

Executive Summary
Environmental Management Study for
WINTERTHUR
Museum, Garden & Library
New Castle County, Delaware



NATURAL
LANDS
TRUST

with
Patricia Ann Quigley, Inc.
and
Hyla Associates

February 2000

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Team Members

Natural Lands Trust

Holly M. Harper, R.L.A. *Project Manager/Stewardship Planner*
David Steckel *Director of Natural Resource Management*
D. Andrew Pitz, R.L.A. *Director of Conservation Planning*
Diane Rosencrance *Planning Assistant*
Claudia Steckel *Consulting Horticulturist*

Patricia Ann Quigley, Inc.

Patricia Ann Quigley *Project Manager/Senior Biologist*
Christopher Mulvey *Project Biologist*
Sarah Willig *Project Biologist*

Hyla Associates

James F. White, Jr. *President*

Winterthur is an American garden and grounds representing a naturalistic style of landscape design based on the rural landscape of the Brandywine Valley. It is of cultural and botanical interest as it is the repository of many of the finest plants available during the first half of the twentieth century, and it reflects an American horticulturist's interest in the ideas of "wild gardening" adapted from Britain to an American setting. Winterthur, an historic garden and grounds of national importance and international concern, represents an example of an American country place and garden and grounds created by an individual of exceptional talent and taste. ...

Winterthur is committed to conserving the former estate and residence of Henry Francis du Pont, who created a major museum of American decorative arts, display gardens embodying his concept of artistic gardening and grounds. The museum and gardens and grounds are interrelated as a totality and are connected by a common thread of taste, design, style, and color. The Board of Trustees recognizes that Winterthur is unique among American educational institutions open for the enjoyment of the public. The original design of the gardens and grounds has been substantially retained over the years. It is Winterthur's policy to conserve this design for posterity, while recognizing the elements of change inherent in living organisms. ...

Winterthur pursues a policy of professional management capable of making horticultural, conservation, maintenance, and related decisions commensurate with the rarity and complexity of the gardens and grounds. This policy assures that Winterthur can take advantage of future opportunities which may arise in the continued development and appreciation of its historic resources.

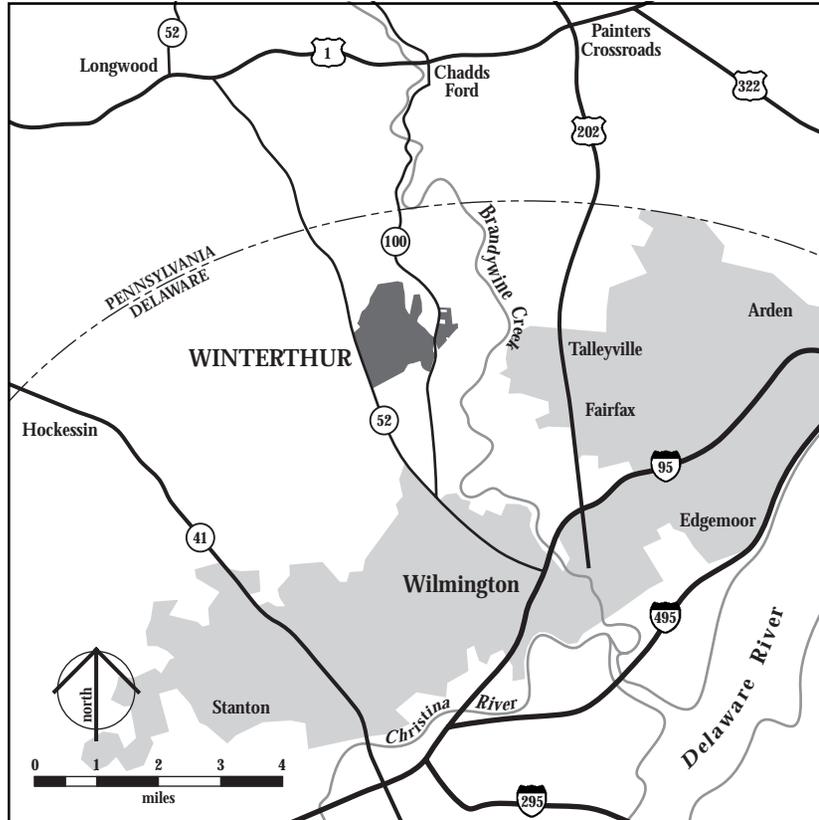
The Board of Trustees recognizes that its gardens and grounds are an educational resource for the public. It is Winterthur's policy to interpret the gardens and grounds to the public. This interpretation should foster a greater understanding and appreciation of landscape design, plant combinations and garden history. The Board is committed to making the garden and grounds as fully open and accessible to the public as resources allow. ...

*From the Board of Trustees Policy and Guidelines for
Winterthur's Gardens and Grounds, May 1987*



Executive Summary

FIGURE 1: Location Map

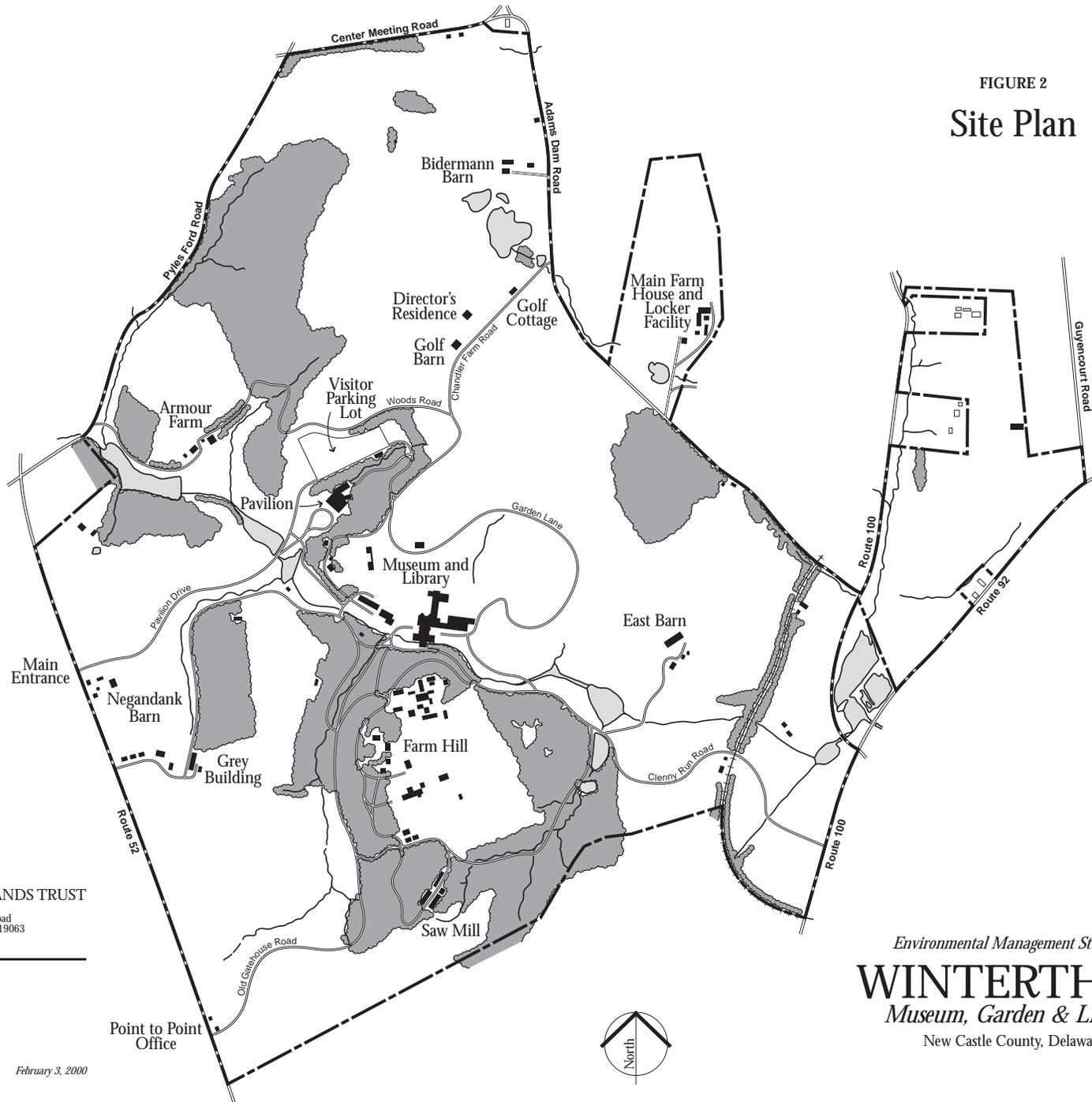


INTRODUCTION

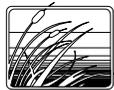
Winterthur Museum, Garden and Library, the former country estate of Henry Francis du Pont (1880–1969), is a ±966 acre property located approximately five miles northwest of the city of Wilmington in New Castle County, Delaware (see Figures 1 and 2). The property features a museum filled with du Pont's collection of American decorative arts made or used in America between 1640 and 1860; a 60-acre naturalistic garden, considered one of the world's finest, that represents the artistic vision of its creator, H. F. du Pont; and a research library for the study of American art and material culture.

Meadows, woodlands, hedgerows, and ponds and streams comprise almost 70% of the Winterthur property. The steeply rolling topography is covered with native grass meadows and primarily native hardwood forests, many of which can be classified as old growth (>150 years old). Clenny/Wilson Run flows eastward through the property to the Brandywine Creek and

FIGURE 2
Site Plan



Environmental Management Study for
WINTERTHUR
 Museum, Garden & Library
 New Castle County, Delaware



NATURAL LANDS TRUST
 Hildacy Farm
 1031 Palmers Mill Road
 Media, Pennsylvania 19063
 610-353-5587

with
PATRICIA ANN QUIGLEY, INC.
 1080 Quarry Hall Road, R.D. #1
 Norristown, Pennsylvania 19403
 610-584-1829

HYLA ASSOCIATES
 1011 Center Mill Road
 Hockessin, Delaware 19707
 302-652-1952

February 3, 2000

creates the primary feature of the property, a stream valley with steep sides and a series of six ponds. The diversity of wildlife inhabiting Winterthur is relatively high including a number of species of special concern, those that are rare or uncommon and/or threatened within the state.

Winterthur is committed to being a good steward of the land and to fostering a greater understanding and appreciation of our environment. As a result of that commitment, in October 1996, Natural Lands Trust, along with Patricia Ann Quigley, Inc. and Hyla Associates, was engaged to prepare an Environmental Management Study for the property. The purpose of the study is to develop and implement a stewardship plan which will assure that future management, events, and site development will be conducted in an environmentally responsible manner.

Winterthur's short term goal for the study is to inventory the environmental resources and review current management practices. The long term goals include using the study as an educational tool, as a baseline for future measurement of the health and quality of the environment, and as a guide for future site development.

Natural Lands Trust's approach to the study was to gain a thorough understanding of the site, its potential, and current management practices, capabilities, and problems, and then develop a stewardship plan that will serve as a long term guide to the future use and management of Winterthur. NLT, along with Patricia Ann Quigley, Inc. and Hyla Associates, conducted an inventory of the biological and physical resources of the property from the fall of 1997 through fall of 1998. Interviews and site visits were held with key personnel to review current management practices and to obtain their input. Work sessions were also held with various staff to discuss existing and potential programmatic uses of Winterthur.

INVENTORY AND ANALYSIS

Biological Resources

Flora

The woodland areas at Winterthur are dominated by hardwood forests, many of which can be classified as old growth (>150 years old). Like most of the mature forests in this area the woodlands occupy those sites that were inappropriate (too steep or wet) for agriculture. Unlike most of the region's forests, the woodlands at Winterthur did not suffer major disturbance (clearcutting, hurricane) over the last one and a half centuries. The result was the creation of a magnificent canopy of large oak, tuliptree, and beech.

The canopy of the woodlands is dominated by native species: oak (*Quercus* spp.), American beech (*Fagus grandifolia*), and tuliptree (*Liriodendron tulipifera*). Native species, primarily American beech and some black gum (*Nyssa sylvatica*), red maple (*Acer rubrum*), and hickory (*Carya* spp.), also dominate the understory. Norway maple (*Acer platanoides*), an introduced invasive species, is becoming established in the understory of most forested areas and is now the dominant understory species in Browns Woods. The shrub layer is generally sparse and dominated by viburnums (*Viburnum* spp.), both native and introduced. Jetbead (*Rhodotypos scandens*), another introduced invasive species, is becoming established in the shrub layer. The herbaceous layer throughout most of the woodlands is sparse.

These woodlands show signs of the degradation which plagues this region's forests. Invasive vegetation, including species from the formal gardens, are well established in the understory.

Regeneration of native tree, shrub and herbaceous species are spotty at best, a result of both competition from exotic vegetation and consumption by white-tailed deer. This raises serious concern for the perpetuation of the existing woodlands.

Hedgerows function as corridors for wildlife to move between woodland patches. Unfortunately, with the introduction of invasive plants, they have become ideal edge habitat for the proliferation of these species. Invasive vines such as Japanese honeysuckle, Oriental bittersweet, and grape thrive along hedgerows and woodland edges where they receive direct sunlight and physical support from the trees. Invasive shrubs such as the shrub honeysuckles and multiflora rose often join these vines.

The hedgerows at Winterthur are chiefly along roads and the railroad and the impact from invasive vegetation is moderate to heavy throughout. While the canopy trees are mostly native, they are experiencing the same lack of native tree, shrub and herbaceous species regeneration as the woodlands.

Meadows (including wet/riparian areas) are the dominant vegetation type at Winterthur. The dominant species in the meadows is the native grass broom-sedge (*Andropogon virginicus*). Most of the meadows contain a high degree of native herbaceous vegetation, due primarily to the regular mowing schedule. The upland meadows are presently in hay production, with either one or two cuttings each year, and the wet meadows are not hayed but are rotary mowed annually. Some areas, especially those now being allowed to succeed to woodlands, are moderately to severely impacted with invasive species.

Fauna

Field surveys of amphibians, reptiles, birds, mammals, butterflies, dragonflies, and damselflies were conducted on foot, aided by the use of binoculars and spotting scope. Species were identified by visual observation, sound (e.g., frog and bird calls), and signs (e.g., tracks). In addition, live traps (have-a heart and Sherman) were used to capture small mammals and hand nets were used to capture dragonflies. Species of “special concern,” those designated by the Delaware Natural Heritage Program as being of 1st, 2nd, or 3rd priority ranking for protection out of 5 ranking categories, were noted.

Overall, the diversity of fauna at Winterthur is good, especially in the woodlands where it appears relatively high. Species of special concern that were observed on the property include:

Amphibians and Reptiles - Northern Red Salamander and Queen Snake

Birds - Great Blue Heron, Great Egret, Black Vulture, Osprey, Bald Eagle, Northern Harrier, Cooper’s Hawk, Broad-winged Hawk, American Kestrel, Herring Gull, Common Nighthawk, Hairy Woodpecker, Pileated Woodpecker, White-breasted Nuthatch, Brown Creeper, Veery, Warbling Vireo, Northern Parula, Chestnut-sided Warbler, Black-and-white Warbler, American Redstart, Kentucky Warbler, Hooded Warbler, Yellow-breasted Chat, Chipping Sparrow, and Eastern Meadowlark

Mammals - Red Bat and Red Squirrel

One uncommon species, the Appalachian Azure butterfly, was found to be fairly common in the Azalea Woods portion of the Gardens Area. Although not listed by the Delaware Natural

Heritage Program as a species of special concern, the Appalachian Azure has only been found in one other location in Delaware. Several larvae were found on their host plant, black cohosh.

Aquatic Resources

Aquatic resources within Winterthur consist of streams, ponds, and wetlands. The property almost fully includes Clenny/Wilson Run, a first to second order tributary of the Brandywine Creek. The segment of the stream that flows through the Winterthur grounds (northwest of Routes 92 and 100) is designated by the State of Delaware Surface Water Quality Standards (February 26, 1993) as “ERES” or waters of exceptional recreational or ecological significance. The watershed is part of the highly valued Brandywine Creek system and is largely undeveloped except for the Winterthur property, several golf courses and low density residential development.

The original hydrology within the property has been altered through dam and stream channel construction, the capping or diversion of natural seeps and springs, the deposition of landscaping waste and rubble into wetlands, and the mowing of stream buffers. The latter has created ideal habitat for Canada geese which further degrade water quality.

Overall, Clenny/Wilson Run supports a moderate diversity of piedmont stream fish. Kick net samples of macroinvertebrates were obtained at five locations along Clenny/Wilson Run, one of which is just downstream of Winterthur in Brandywine Creek State Park. Three of these correspond with established Delaware Department of Natural Resources and Control (DNREC) water quality sampling stations. The stations within the property ranged from man-made stream habitat with very poor water quality to natural stream habitat with fair water quality. The downstream off-

site station presented good macroinvertebrate habitat with excellent water quality.

All of the twelve relatively small ponds at Winterthur maintain populations of fish. Grab samples of pond water were obtained at the outflow structures of six ponds: Armour Farm Pond, 11th Tee Pond, Upper Pavilion Drive Pond, Lower Duck Pond, East Barn Pond, and the Routes 100/92 Pond.

Total suspended solids, which relate to turbidity, were below the 10 mg/l detection limit in all ponds except East Barn Pond which displayed 12.0 mg/l. Dissolved oxygen levels were generally favorable except for Armour Farm Pond. pH levels, a measure of aqueous acidity and basicity, were generally favorable except for the 11th Tee and Routes 100/92 Ponds which had slightly elevated (more basic) values. Phosphorus is an important nutrient for plant growth, but excessive levels can cause increased algal or macrophyte growth leading to pond eutrophication. Total phosphorus levels were favorable except for East Barn Pond which slightly exceeded the recommended value. Total coliform is a measurement of certain bacteria which are associated with sewage (certain levels of which are always present in healthy aquatic systems). The highest total coliform values occurred within Armour Farm Pond, Lower Duck Pond, East Barn Pond, and the Routes 100/92 Pond. Coliform inputs to the ponds do occur naturally and wide variation in total coliform values is common. However, excessive loadings are occurring through the droppings of resident Canada Geese and probably from off-site septic systems. Chlorophyll a, a plant pigment which converts light energy to chemical energy during photosynthesis, indirectly measures growth, primary productivity, and algal abundance or standing crop. Only the 11th Tee Pond exceeded the level for a healthy non-eutrophic lake or pond.

Due to the large study area, a full-scale point-to-point survey of all regulatory wetlands on the Winterthur grounds was not recommended. To meet the goals of an overall land stewardship plan, it is essential though to have preliminary boundary identification, based on field observations, with detailed observations recorded of the wetland type, dominant species, rare or endangered species, and degree of disturbance. Full-scale surveying of wetland boundaries should be reserved for key areas where potential future facilities development or expansion is considered which may encroach on regulated wetlands.

A diversity of wetland types — swamps, marshes, and ponds — are found at Winterthur. These wetlands occur in association with seeps, streams, and impoundments located in the watershed of Clenny/Wilson Run which drains eastward to Brandywine Creek. Forested wetlands occur where a canopy has remained and wet meadows occur in areas that are periodically mowed. Extensive manipulation of the ground and surface water resources at Winterthur have effected the wetlands. Piping has depleted water from some areas causing wetlands to diminish in area over time while elsewhere, wetter circumstances have been created. Winterthur as a whole has an abundance of water which supports an array of relatively natural wetlands as well as the many lovely, yet unnatural, ponds.

Physical Resources and Features

Geology

Winterthur lies almost completely within the Wissahickon Formation, the dominant rock type in the northwestern geologic Piedmont Province in Delaware. This province, whose name

literally means lying at the base or the foot of the mountains, is commonly referred to as “Delaware’s hard rock country.”

The Wissahickon Formation may be greater than 8,000 feet thick and is less resistant to chemical and physical weathering. Thus, deeply incised stream valleys and steep slopes characterize this portion of the basin. Amphibolites and gneisses support ridges while mica schists erode to form deep-sided valleys. The formation has considerable secondary porosity and therefore has capacity to store and transmit groundwater. Although high densities of joints and faults exist in some locations and may be able to support initial groundwater yields of 300 to 400 gallons per minute, groundwater typically yields 10 gallons per minute.

Soils

Winterthur lies with the Glenelg–Manor–Chester soil association. This association is in one large area in the northern and northwestern parts of the county. It consists mainly of gently sloping to moderately sloping soils. On the bottomlands and crests, however, the soils are nearly level, and in some areas above streams they are steep. The major soils in this association are deep, well drained, and micaceous and provide good building sites, though slope is a limitation in places. In most places excavation is not difficult and is not limited by wetness. The soils generally have only slight to moderate limitations to use for sewage disposal by septic tanks.

Topography and Slopes

Winterthur’s topography is very typical of the character of the underlying Wissahickon Formation — deeply incised stream valleys with steep slopes. The primary feature is the main Clenny/Wilson Run valley running roughly west to east. The ridges to the

north and south of the stream have gentle, 0–8%, slopes on their tops with the side walls typically over 15% with large areas over 25%. The highest elevation is approximately 432 feet, occurring in the northwestern corner of Bidermann Golf Course near the intersection of Center Meeting and Pyles Ford Roads. The lowest elevation, approximately 218 feet, occurs just below the Routes 100/92 Pond for an overall difference of 214 feet.

Existing Land Use

Meadows.....	± 468 ac.	48%	of total area
Woodlands and hedgerows	± 192 ac.	20%	
Golf course	± 150 ac.	16%	
Gardens, <i>incl. Pavilion Pine Grove</i>	± 52 ac.	5%	
Ponds	± 11 ac.	1%	
All other areas	± 93 ac.	10%	

Total ± **966 ac.**

Streams	28,000+ lf / 5.0+ miles
Railroad	3,500+ lf / 0.5+ miles
Roads	75,500+ lf / 14.0+ miles (± 80% are “improved”)

PROGRAMMATIC USES

Current Uses and Events

General admission to Winterthur includes access to the “Garden Area Proper.” Maps are available for self-guided walking tours. Also included with the general admission is a 30–45 minute narrated tram ride through the garden and outlying areas of Winterthur. Topics covered include the history of the property and the story of Henry Francis du Pont, as well as aspects of nature, color, and seasonal interests. Guided garden walks are also offered.

Programs offered by the Garden Department have included garden lectures, horticultural and design symposiums featuring national and international experts and speakers, and the “Successful Gardener Series,” a series of hands-on workshops for the home gardener.

Special events have included “Picnicking Under the Cherry Blossoms,” “Easter in the Garden,” a family event, a “Plant Extravaganza” with experts available to answer questions, talks, guided garden walks, and plants and books available for purchase, and the annual Point-to-Point Races and Craft Festival. The Point-to-Point Races are held on the first Sunday in May each year with 20,000 to 24,000 people attending typically. The Craft Festival, which will have its fourth year in 1999, is a 2-day event over the Labor Day weekend with 180 juried craftsmen that attracts over 20,000 people.

Future Uses and Events

Gardens, Programs, and Special Events

The following recommendations for additional or expanded programmatic uses related to environmental issues and concerns have been generated as a result of this study and from internal work sessions of the Winterthur staff.

- ~ Highlighting native plants throughout the garden
- ~ Special subject tours including “Birds in the Garden,” “Native Plants in the Garden,” “The Winterthur Estate/Farm,” and “Winterthur’s Natural Areas”
- ~ Lectures and/or walks on subjects such as birdwatching and fungi identification
- ~ Workshops on natural areas management and restoration techniques
- ~ Arbor Day events highlighting native species
- ~ Azalea Festival events highlighting native species

Trails

The opportunity exists to utilize the natural areas to greatly enhance the recreational and educational experience of Winterthur visitors. A well defined trail system with interpretive materials (brochures, signage) could be used to tell a more complete story of the property, inform visitors of proper management techniques, and provide inspirational views of meadow vistas and the large trees of the woodlands. A potential trail system, divided into three phases, has been proposed for the Winterthur property. The

phasing is to allow Winterthur to experiment with increased public use of the natural areas and to evaluate the program throughout its implementation.

Research and Education

The natural areas at Winterthur offer a wide range of research and educational opportunities through which Winterthur, local natural resource managers, and local schools and universities can benefit. Winterthur staff and other resource managers will benefit by receiving information that can assist them in better understanding and managing their natural areas. The academic world gains by having access to relatively secure natural areas with diverse plant communities. In addition, supporting environmental education helps to educate the next generation to the importance of stewardship.

There are three resource management issues associated with research and education programs. The first is the concern for balancing public use policy with the need to protect research and interpretive sites from unintentional damage from property users (hikers) and vandals. Before promoting or increasing passive recreation, it must be ascertained how this will impact current or future research and education activities. The second concern is the potential impact on staff resources that would accompany these activities. While Winterthur has no plans to conduct research or educational projects itself at this point, there will be a need to coordinate and monitor the activities. Increases in staff demands could result in a reduced management level or lost research or educational opportunities. Finally, consideration should be given to possible conflicts with other existing programs such as agricultural leases and deer management.

Conservation Easements

A conservation easement is a legal agreement between a landowner and a conservation organization or government agency that protects land while leaving it in private ownership. The restrictions of the easement, tailored to suit the particular property and landowner's goals, permanently limit a property's uses in order to protect its conservation values. The easement binds all present and future owners of the eased land. A landowner generally donates the easement to a qualified conservation organization or government agency, which in turn ensures that the conditions of the easement are met over time.

Conveying a conservation easement is a way of making a tangible commitment to the preservation of the natural resources, cultural heritage, scenic beauty, and open spaces of a property, and the community in which it lies, for present and future generations. Winterthur is a significant property not only for its size, almost 1,000 acres of which 90% is open, but also for the diversity and health of the natural habitats that occur there. Over time, these lands will become more and more important as development pressures increase and open space and natural areas are lost. The property could also provide valuable information to local resource professionals trying to understand current ecological problems and to prepare for future ones.

The Board of Trustees for Winterthur has already begun to address these issues. The *Policy and Guidelines for the Gardens and Grounds*, May 1987, states that "Winterthur is committed to conserving the former estate and residence of Henry Francis du Pont." The Board also authorized this Study, which has a goal of developing and implementing a stewardship plan to assure that future management, events, and site development will be conducted in

an environmentally responsible manner. The logical next step in ensuring this commitment into the future would be for the Winterthur Board of Trustees to consider conveying a conservation easement.

Future Site Development

The first step in identifying suitable areas for future site development is to identify areas which should not be developed. These "preservation areas" contain critical constraining natural features such as wetlands, hydric soils, and steep slopes which make them unbuildable. The next step is to identify "conservation areas" where development could occur, but in a limited manner; areas with fewer development constraints but important natural features. These include features that are still environmentally sensitive, such as soils with a seasonally high water table, moderate slopes, woodlands, and scenic viewsheds, but vary in importance, vulnerability, or fragility. What remains are the areas most suited for development, the "potential development areas."

The Future Site Development plan shows such an analysis of Winterthur. What this mapping does not include though, is scenic viewsheds. The determination of these are very site specific and involve many factors such as historical and cultural significance, botanical interest, and garden design which are outside the scope of this Study. Winterthur staff will need to overlay this information during the planning process for any future site development.

LAND STEWARDSHIP

Winterthur's natural landscape offers an excellent representation of regional physiographic characteristics. Its balance of woodland, meadow, and stream habitats supports a diverse assortment of plant and wildlife species and beautifully complements the formal horticultural areas. Like the Garden, these natural areas offer a unique menu of management challenges and opportunities. Successfully addressing the challenges and opportunities within such an important natural areas will require a serious, on-going commitment to stewardship based upon a long-term perspective of protecting and enhancing the natural communities and their environmental and ecological benefits.

All stewardship programs should be based upon the conservation priorities of the site. Conservation priorities can be ecological, recreational, historical, or programmatic depending on the context of the site within the local landscape, legal restrictions, the historical use of the property, and the goals of the landowner. Based upon Winterthur's goals and the existing natural resources within and around Winterthur, we recommend establishing the following conservation priorities to guide the management of the natural areas:

- ECOLOGICAL: Water resources of the Clenny/Wilson Run watershed
- Habitat for local wildlife
- Rare and endangered species

- HISTORICAL: Open landscape resulting from the design intent of Henry Francis du Pont
- Landscape design, including scenic views from the Garden

PROGRAMMATIC: Environmental education for visitors

RECREATIONAL: Natural environment for visitors and staff

BUDGETARY: Human resources
Financial resources

Once conservation priorities are established, a stewardship plan is developed to minimize the internal and external threats to these priorities with the further goal of enhancement.

This chapter provides guidelines on which to develop a detailed stewardship plan. It includes sections on woodlands and hedgerows, meadows, and aquatic resources that outline general recommendations for resource types, give specific recommendations for management units, and provide stewardship guidelines for achieving the recommendations. The stewardship guidelines include sections on vegetation management/restoration, wildlife management, stormwater management, and aesthetics/hazards. These are based upon the current health of each resource, a review of current management practices, and the goal to protect and enhance the conservation priorities listed above. There are also sections on trail design and maintenance, staffing and equipment, and priorities.

The recommendations offered within this report are based upon current information and technology and land management experience within other natural areas. These recommendations should not be implemented with blind faith in perpetuity. Because of the uniqueness of every property and the fact that we are dealing with evolving natural systems, the management regime should similarly evolve over time as new "bad actors" are identified, land management knowledge and technology change,

and Winterthur's goals are modified. Land stewards need to be aware of both the ubiquitous and site-specific natural processes involved and the potential of existing management techniques, but creative in applying each technique to (and developing new ones for) individual natural areas.

Woodlands and Hedgerows

The woodlands at Winterthur were actively managed until the mid-1950s to produce lumber for in-house use. The current management goal is to maintain them in as natural a state as possible. Aesthetics and hazards are the main concerns, particularly in the areas that receive more public use or scrutiny. Management in all other areas is largely done on an as-needed basis to remove down or hazardous trees and any obstructions to the internal roads. The control of invasive vegetation has not been a management priority.

Given the conservation priorities and the current goals of Winterthur, there needs to be a significant increase in management of the woodland resources. Because of their many environmental, ecological, and human benefits every attempt should be made to sustain the woodlands on the property. Today there are serious threats to that goal. Addressing those issues and facilitating additional public use will require an increased commitment of staff resources.

The perpetuation of any woodland community depends upon the ongoing establishment of tree and shrub regeneration that are sufficient in number to occupy the gaps that are created by natural or human disturbance to the various structural layers (canopy, understory, shrub) within these plant communities. Throughout the woodlands and hedgerows of Winterthur there is a clear

deficiency of native tree and shrub regeneration. Given the age of the canopy trees and their increased susceptibility to windthrow, this lack of regeneration raises concerns for the perpetuation of all the existing woodlands and the loss of the genetic material that created these impressive communities. The presence of invasive vegetation further decreases the probability that the future wooded areas of Winterthur will come close to resembling the current woodlands.

The lack of tree and shrub regeneration results principally from competition with invasive vegetation for growing space and an overabundance of white-tailed deer. In order to perpetuate the existing woodlands it will be necessary to aggressively address these problems as soon as possible. If allowed to reach a crisis level, the task of restoration will become formidable. More importantly, valuable ecological and human benefits will be lost for many decades.

General Recommendations

- ~ Control invasive vegetation through physical removal, chemical application, and the reduction of forest edge.
- ~ Expand woodland areas to protect water resources, reduce edge, and create wildlife corridors between woodland parcels by releasing designated meadow areas to succession.
- ~ Eliminate/minimize the practice of removing dead and dying trees.
- ~ Reduce deer impact through increased harvest levels and protective devices (fencing, tree shelters).
- ~ Establish 10 x 10 meter exclosures in several woodlands for monitoring and interpreting the deer impact on woodland vegetation.

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- ~ Improve aesthetics/eliminate hazards by cleaning up scattered trash, removing obsolete structures (with no historical, interpretive, or functional value) and materials, and consolidating needed materials (woodchips, soil) in least conspicuous area(s).
 - ~ Address stormwater erosion areas through maintenance and modification of man-made structures and stabilization of terrain and natural streams.

Meadows

Historically, meadows occurred as breaks in the eastern deciduous forest resulting from human and natural disturbances such as clearing for agriculture by native Americans, fire, periodic flooding, insect infestation, and soil conditions (saturated, serpentine) that restricted growth of woody plants. Most meadows, therefore, existed as temporary ecosystems. Without further human or natural disturbance, natural succession would return a meadow to native woodland conditions within 50 to 100 years.

The meadows at Winterthur, like those throughout the East, are the result of the rise and fall of agriculture following European settlement. During the next three centuries all but the most restrictive (wet, steep) lands were cleared to raise crops for the growing eastern cities. As the agricultural center of the country moved south and west during the 20th century, and, more recently, development pressure has increased, much open land (particularly that on marginal soils) has reverted to woodlands or has been converted to housing developments.

The historic agricultural landscape remains at Winterthur by maintaining the open areas as meadows. Indeed, meadows

currently make up almost 50% of the property and total almost 470 acres. This unusually large meadow resource provides not only beautiful vistas from the Gardens but significant ecological benefits. Currently the meadows are maintained through a lease agreement with a local farmer who takes two cuttings of mushroom hay each year. Modifying the current management regime could significantly increase the ecological benefits without impacting the Garden vistas.

In general, the meadows are in very good condition compared to most meadows in this region. They are relatively free of invasives and are dominated by native warm-season grasses, particularly broomsedge. Warm-season grasses are desirable because they are preferred as nesting and feeding sites for native animals, including grassland nesting birds. Many of these birds, such as bobolink, Eastern meadowlark, grasshopper sparrow, savannah sparrow, upland sandpiper and bobwhite quail, have declined drastically in recent years due to the loss of habitat from development and changes in farming practices, including earlier mowing times and the extensive use of non-native cool-season grasses for turf and hay.

General Recommendations

- ~ Delay the timing of haying from early June to the beginning of July to improve habitat for grassland nesting birds (e.g. Eastern Meadow Lark, Grasshopper Sparrow, Field Sparrow, and possibly Bobolink) by allowing adequate time for successful nesting and rearing of young.
- ~ Harvest only one crop of hay per year instead of two or harvest hay in designated fields on a rotating schedule, cutting each field every other year. This will create tall grass areas in winter that provide winter habitat for grassland birds.

-
- ~ Create successional habitats by removing designated meadows from mowing to favor old field dependent species.
 - ~ Install artificial bird nest boxes for species such as Eastern Bluebird and American Kestrel.
 - ~ Develop and maintain a trail system through the upland fields and the restoration areas to allow for routine maintenance, nature study, and passive recreation.
 - ~ Gradually increase the diversity of meadows by planting plugs or overseeding several additional native species including Indian grass, switchgrass, big bluestem and little bluestem.

Aquatic Resources

According to the Delaware Department of Natural Resources and Environmental Control (DNREC), water quality concerns in Clenny/Wilson Run on the Winterthur grounds include periodic algal blooms that occur in the many ponds and which are often transported downstream during storms. In addition, the large and increasing number of Canada geese using the ponds and mowed fields contributes significant nutrient and fecal coliform loading to the aquatic system resulting in eutrophic conditions in the ponds and periodic release of nutrient-rich waters to the Brandywine system. Other concerns noted by DNREC include the lack of riparian buffer or natural edge around the Winterthur ponds and creek edge.

It is clear that although still relatively healthy, the aquatic resources (ponds and stream complex) through the Winterthur portion of the watershed are being stressed and are in danger of becoming permanently degraded if measures are not taken to better manage the lands surrounding them.

General Recommendations

- ~ Provide more riparian buffers. Establish at least tall grass meadow buffers (preferably shrub and/or tree buffers where appropriate) along all streams and ponds. Establish or expand woodland buffers where they do not impact important viewsheds.
- ~ Address stormwater erosion areas through maintenance and modification of manmade structures and stabilization of terrain and natural streams.
- ~ Control invasive vegetation (particularly exotic vines) which prevents natural regeneration or planted trees and shrubs from becoming established. Monitor and control invasives (phragmites, knotweed) which displace native wetland species.
- ~ Install nest boxes for Wood Ducks and Eastern Screech Owls and basking logs for turtles. Establishing riparian buffers should discourage Canada Geese.
- ~ Remove cement lining from stream areas and re-establish a more natural, meandering stream channel using bioengineering techniques.

Trail Design and Maintenance

This section provides guidelines for new and existing trails that fall into three types: recreation enhancement, environmental protection, and public use and safety. Specific guidelines and recommendations are provided for trail construction, trail marking, and trail signage.

Staffing and Equipment

Staffing

The natural areas encompass over 70% of the land area at Winterthur, yet there is no personnel dedicated exclusively to their management. Currently, management within these areas is done on an as-needed basis by members of the Horticultural Department as part of their job responsibilities that focus on maintenance of the hardscape (roads, bridges, garden structures) within the Garden and setting up for the Point-to-Point and Craft Fair. While this has served to handle urgent maintenance needs, such as removal of hazardous trees, it has fallen far short in protecting these areas from natural and human degradation. To seriously address existing problems and to realize potential opportunities highlighted within this plan, a greater commitment of staff time will be needed for the management of Winterthur's natural areas.

It is recommended that Winterthur dedicate one staff member to focus exclusively on the management of the natural areas. This person should have an educational background and hands-on experience in natural resource management and environmental education. Responsibilities would include (1) to prioritize and organize restoration and enhancement projects, (2) to coordinate with other staff for time and equipment, (3) to monitor ongoing projects, and (4) to develop and implement an environmental education program to compliment the tours of the formal gardens. This person would also provide a natural resource perspective to review activities proposed by other departments that might impact the natural areas.

Equipment

The staff at Winterthur appears to be well-equipped to effectively handle management needs within the natural areas. Most maintenance and restoration work within the woodlands can be accomplished with small hand tools, a small chainsaw, and a handheld or backpack herbicide applicator. The only specialized equipment would be that needed for meadow restoration and maintenance.

Priorities

This report offers numerous recommendations for the restoration and management of the extensive natural areas of Winterthur. Given the many other on-site priorities of the management staff there is currently insufficient time to address all of these recommendations. Therefore, ***the first priority Winterthur should consider is the dedication of one staff member (or equivalent) to focus exclusively on the management of the natural areas***. This person would oversee and coordinate the necessary restoration and enhancement projects, monitor ongoing projects, and oversee and coordinate public use and research and environmental education programs.

To assist Winterthur in making the most efficient and effective use of the time and resources available, we are providing a list of overall priorities for work within the natural areas. Initiating these will have the greatest environmental and ecological benefits with the least investment of staff resources. These priorities are based upon current conditions and should be reviewed on a periodic basis as conditions and internal priorities change.

~ ***Reduce the local deer population***

Continue efforts to lower the population to encourage native tree and shrub regeneration and protect woodland wildflowers.

~ ***Modify the meadow mowing schedule***

Mow only once per year after July 15th and consider mowing only half of the meadows each year to provide better habitat for grassland dependent fauna, particularly birds.

~ ***Cut invasive vines on canopy trees***

Protect the existing canopy to help shade invasives and provide a native seed source.

~ ***Address stormwater runoff***

Reducing the rate of flow from the main parking lot and from the golf courses will protect on-site soil resources and water resources within and outside of Winterthur.

~ ***Reduce ornamental groundcovers***

Eradicate or at least control patches of invasive exotic groundcovers in order to maintain and/or restore the native herbaceous vegetation.

~ ***Cut understory invasive trees and shrubs***

Removing these trees will allow more light to penetrate to the forest floor and encourage tree regeneration. It will also reduce the invasive seed source.

~ ***Riparian buffer***

Establish at least tall grass meadow riparian buffers (preferably shrub and/or tree buffers where appropriate) along all streams and ponds to improve water quality.

~ ***Promote research and education***

Contact local schools and universities and offer the site for appropriate research and education projects. Students and researchers will benefit by having diverse and relatively secure sites and property managers will benefit with an increased understanding of the on-site resources.

~ ***Establish public trail system***

Creating an interpretive trail system (starting with Phase I) will provide visitors a contrasting experience to the formal gardens and perhaps garner support for needed management.

