehicle storage; and (6) a two bedroom residence. All buildings have electricity and heat, where provided, is generated by fuel oil except in the heated cabins that have electric heat. Immediately west of the field campus is the sugarhouse including a modern sap evaporator and associated syrup production equipment, an old sawmill (defunct and disassembled) now used for storage, and a lumber shed.

Volunteers initiated construction of the lodge, cabins, and bathhouse which began in the 1950's and were used extensively for 4-H educational programs through the mid-1980's. During the 1930's the camp area was used by the CCC and during the 1940's as a prisoner of war camp. CCC and POW structures were removed in the 1940's and replaced by the current facilities.

³ Sawtimber stands are those management units with an average tree diameter that exceeds 12 inches DBH.

Administration and Staffing

The Arnot Forest full time permanent staff includes a property manager who provides oversight for all activities on the property including the professional management of forested stands and a mechanic/laborer. In addition, part time assistance is provided by a general laborer (0.5 FTE) and an assistant to the manager (0.25 FTE) who coordinates camp use. Recent temporary hires have included a resource technician for data collection on forest stand conditions, and support when regular employees have been on extended leave. The Arnot Director has a 20% administrative appointment and is on-site one day per week.

Recent and Current Activities

Teaching and Undergraduate Education

Several academic courses utilize the Arnot Forest and its field campus. These include especially field-based courses that address aspects of managed forests, notably NTRES 210 - Field Biology; NTRES 302 – Forest Ecology; NTRES 303 – Woodlot Management; and NTRES 415/615 - Agroforestry Techniques. Other CU courses have used the forest less intensively, including courses such as forest soils, agricultural economics, and plant physiology. Although regularly used, the Arnot Forest is a 35-minute drive from campus that inhibits more frequent use by classes.

In 2000, efforts were made to build a relationship between the Arnot Forest and the Cornell Outdoor Education program. During the first year COE developed a two-mile trail immediately north of camp. Additional use of the camp facility and forest by COE is anticipated in the near future.

Research on Hardwood Forest Ecosystems

Research projects typically address issues relevant to the ecological or economic characteristics of sustainably managed hardwood forests. This balance of conservation and production addresses the ownership objectives and applied problems common on private forests throughout the region. Research that integrates with management activity has been encouraged to address "working forest" issues and to minimize the amount of land that is taken out of production for long periods of time. While some active research projects preclude management over a 5 year horizon, most research seeking long-term set aside areas is directed towards property owned and managed by the Cornell Natural Areas/Plantations. The Arnot maintains a limited database of research projects, their objectives, methods, locations, and duration. Beginning in 2000, several research projects included active participation by Cornell University undergraduates participating in a field research summer internship program. Listed below by time since initiation are active or recently concluded research projects and some associated information.

Long-term ecological dynamics of forest ecosystems

Principal Investigator: Tim Fahey, DNR. Initiated: plots originally established in the 1930's, re-inventory and documentation of 35 one-acre plots began again in 1980's. Each plot includes a 2 chain (132 ft.) buffer. Objectives: assess long-term changes in forest composition, structure, and associated changes in ecosystem function especially as

relates to nutrient and biogeochemical fluxes. Expected end date: on-going. Approximately 60 acres.

Population trends of birds in an interior hardwood forest

Principal Investigator: Charlie Smith, DNR. Initiated: 1998. Objectives: To assess characteristics of bird population size and community diversity in an undisturbed mature mixed hardwood forest. Expected end date: 2006. Approximately 200 acres.

Forest health monitoring

Principal Investigator: Doug Allen, SUNY-ESF. Initiated 1991. Two plots as part of a NE regional network of plots. Objective: Document the relationship between forest composition and structure and forest health, especially as related to sugar maple health and vigor. End date: 1999.

The use of meat goats to control interfering woody vegetation in forests

Principal Investigator: Peter Smallidge, DNR. Initiated 1997. Objective: Assess the effectiveness of meat goats as a vegetation management tool to reduce the abundance of beech and striped maple in hardwood stands and their competitive influence on desired hardwood seedlings. End date: 2005. Approximately 25 acres of forest, 20 acres of field.

Site relationships and the production of agroforestry understory crops

Principal investigator(s): Ken Mudge, Plant Science; Bob Beyfuss, CCE-Greene and Louise Buck, DNR. Initiated 1997. Objective: Investigate the establishment, survival, and propagation of various understory crops and their relationship to site conditions. End date: 2005 (on-going). Approximately 5 acres among four locations.

Sugar maple seedling establishment

Principal Investigator: Peter Smallidge, DNR. Initiated 1998 with a planting of 220 sugar maple seedlings. Objective: Provide a replicate study to a Lake Placid study assessing the effectiveness of tree tubes and weed protection on the survival and growth of sugar maple seedlings. End date: 2003. Approximately 4 acres of field.

Interactions of deer on hardwood regeneration

Principal Investigator: Paul Curtis, DNR. Initiated 1999. Objective: Use a combination of exclosures and brush cutting to assess the relative influence of deer and competing woody vegetation on the regeneration of desired hardwood species. This project includes the "Earn-a-Buck" program administered by Gary Goff as a hunter education program to reduce deer herd size. End date: 2006, Earn-a-Buck is ongoing. Two stands, approximately 60 acres.

Earthworm distribution as a function of topography and tree species composition

Principal investigator: Tim Fahey, DNR. Initiated 1999. Objective to assess the distribution and abundance of native and introduced worm species relative to topographic, forest, and historic variables and to relate abundance to biogeochemical processes. End date: 2006. Approximately 10 acres, plus temporary observation plots throughout the property.

Interrelationship of forest management and conservation of amphibians

Principal Investigator: Steve Morreale, DNR. Initiated: 2000. Objective: Characterize the diversity of woodland terrestrial amphibian populations and how those populations respond to forest management activities. End-date: 2006. Five stands, approximately 100 acres.

GIS-Based Environmental and Ecological Thematic Mapping

Principal investigator: Steve Morreale, DNR. Initiated 2000. Objective: collect ecological and physical measurements, historic and current geographic data, and remotely sensed data that supports research and management needs.

Methods to restore old-fields to native grasslands

Principal investigator: Charlie Smith, DNR. Initiated: 2002 (tentative?). Objective: Evaluate techniques and associated costs to reclaim abandoned agricultural fields and establish native warm season grasses. End-date: 2007 (?). Approximately 60 acres of field.

Extension of Natural Resource Management

The Arnot Forest has been used extensively for formal and informal Cooperative Extension programs, and has thus made good use of the juxtaposition of the field campus and cabins to actively managed forests and associated demonstration areas. Extension activities make regular use of managed stands, fields, ponds, and demonstration areas. As with teaching, activity is restricted predominately to non-winter months due to facility limitations. Historically the Arnot has been used for extension programs for teachers, sportsmen and sportswomen, youth, forest owners, and loggers. The Arnot Forest is regularly used by campus or county-based Cooperative Extension groups, though not as a central part of their program's objective. Recent Cooperative Extension programs are described below in order of duration.

Master Forest Owner/COVERTS Volunteers

Program Director: Gary Goff, DNR. Characteristics: Since 1991, an annual 5-day training of 25 to 40 private forest owners in stewardship and adult education topics to prepare them as a corps of volunteers for outreach to other NY private forest landowners. Occasionally a refresher training has been offered at the Arnot, when not offered elsewhere in the state.

Natural Resource Management Extension Inservice (NRMEI)

Project Leader: Peter Smallidge, DNR. Characteristics: In 1999 and 2000 approximately 25 CCE educators from 20 counties received in-depth training each year on a variety of natural resource topics. As part of the inservice training sessions, educators learned about and participated in a collaborative research project that was demonstrated at the Arnot and which they would take to their home county to replicate.

Extension Natural Resource - special workshops

Project Leader: varied. Characteristics: Annually several DNR Cooperative Extension programs use the Arnot Forest for training sessions. These programs make primary use of the Arnot facilities and their proximity to campus, and to varying degrees utilize the integration of the managed forest and the field campus. Examples include the Invasive Species Workshop and the New York Society of American Forester summer meeting.

New York Forest Owners Association

Point of Contact: Peter Smallidge. Characteristics: The NYFOA has made use of the Arnot for various activities including board-of-director meetings and local chapter meetings. Local chapter use has primarily taken advantage of the facilities for meetings, while state-level activities have also utilized the associated forest and demonstration areas.

Game of Logging, Inc.

Point of Contact: Don Schaufler. The Arnot Forest has consistently donated space and trees to groups interested in conducting the Game of Logging training. These trainings emphasize safe and productive chain saw use and have recently been offered for both loggers and landowners. The local NYFOA chapter sponsors the landowner version.

County-Based Cooperative Extension

Local county offices of Cornell Cooperative Extension occasionally use the Arnot for programs related to natural resources. These include maple producers, 4-H, and other youth programs. Most frequent use is through the counties of Schuyler and Tompkins.

Resource Utilization

The Arnot Forest is "endowed" with approximately 3800 acres of timber and 40 acres of sugarbush producing forestland. As described above, many academic efforts take advantage of the managed acreage for research and education. Timber and sugarbush production provides opportunities for investments in these academic functions and is the basis for maintenance of the property. However, demands on staff in recent years have restricted regular collection of data on forest productivity and growth. A technician inventoried all sawtimber stands during the summer of 2000. These data will

be compared to the timber inventory conducted in the mid 1980's and be used to project annual forest production and allowable cut.

University Activity and Community Functions

In addition to formal education and research programs that typically originate in the Department of Natural Resources, other members of the Cornell University community and various local, state, and regional groups frequently have used the Arnot Forest. These activities tend to focus on the Arnot Forest because of the privacy provided in the field campus, the primitive/rustic ambience of the facilities, the proximity of the field campus to forested environments for meditation or spiritual renewal, and a competitive pricing structure. The Arnot Forest has welcomed these groups due to its commitment to support of, especially, university functions but also other organizations. While all these groups don't optimally utilize the integration of managed forest and field campus, they are important to maintaining good neighbor relations, supporting community interests, and have helped provide a source of income. Examples of groups recently using the facility include:

Cornell University Groups

- Cornell Outdoor Education
- Rural Sociology
- Department of Soil and Crop Sciences
- Cornell Farm Managers
- Lab of Ornithology
- Korean Church at Cornell
-

Community Groups

- Ithaca Area Buddhist Monks
- Dancers for Universal Peace
- Ithaca Alternative Community Schools
- New York Maple Producers
- Tressler Care Wilderness Center
- Ithaca Youth Bureau
- Unorganized users include hundreds of person-days devoted to hiking, skiing, hunting, fishing, biking, and horseback riding.

Conclusions and Interpretations

The Arnot Forest provides a critical resource for educational and research programs of the Department of Natural Resources and is appreciated by the larger university community and public organizations. The juxtaposition of managed woodlands with research and educational opportunities next to field campus provides unique opportunities in the region, but the facility is not fully utilized by any category of users. There is a great opportunity to expand the contribution of the Arnot to university programs. However, its aging infrastructure would be quickly strained by a dramatic increase in use. The resource base (timber, maple, and camp facility) provides the core of funding and the success of the property depends on their sustainable management.

Future Opportunities - Objectives and Needs

Overview - Integrating Teaching, Research, and Extension on a Working Forest

The juxtaposition of field campus to managed forest landscape is a primary strength of the Arnot Forest and provides opportunities for users who want extended access the property forest for teaching, research, or extension activities. Research and education activities all benefit from the same infrastructure and land base. Research and education objectives are synthesized and presented by end product rather than end user.

Summary of Objectives and Benefits

Primary Objectives	Benefit
1. Expand the breadth and diversity of talents on the Arnot committee	An expanded committee will diversify the breadth and talents available and provide better representation of user groups.
2. Enhance road infrastructure to allow vehicular access on the existing road network for research and education purposes.	The 2 WD road system restricts access and limits opportunities to near-road areas. Upgrading defunct roads would allow greater use by the target audiences.
3. Increase opportunity for faculty and graduate student research.	Increased research is a core DNR function and directly contributes to the Arnot mission for a more thorough understanding of managed forests.
4. Modernize the field campus facilities to accommodate user groups with safe and reasonably comfortable conditions.	The camp infrastructure limits the scope and seasonal access of users.
5. Encourage increased research activity, especially through an undergraduate internship program.	Internships provide a learning experience for students and extension audiences through research projects and products.
6. Serve as a working educational model for the production and sale of low-grade timber and non-timber products as a supplement to traditional income sources	Improve revenue flow and utilization of forest resources. Working model for landowners with similar situations.
7. Expand the number of demonstration areas	Demonstration areas provide educational opportunities for student, faculty, and extension audiences.
8. Encourage greater use by the university community and public organizations linked to natural resource management.	Increased use multiplies the outreach through groups who experience managed forested landscapes.

Arnot Committee

The current Arnot Forest steering committee⁴ includes faculty and staff of the Department of Natural Resources. While this committee is effective and participatory, it

⁴ Committee as of April 2001 includes: B. Bedford, T. Fahey, G. Goff, J. Lassoie (ex officio), S. Morreale, D. Schaufler, P. Smallidge (chair), and C. Smith

lacks a broader perspective for how the Arnot might contribute to college and university needs and interact with partners. Expansion and diversification of the committee might seek members from CALS administration, directors of other college or university programs with interest or skills related to the Arnot, DEC Division of Lands and Forests, SUNY-ESF and private forest landowners/maple producers.

Further, with the projected emphasis on specific programmatic outcomes, the committee should include members designated with “associate director” status to perform specific tasks in consultation with the director. As developed below, two areas of program development are research and extension/outreach. Thus, two Associate Director positions that will contribute to current and anticipated initiatives are: Associate Director for Outreach Programs (Gary Goff) and Associate Director for Research Programs (pjs suggests Steve Morreale).

Arnot Committee – Action Step Summary

1. Revise the charge of the Arnot Forest steering committee. Clarify interest of current members in continued participation and solicit involvement from 3 to 5 additional members to provide a diversified committee that includes representation of target stakeholder audiences.
2. Formally designate two Associate Director positions, including position statements and programmatic activities.

Property Infrastructure

Roads and Trails

The road network is a critical component of all aspects of the Arnot for education, research, and resource management. Research and teaching access, extension activities, recreational access by camp users, and public access is limited on most areas during most months due to a poor or degraded road infrastructure. Poor access limits the salability of marginal, low-grade timber and thus restricts improvement of stand quality and value. The main roads through the Arnot (Irish Hill Rd. and Banfield Creek Rd.) need investments to repair surface quality and to ensure their stability. Reasonable access for Arnot activities warrants significant investment to resurface Banfield and Irish Hill Roads, to upgrade Loop, Overlook, Plantation, and Recknagel Roads for vehicular traffic, and to open Station and Aspen Roads for 4WD access. The hill section of the main road (approximately 25% of the road system) was surface graveled in 1999. Through regularly scheduled maintenance we will annually gravel and grade 20 - 25% of Banfield and Irish Hill Roads. Roads upgraded to passenger vehicle status will not be generally open to the public, but will rather facilitate university-based activities.

A trail system for hiking, mountain biking, skiing, and equestrian use will improve the utility of the property for user groups in camp and support a goal of community public relations. Importantly, a trail system would permit recreational users to experience demonstration management areas that would otherwise be inaccessible.

Currently there is one dedicated trail, the "East Boundary Trail⁵" located immediately north of camp. This trail will nicely serve camp needs, but could be integrated into a larger, more comprehensive trail system throughout the entire forest. Often, historic roads and scenic vistas could be incorporated to provide greater efficiency of trail establishment and recreational opportunities.

Road and Trail - Action Step Summary

1. Use GIS to map all roads and assess their potential utility in research, education, or resource utilization based on current location.
2. Evaluate the costs of upgrading roads deemed important to 2 WD status.
3. Develop a plan to re-gravel roads and then maintain those roads through grading.
4. Layout a trail system and work with Cornell Outdoor Education to establish a trail system.

The Arnot Field Campus

Scheduling events at the Arnot Field Campus requires a balance of department needs for availability with the needs of other groups who desire confirmation of a location that allows them to market their programs. The existing practice has been to hold non-departmental reservations as tentative for dates more than six months distant. While this is an important practice that supports DNR needs, greater flexibility is needed to allow the Arnot to develop partnerships with other groups who regularly use the field campus. This is especially true for groups who will use the forests of the Arnot in educational programs.

Prior policy on the camp attempted to maintain the condition of the camp to ensure that buildings, driveways, and systems remained functional. There was no intent to upgrade the camp due to a lack of funds and personnel. Camp Arnot is a unique facility that is underutilized in meeting departmental and university missions. Increased use requires improved facilities but improved facilities will attract attention from and support the needs of potential users.

Consistent with needs identified in extension, teaching, and research, camp facilities are inadequate to support active, year-round use. Some users have recently describe the facilities as primitive. Minimally, upgrades are necessary to winterize the lodge and kitchen, modernize the kitchen with functional appliances, winterize the seasonal-use cabins, provide upgraded maintenance to cabins, and renovate the bath house. Optimal expansion would include a dormitory facility with a computer lab, seminar room, research "shop", and office space.

Increasing camp revenue must mesh with improvements in its quality, condition, and use. Field campus revenue is intended to sustain its availability for academic program needs that requires maintaining structures and personnel to manage the field campus.

⁵ Established by Cornell Outdoor Education in summer/fall 2000.

Strategies to increase revenue include increasing the number of users and/or increasing the cost per group or user. Current information has been obtained to compare the value of Camp Arnot to similar facilities in the region, and to relate maintenance and cleaning costs to group size and the nature of group use. Based on an interpretation of this information, pricing policies have been revised⁶.

Following the revised camp use pricing policy, efforts will focus on marketing the camp within the university community. Several marketing strategies will be used. The web page will be enhanced to illustrate the features of the camp and forest, pricing policies, layouts of structures, road and trail systems, and other marketable features. A glossy brochure will be developed and distributed upon request. An awareness campaign will be conducted among department chairs and department extension leaders describing the way other departments have used camp. Finally, the potential to advertise for corporate use will be evaluated considering both anticipated demand and costs of advertising.

Field Campus - Action Step Summary

1. Interview recent camp users and faculty to assess the sequence of modifications that would improve their camp experience.
2. Evaluate policies that support DNR program needs yet permit enhanced partnership with organizations wishing increased predictability in their scheduling of the field campus.
3. Prepare a schedule to maintain and upgrade camp facilities to forestall additional degradation and provide for improved functionality.
4. Develop a marketing plan to attract university groups to the Arnot Field Campus. Create web page and brochure, contact CU departments indicating the availability and options of Camp Arnot.

Undergraduate Summer Research and Extension Intern Program

Sufficient funds are available from external sources to support the core of an active undergraduate field research intern program. This program facilitates research by engaging faculty project leaders at the Arnot, it increases faculty awareness of opportunities, it creates a research base from which other research can build, it contributes to extension materials based on Arnot research, and it supports the education of Cornell University undergraduates. The intern program in 2000, expanded to include six undergraduates, was successful and serendipitously provided a Cooperative Extension experience for three of the interns. The program could be restructured to ensure that all interns have an improved understanding of Cooperative Extension and also contribute to that educational base through presentations or written materials.

The Arnot will maintain its commitment to an active undergraduate field research program by supplementing funds provided through the Connecticut Hill endowment, the

⁶ During January 2001, the camp pricing and fee structure was revised to reflect costs more consistent with the expenses of maintaining camp and that are similar to prices charged by other facilities of like character.

Robert A. and Olive Boehlecke Cornell University Foundation Account, and donations by other benefactors. We will respond to potential opportunities for expanding the financial base for the intern program.

Intern Program - Action Step Summary

1. Maintain investments in the program, secure additional funds where possible through grants and gifts to ensure program momentum.
2. Work with departmental and college faculty to identify projects that address the Arnot Forest mission. Favor those projects in funding of summer interns.
3. Expand the scope of the internship program to include experience with Cooperative Extension.

Enhancing Research Opportunities for Faculty and Graduate Students

Access to and knowledge of land based resources are two key elements for field research. Consistent with primary needs in other areas is the improvement of the Arnot road infrastructure as describe in an earlier section. Knowledge of the land resource was enhanced during summer 2000 with a reinventory of the majority of forest stands including data on forest production and nominal features of wildlife habitat. We will work with DNR faculty to incorporate these data into a GIS that can be viewed online by prospective research scientists.

Several research projects use the Arnot, yet we lack a system to monitor the status, location, duration, and needs of each project. During the next year we will compile research project descriptions and status reports for all active research projects. We will establish a database of research projects including project proposal, sample locations, requested management concessions and their duration, and their plan for dissemination of knowledge to various audiences.

With increasing awareness of Arnot resources and improvements in facilities we anticipate increased research activity. We will solicit policies that other facilities (e.g., Cornell Biological Field Station, Hubbard Brook, Coweeta) use to coordinate field activity. With this information, the Arnot Director, Associate Director for Research Programs, and the Arnot Committee will synthesize a plan to coordinate multiple field research projects and forest management at the Arnot Forest.

Research Opportunities - Action Step Summary

1. Develop GIS database of property features.
2. Identify someone to serve as Associate Director of Research programs, coordinating both faculty and intern activities.
3. Develop a research policy statement describing desired research projects, a process to initiate research at the Arnot, allocation of land to long-term research projects, and expectations of research faculty.
4. Market information on research opportunities to DNR, CALS, and SUNY-ESF faculty.

Resource Utilization

Creating a uniform distribution of stand age structures (i.e., a "regulated forest") at the Arnot will stabilize the average income generated from timber production and allow for greater coordination with research projects. Managed forests in the eastern hardwood region might expect a financial maturity at 80 to 110 years depending on soil conditions and stand history. An average rotation age of 100 years per stand at the Arnot would result in production of large diameter mature stands with minimal compromise of financial opportunity. Because the annual cut is standardized by acreage rather than volume or value, the operating budget will be stabilized by adding to a reserve fund in years when cutting yields above average volume (and value) and withdrawing from the reserve fund during years with below average yield.

With approximately 3800 acres of managed forest, a 100 year rotation will result in an average of 38 acres regenerated (e.g., overstory removal) per year plus any acres receiving intermediate treatments such as thinning or preparatory cuts. In many forest stands, successful regeneration will require control of interfering vegetation through herbicide application and fencing if deer herd impact is not otherwise reduced. A database of forest stands to include acreage, composition, structure, and timing of recent and future management activity will allow research personnel to identify areas having desired features of forest characteristics and match those features with the expected duration of their project.

Low-grade timber markets rarely exist throughout New York and the region. Timber management in recent decades at the Arnot has attempted to remove low quality trees while growing high quality and high value timber. Currently, significant acreage has an abundance of low-value hardwood that would impede forest regeneration. In other areas, timber productivity appears limited due to soils or topographic position. These constraints on sustainable forest management and revenue potential are common to the region, and the Arnot is positioned to test remedies. Under the direction of the manager, two resource management strategies will be attempted. First, buyers of low-value hardwood will be located and solicited to either purchase the stumpage or indicate their willingness to buy roadside. As necessary, Arnot will contract logging and skidding to sell roadside. Second, with consultation from the CU agroforestry working group, areas of limited timber production will be enhanced with forest farming practices appropriate to the site. Revenue generated using these strategies will support the personnel necessary to manage these programs and subsequently help support academic agroforestry programs.

Hiring a forest technician would permit regular collection and analysis of forest inventory data, geo-reference stand boundaries, conduct post harvest regeneration surveys, assist the forest manager in timber sale administration, and syrup production. A technician could also coordinate the development of agroforestry production areas. Depending on skill level, the individual might assist the forest manager in revision of silvicultural prescriptions.

Maple syrup provides approximately 20% of operating expenses. The sugar bush has been well managed and recent harvests have removed diseased and unhealthy trees. New evaporator pans will improve efficiency and quality of syrup production. The tubing system is replaced on a regular schedule depending on degradation and damage.

The sugar house is showing wear in some areas, especially the roof which needs to be replaced.

Resource Utilization - Action Step Summary

1. Identify a list of potential buyers of low grade forest products
2. Revise the forest management plan, including stewardship elements, with the recent forest inventory data.
3. Determine the feasibility of hiring a full time permanent forest technician.
4. Maintain an active maintenance schedule for the sugar bush, tubing system, and sugar house to ensure sustained and quality production. Explore new and expanded markets for syrup and/or the production of value-added products.
5. Work with the CU Agroforestry Working Group to assess educational and production potential of areas for specialty forest products.

Extension/Outreach of Managed Forest Ecosystems

The potential exists to encourage or develop educational programs that would more fully utilize the Arnot field campus. These include increasing awareness among nearby extension offices and initiating discussions with prospective program leaders who would operate at the Arnot. Efforts should focus on those groups who most closely align with the mission of the Arnot Forest.

The infrastructure for extension programs includes lodge, cabins, and access to natural resource management demonstrations. Camp infrastructure is described elsewhere. Several management demonstration areas exist both as formal locations and through the use of areas managed for resource production and extraction. To facilitate both types of demonstration, two strategies will be used. First, as described for the research strategy, all forest management activity will be documented using GIS including data on extent of treatment, timing, area, and pre- and post-treatment conditions. Second, other than the sugar house, no formal demonstration area exists in close proximity to the lodge. An area near the eastern boundary, north of the lodge and fire pond of the field campus, will be developed into a silvicultural and stewardship demonstration area. This area will show various silvicultural practices, the effects of forest management on wildlife habitat, water quality best management practices, sawtimber economic production scenarios, and the use of different wildlife forage crops to stabilize skid trails and landings. Once established, demonstration areas will be maintained, including the collection of data in support of educational materials.

Cooperative Extension Programming - Action Step Summary

1. Develop additional natural resource management demonstration areas, that illustrate silviculture, wildlife habitat enhancement, and improved water quality.
2. Encourage CCE county associations within an easy drive to utilize the Arnot Forest for educational programs.

3. Support educational programs that are consistent with the mission of the Arnot Forest, especially those blending sustainable forest production and conservation values.
4. Evaluate the potential for outreach/education programs to a variety of audiences (e.g., landowner short courses, teacher training, citizen science internships, undergraduate field courses)

University and Community Support

The Arnot Forest is under-utilized by the university community and other groups in the region. Groups that use the facility have reported very favorably on their experience, yet much of the use is by the same groups and the Arnot has experienced minimal growth among organizations. This restricts educational awareness of natural resource management and represents a new potential source of revenue. Groups are expected to comply with all university policies, and those not formally recognized as Cornell University "organizations" continue must continue to provide written proof of liability insurance coverage before they can reserve the facility.

University and Community Support - Action Step Summary

1. Develop a marketing plan to increase community awareness of the Arnot Forest and the Arnot Field Campus.

Summary and Future Profile

The Arnot Forest mission supports the safe, efficient, and sustainable production of natural resources, conservation values, and aesthetic benefits associated with rural landscapes in New York and the Northeast. The Arnot contributes significantly to the mission of the department and college, yet is under-utilized relative to its potential due to a lack of awareness and insufficient infrastructure.

Changes in the near future should focus on infrastructure and programmatic improvements. Infrastructure needs include: road system upgrade, established and maintained GIS, building maintenance, lodge equipment, and demonstration areas. Programmatic changes should include: clearly defined research policy and associated protocol, expanded undergraduate intern program, and a marketing plan to increase university and community awareness of Arnot's resources.

The Arnot will look quite different in the year 2006, assuming access to new sources of funding for special projects and an ability to maintain historic levels of revenue from timber, maple syrup, and field campus rent. The Arnot Forest will continue to be a managed forest, but with a more deliberate integration of conservation and stewardship principles into research, teaching, and extension functions. The adjoining 125 acre property on the southeast corner will be acquired, resources inventoried, and the perimeter marked. Paid Arnot staff will include the manager, resource technician & educator, two full-time hourly laborers, and part-time camp coordinator. A GIS database will provide visual and managerial coordination of research, extension, and management activities. Programs will include an undergraduate research intern program serving 12 students per year, 15 active faculty research projects including two from outside Cornell

University, a dozen extension program activities, and regular use by 10 to 15 academic courses. The Arnot Field Campus will be used 175 days per year with an average of 15 people per day (2525 user-days). A well-graveled and graded road system will permit three-season 2WD access for academic use to Banfield, Irish Hill, Loop, Recknagel, and Station Roads. Three-season 4WD access will be possible to Plantation, Overlook, Aspen, Birch, and portions of McCleary Roads. A trail system will allow recreational access among five to seven loops of different sizes. Average annual timber harvesting will successfully regenerate approximately 35-40 acres per year plus intermediate treatments applied to 50 to 75 acres. Regeneration of desired high-value species will not be inhibited by deer or interfering vegetation. Agroforestry and related natural resource based enterprises will provide educational opportunities for landowner and student audiences and supply 15% of the annual operating budget. The field campus will include a winterized lodge, nicely graveled drives, and well maintained cabins (winterizing all cabins, renovations of the bath house, and a research shop/dormitory is for next planning cycle).