



4-2010

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### Recommended Citation

Ollerich, Kimberly, "Installation and Planting Design of The Penn's Woods Native Plant Restoration Project Below the Out On A Limb Canopy Walk" (2010). *Internship Program Reports*. 89.  
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**Installation and Planting Design of The Penn's Woods Native Plant Restoration Project Below the Out On A Limb Canopy Walk**

**Title:** Installation and Planting Design of The Penn's Woods Native Plant Restoration Project Below the *Out On A Limb* Canopy Walk

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**Date:** April 2010

**Abstract:**

The deer population surrounding the Arboretum has led to a vastly different landscape than what would be found in forests. The forest floor is more likely composed of invasive plants or even a barren landscape rather than native flora. To depict the impact deer populations have on our landscape, specifically on native plants, a deer enclosure was installed below the *Out on a Limb* Canopy Walk. This will allow for not only an up-close view of deer pressure but also a view from above. The enclosure, which encompasses about a quarter of an acre, will be planted with a number of plants native to the Wissahickon. Selected plants range from herbaceous perennials to shrubs and small trees that are both preferred and not preferred by deer. Plant tolerance of deer is essential since plants typically not under browsing pressure will be placed both within and outside of the enclosure to allow for a more accurate depiction of their impact in the future. Prior to planting, invasive plants including *Euonymus* spp., *Vinca minor* and *Pachysandra terminalis* will be removed. The installation of paths will allow for access to the current pathways and for easier traveling through the enclosure itself. Arboretum guests will have the opportunity to view the impact of deer and learn about native plants not found elsewhere in the Arboretum.

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(A larger copy can be found in the Morris Arboretum Library.)

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(A larger copy can be found in the Morris Arboretum Library.)

## INTRODUCTION

Deer populations have greatly reduced native plant populations in the Wissahickon and surrounding areas (Bowman's Hill Wildflower Preserve, 2009). A 1996 survey by the Natural Resource Consultants revealed deer populations in the Wissahickon Valley section of Fairmount Park were ten times the optimum density of 10 to 15 deer per square mile. Resulting deer culls carried out during the winters of 2001 through 2006 produced record harvests, but populations are still on the rise (Rawinski, 2009). In 2009, the deer population within the park had decreased to 17.7 deer per square mile. Continual management activities aim to lower populations to ten deer per square mile (McCarthy, 2010).

Excess deer pressure has several negative effects on the forest environment. "Browse lines," areas with little leaf cover between the forest floor and approximately 4 feet above ground, are prevalent. Browsing of tree seedlings and other small plants is preventing regeneration of the forest flora. Reduction of native flora at both the Arboretum and surrounding forests has provided optimal growth conditions for invasive plants. This is a direct result of deer preference for native plants rather than invasive species that are no longer shaded out by other plants. Lastly, deer have eliminated the shrub layer, leaving ground nesting birds and other animals without a desirable habitat (Bowman's Hill Wildflower Preserve, 2009).

The Arboretum's Botany Department began a five year vegetation monitoring program in 2002 to assess the need for deer culls (Friends of the Wissahickon, 2006). The study revealed little native plant regeneration through fall 2009 within small enclosures protected from the deer. Botanist, Dr. Tim Block, attributed this result to the absence of a native plant seed source. This would also explain the presence of invasive plants such as *Euonymus* spp. and *Berberis* spp. littering the forest floor since a seed source can be found in many residential backyards (Block, 2009).

Individuals from Friends of the Wissahickon, however, have found that the reduction in the deer population has led to some positive understory recovery. For example, native plants such as *Podophyllum peltatum* and *Arisaema* spp. have once again been found within the Wissahickon section of Fairmount Park in addition to the slow regeneration of mountain laurel stumps. As a result of these findings, the first structured replanting within the park in 15 years was performed in 2008. In 2009, it was found that almost 90% of the woody plantings had survived (McCarthy, 2010). The regeneration of the forest flora has been quite slow following the reduction of the deer population in these areas. However, the number of deer has appeared to play a major role in the landscape and the reduction of their numbers seems to have benefited the plants within these areas.

## **PURPOSE**

To provide the Arboretum with a planting area for native plants typically decimated by deer and other animals, an eight foot tall deer fence was installed on a quarter of an acre in Penn's Woods below *Out on a Limb*. The enclosure also provides an opportunity for the area below *Out on a Limb* to be replanted following construction. Following installation the area within the fence was planted with a number of native plants that ranged from being deer "resistant" to plants that are highly preferred by the deer. The impact of deer populations will not be clearly visible immediately. In time, comparisons between the areas accessible to deer and the enclosure will show implications of high deer populations. The fence is also intended to educate those who visit the Arboretum about native plants and make them aware of the impact of deer.

## **SITE CONSIDERATIONS**

Several issues were addressed in determining access to the enclosure. The Office of Risk Management & Insurance at the University of Pennsylvania requested the enclosure of the *Out on a Limb* structural pillars to prevent individuals from climbing them. The steep hillside is also a potential danger. Several paths were planned to allow visitors to explore the area and retrieve items fallen from *Out on a Limb*; however concerns arose regarding foot traffic through the planting beds. As a result of these concerns, traffic through the enclosure is limited to Arboretum staff, tour groups and class participants. Although access to the enclosure is limited, the site can be viewed from a number of areas: service and public paths, the stumpery, and the greenhouse.

The placement of the fence was determined by considering the slope, placement of current plant material and set stipulations. Prior to installation it was decided that the fence be 10-15 feet from the service road and set back from the stumpery's grassy slope. Some trees and shrubs that were not native were removed from the fence's intended path and the fence was placed along the flatter areas of the slope. Initially the fence was intended to form a rectangle; however, due to the site, it was instead erected with several sides to make it less obtrusive.

## **FENCE CONSIDERATIONS**

Fence material, height and gate type were determined following consultation with vendors, Arboretum staff and the Horticulture Committee. Material concerns included ability to withstand branch damage, potential hazards for wildlife, prevention of deer access and the prevention of soil compaction. Two companies, Ag Fence, LLC and Deer Fencers, Inc. provided cost estimates (Table 1).

Deer Fencers, Inc. offered a number of deer fencing options which included: Ultra-flex, Armor-flex and Commercial-flex. Ultra-flex was selected after consulting the Horticulture Committee and based on the company representative's recommendation. Ultra flex, a combination fence, is composed of a tougher material that prevents deer from crawling under it and a flexible material on the upper half so that branches and small trees will not damage it. The fence material is resilient and during construction it does not require the use of heavy equipment. Entrance under the fence by deer or other animals was resolved by staking an extra foot of fence material at the base of the fence. Another option, Armor-flex, is a welded wire material that is extremely strong. It is not very resilient and would easily be bent if something fell on it. The last option offered by the company, Commercial-flex, is very strong but would require the use of heavy equipment such as a skid-steer for installation.

Quotes for these three fence materials in both eight feet and ten feet in addition to the use of either wooden or metal posts were received (Table 1). The cost of a ten foot tall fence with either wooden or metal posts was very high. Deer Fencers, Inc. suggested the use of an eight foot tall fence. According to the company, the size of the area being enclosed, the slope, and the fact that there were a number of unprotected plants surrounding the enclosure made it far less likely that deer would jump the fence. Another difference in cost was found in the posts to be installed since metal posts were \$750.00 cheaper than wooden posts. Wooden posts were considered to be more natural and were chemically treated so that they would last a number of years; however, metal posts were cheaper and are easier to switch out if they were ever damaged. After consulting the Horticulture Committee, the installation of metal posts was selected.

Another company, Ag Fence, LLC. was also contacted after being recommended by Meadowbrook Farm who purchased a ten foot high agricultural fence with wooden posts. The company offered both a ten foot and eight foot tall fence that was similar to Deer Fencers, Inc. Commercial-flex. Meadowbrook Farm found that the fence was not a danger to deer. Furthermore, the fence was able to withstand tree damage. Unlike the three to four-inch diameter wooden posts from Deer Fencers, Inc., the wooden posts used by Ag Fence, LLC. were the diameter of telephone poles. However, the installation of the fence and the wooden posts required the use of equipment that would lead to compaction of the site which was not feasible. During the installation of the *Out on a Limb* Canopy Walk there was a strong emphasis on avoiding compaction of the site since plantings were intended.

After speaking with both companies, the Horticulture Committee, and Morris Arboretum staff, the eight foot Ultra-flex fence with metal posts from Deer Fencers, Inc. was selected with access to the enclosure by way of an upper and lower gate (Figure 1). The fence was considered to be resilient, moderately priced and did not require the use of heavy equipment that would cause compaction. Furthermore, it was decided that the company would also enclose the pillars with the Ultra-flex material and metal posts to solve the risk management requirement concerning pillar access.

## PLANT CONSIDERATIONS

The site enclosed and immediately surrounding the deer enclosure is characterized by areas of varying slope. A dry, well-drained soil with below optimum nutrient levels is present (Figure 2). Soil tests reveal a pH of 4.8, making it a suitable area for acid loving plants such as native azaleas and rhododendrons. The area is characterized by mostly shade due to the tree canopy; however, some areas along the service road, stumpy slope, below *Out on a Limb*, and within the tree canopy allow for sun or part sun. A slightly wetter environment exists at the lower end of the enclosure, due to the absence of surface drainage.

Plants will also be chosen to establish an understory, mid-story, and upper-story. Establishing a mid-story will provide a habitat for ground nesting birds and other forest inhabitants that have been displaced by deer browsing. Selected plants will be native to the Wissahickon. Some plants, not found within the arboretum due to deer pressure and lack of appropriate conditions, will also be planted even though their native range falls outside the Wissahickon. Cultivars of native species will be selected if necessary due to the specificity and difficulty in finding straight species. In the future, the impact of deer will be apparent as native species will be planted both inside and outside the enclosure. Some trees, shrubs and herbaceous plant material will be chosen for deer tolerance.

A few vines such as *Aristolochia macrophylla* (Dutchman's Pipe) will be selected to climb up the pillars holding the bird's nest. It is hoped that the vines can provide some additional aesthetic appeal to the pillars while providing another interest to those visiting the bird's nest.

Several plants were chosen for their educational value. For example, *Aristolochia macrophylla* not only produces an intriguing flower but it is the larval food of the pipevine swallowtail butterfly (*Battus philenor*). The black-purple color and orange spots of this butterfly's larvae are an adaptation to alert predators of its toxicity. *Lindera benzoin* possesses not only a lovely yellow fall color and early season nectar source for pollinators but is a larval host of the spicebush swallowtail butterfly (*Papilio troilus*). The larvae are a mint green color with black and yellow lined eyes on the top of their heads that help them scare off predators (Cullina, 2002). *Cyripedium acaule*, the pink lady slipper orchid, will be planted since they are less common in their native habitat today. Also, the plant displays an interesting pollination relationship with bees (Cullina, 2007).

## **DESIGN OF EXCLOSURE**

The planting design of the enclosure takes into consideration site and plant requirements, location of irrigation and service paths. Other considerations were the view from *Out on a Limb*, the service roads and pathways. Plants highlighted for education, such as *Cypripedium acaule*, were placed along the periphery of the fence to allow all visitors an opportunity to learn their interesting characteristics. Plants were placed based on their varying heights to promote further exploration of the enclosure from the outside. Additionally, more shrubs and trees were planted below the squirrel scramble and bird's nest where many of the previous plants had been removed during construction. Herbaceous plants were planted in greater numbers underneath the tree canopy due to the dense population of *Fagus grandifolia* in that area. Due to the \$5,000 budget available for purchasing plant material during the 2009-2010 and 2010-2011 fiscal years, the design takes into consideration future plantings. A number of the trees, shrubs, and plants within the greenhouse and difficult to find plants (ie: *Cypripedium acaule*), will be planted during the current 2009-2010 fiscal year. Herbaceous plants such as the ferns will be planted during the fall and spring of the next fiscal year. Furthermore, a number of plants such as *Trillium* spp. and *Erythronium americanum* will also be planted during the next fiscal year, following the completion of the plantings, since they will be scattered throughout the woodlands. The planting during the current fiscal year will focus on the areas that contain very few plants in hopes that it will prevent future erosion problems and return the aesthetics to the landscape in that area. The plants within the design can be found by using the design numbers (Table 2).

## **SITE PREPARATION AND INSTALLATION**

Invasive plants such as *Euonymus* spp., *Vinca minor*, *Pachysandra terminalis* and *Lonicera* spp. were removed prior to fence installation; however, control of invasives will be ongoing. Additionally, a few trees that had been impacted by the building of the *Out on a Limb* Canopy Walk structure and some invasive trees such as *Tetradium* spp., *Acer palmatum* and *Phellodendron amurense* were removed. The enclosure was placed so that it could avoid the removal of a number of desirable trees and also problematic areas caused by the slopes. Following the removal of some of the invasive plants, the metal posts were installed for the fence. The posts and fence were securely braced and additional fencing at the base of the enclosure was held securely by screws.

Further site preparation required the installation of woodland pathways. An existing woodland path leading to the grassy slope along the stumpery was redirected to a lower path ending at the greenhouse. This path was also altered to provide safer access to the wetlands. A new path was built within the enclosure connecting the lower and upper gates for both visitors and Arboretum employees working within the area.

## **CONCLUSION**

The area below *Out on a Limb* is moving toward a community of native plants both within and outside of an enclosed space. Not only does the Tree Adventure exhibit give visitors a bird's-eye view of the forest, it also provides a view of the forest floor with and without the presence of deer. The area, which previously had very few plants due to the construction of the *Out on a Limb* Canopy Walk, is now composed of a number of plants that would have been found there. Furthermore, the planting and fence installation provides visitors with another educational reason to visit the Tree Adventure exhibit and provides an additional aesthetic appeal to the forest floor.

## REFERENCES

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- Cullina, William. 2002. Native Trees, Shrubs & Vines. The New England Wildflower Society. New York, NY pp. 51-52.
- Cullina, William. 2007. Pollinating *Cypripedium acaule* (Pink Lady-slipper). Viewed January 24, 2010. <<http://williamcullina.com/files/Download/Pollinating%20Cypripedium%20acaule.pdf>>.
- Friends of the Wissahickon. 2006. Deer Management. Viewed January 24, 2010. <<http://www.fow.org/deer.php>>.
- McCarthy, Maura. Deer Populations within the Wissahickon. Email Correspondence. January 28, 2010.
- Rawinski, Thomas J. "Impacts of White-Tailed Deer Overabundance in Forest Ecosystems: An Overview." Forest Service. U.S. Department of Agriculture.

**APPENDICES**

Table 1: Estimated Costs for Fence Installation

<b>Company</b>	<b>Fence Type</b>	<b>10' + wooden posts</b>	<b>10' + metal posts</b>	<b>8' + wooden posts</b>	<b>8' + metal posts</b>
<b>Benner's Gardens</b>	Ultra-flex	\$12,720.00	\$11,970.00	\$11,558.00	\$10,808.00
	Armor-flex	\$13,799.00	\$13,049.00	\$12,357.00	\$11,607.00
	Commercial Flex	\$14,595.00	\$13,845.00	\$13,519.00	\$12,769.00
<b>Ag Fence, LLC.</b>	High tensile woven wire	\$8,605.73	n/a	\$6,996.79	n/a

**Figure 1: Benner's Garden Quote for Selected Fence**

# Deer Fencers

1100 Schell Lane, Suite 1  
Phoenixville, PA 19460  
1-800-BIG-DEER

PA Contractor's Lic. No. PA024019

NJ Contractor's Lic. No. 13VH05168400

Quote No.: MORRIS001-DF-AA-Revised

Date: 11/20/09

## Installation

Fencing materials will be professionally installed in a timely manner by Deer Fencers, LLC. Deer Fencing will be installed along fence line that was marked by a Deer Fencer's Field Technician. Deer Fence will be attached to trees that have been flagged and, or to posts whose positions have also been marked by flags. If property owner changes the fence line prior to installation, then property owner agrees to pay any additional material and labor charges. **IMPORTANT!:** Payment for the installation of the project must be paid by check (made payable to Deer Fencers, LLC) or credit card. A deposit of 1/2 of the total installation cost must be paid immediately with the balance due upon completion (use same address as above). Finance charges are computed at a periodic rate of 1.5% per month, which is an annual rate of 18% plus legal fees for any and all collections. Installation costs are as follow:

**Linear Feet: 500'**

<b>Deer Fence System Cost:</b>	<b>\$ 8,336.00</b>
<b>Support Enclosures:</b>	<b>1,967.00</b>
<b>Gate System Cost:</b>	<b><u>2,472.00</u></b>
<b>Total Project Cost:</b>	<b>\$12,775.00</b>

## Project Specifics

**8' Deer Fence:** Ultra-Flex System- 5' Heavy Perimeter Poly Fence above 48" PVC Clad Welded Wire Mesh Base  
Support on Tubular Steel Black Powder Coated Posts  
High Tension Nylon Cable reinforcement at top and 30" above ground level  
Fence base secured with galvanized steel ground stakes

**Support Enclosures:** 2" x 4" Class 3 Galvanized 12.5 ga. "No Climb" Woven Wire Mesh -- mesh secured to ground with galv. steel earth anchors. Top of mesh secured to support pillars with Stainless Steel Strapping.

**Gates:** 5 ea. Black Powder Coated Welded Steel Frames with self closing hardware -- Deer Mesh screening

**Site Survey By: Guy Keon**

**Customer Name:** Morris Arboretum -- Kimberly Oellerich

**Address:** 100 E. Northwestern Ave.,  
Philadelphia, PA 19118

**Day Phone:** (570) 249-0101, (215) 247-5777 x 145  
**email:** koell@upenn.edu

**Deposit:** Credit Card #, Exp. Date: \_\_\_\_\_

Proposal Submitted by:  Date: 11/20/09  
Guy F. Keon

Proposal Approved by: \_\_\_\_\_ Date: \_\_\_\_\_ **Customer has a 3 day right of recession from date of sending acceptance e-mail.**

Notice: Installer is not responsible for the removal of debris associated with clearing of the fence line. It is the Owner's responsibility to notify Installer of any underground wires, pipes or other hazards in the area of installation. Owner shall be liable for, and shall indemnify Installer against, any injury, damage or loss to the property or person of any party, including Installer, arising from a failure to notify Installer of potential hazards. Fees, permits and conformance to local zoning by-laws is the Owners sole responsibility.

## The Deer Fence Installation Experts

Figure 2: Soil Test for Exclosure Site



SOIL TEST REPORT FOR:				ADDITIONAL COPY TO:		
KIMBERLY OELLERICH MORRIS ARBORETUM 100 E. NORTHWESTERN AVE PHILADELPHIA PA 19118						
DATE	LAB #	SERIAL #	COUNTY	ACRES	FIELD ID	SOIL
01/07/2010	S09-18785	47108	Philadelphia		Out On A Limb	

SOIL NUTRIENT LEVELS		Below Optimum	Optimum	Above Optimum
Soil pH				
Phosphate (P <sub>2</sub> O <sub>5</sub> )				
Potash (K <sub>2</sub> O)				
Magnesium (MgO)				
Calcium(CaO)				

**RECOMMENDATIONS FOR: *Landscape, To Plant, pH 6.5***

**Limestone, Calcium And Magnesium Recommendations**

Apply the following quantities of limestone, epsom salts and/or gypsum to the soil to correct soil pH, calcium and magnesium levels.

**Calcitic Limestone:** 21 lb/100 square feet  
(0-3 % Mg)

**Magnesium:** Magnesium requirement can be met by replacing the CALCITIC LIMESTONE recommended above with an equivalent amount of DOLOMITIC LIMESTONE -OR- by applying 2.6 lb/100 sq feet of EPSOM SALTS (MGSO4) in addition to the amount of calcitic limestone recommended.

**Gypsum (CaSO<sub>4</sub>):** NONE

**Nitrogen, Phosphate And Potash Recommendations**

Apply 1.5 lbs per 100 square feet of 5-10-10 and 0.5 lbs per 100 square feet of 0-46-0.

**MESSAGES**

The above lime and fertilizer recommendations are for this soil sample and this season only. Nitrogen, phosphate and potash recommendations are for fertilizers containing specific ratios of nitrogen (N), phosphate (P<sub>2</sub>O<sub>5</sub>) and potash (K<sub>2</sub>O). As an example 5-10-10 contains 5 % N, 10 % P<sub>2</sub>O<sub>5</sub>, and 10 % K<sub>2</sub>O. If fertilizers with the ratio(s) shown are not available, contact your local garden center or fertilizer supplier for the appropriate substitution.

LABORATORY RESULTS:								Optional Tests:				
pH	P lb/A	Exchangeable Cations (meq/100g)					% Saturation of the CEC			Organic Matter %	Nitrate-N ppm	Soluble salts mmhos/cm
		Acidity	K	Mg	Ca	CEC	K	Mg	Ca			
4.8	134	10.5	0.1	0.5	1.7	12.8	0.7	4.0	13.5			

Test Methods: <sup>1</sup>1:1 soil:water pH, <sup>2</sup>Mehlich 3 (ICP), <sup>3</sup>Mehlich Buffer pH, <sup>4</sup>Summation of Cations

Home Garden-1