

Robert Treat Paine Estate Historic Landscape Preservation Initiative  
Project Completion Report

**City of Waltham**

**Robert Treat Paine Estate  
Historic Landscape Preservation  
Initiative, Phases I and II  
Project Completion Report**

**Department of Environmental  
Management  
Historic Landscape Preservation  
Grant Program**

**1999 and 2000**

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(2 copies, separately bound)

Carl Cathcart. Tree Inventory and Management Plan  
(2 copies, separately bound)

**Robert Treat Paine Estate  
Maintenance Plan  
September 2000**

**Maintenance Objectives**

Through two Historic Landscape Preservation Grants from the Massachusetts Department of Environmental Management, the rehabilitation of the historic core of the Robert Treat Paine Estate has begun. The target era for the rehabilitation is 1886 (completion of the Richardson and Olmsted commission) through 1910 (the death of Robert Treat Paine). While future projects have been identified by Shary Page Berg, maintenance of these first broad attempts to reclaim the Olmstedian landscape and its bold design features are the immediate challenge. Fortunately, this naturalistic landscape is low maintenance by design.

The following objectives are provided to help guide allocation of the limited municipal funds for the maintenance of the historic core of the Robert Treat Paine Estate landscape.

- Preserve the “bones” of the Olmsted landscape, reclaimed through the DEM grant
- Preserve the Richardson building while maintaining its historic affiliation with the landscape
- Encourage use of the historic landscape for public enjoyment and education

This initial plan is intended to expand and develop over time.

**Maintenance Priorities**

The above objectives establish, at the minimum, the following maintenance priorities for the historic core. Each item is described more fully in the plan.

- Maintain open fields and vistas
- Preserve trees and shrubs
- Prune vines attached to the house
- Eliminate poison ivy
- Maintain lawns in the vicinity of the house

## **Maintain Open Fields and Vistas**

The newly reclaimed open fields and vistas are essential components of this Olmstedian landscape. The south field, which has been cleared of trees and stumps, limed, harrowed, seeded, and fertilized, is several steps ahead of the west field and drive areas which have simply been cleared of trees. The Park and Recreation Department has agreed to maintain the fields.

### **Standards**

- Follow attached recommendations of Kyle S. Zick of Carol R. Johnson Associations, Inc. summarized here.
- This area can be mowed to a six-inch height.
- Meadow grass will have a height of 6 to 12 inches. It will have a rough lawn-like appearance but will be less intensively maintained than a lawn. Meadow grass will be allowed to go dormant in the summer months.
- The objective is to have a single mowing, after the full growth of autumn. This schedule, preferred by 19<sup>th</sup>-century farmers, allows certain native wildlife to flourish that otherwise would not.
- A brush hog will be used to mow the fields.
- Any overseeding should be performed in two operations. The second operation being at a 45 degree angle to the first operation. Seed at a rate of 100 pounds/acres. Seed mix shall be as follows: 50% Chewings Fescue (Jamestown II); 20% Hard Fescue (Reliant II); 20% Creeping Red Fescue (Pennlawn); 10% Perennial Ryegrass (Palmer)

### **Procedures and Schedule**

2000-2002 or 2003

- Mow the south field, drive area and west field 2-3 times annually until woody sucker material has been eliminated. Those cleared areas that cannot be mowed with the brush hog shall be controlled with a weed wacker.
- Fertilize fields annually. Fertilize to UMass recommended rates to offset nitrogen uptake by decaying wood chips.
- As funding allows, 1) grind stumps along drive and in west field to facilitate maintenance 2) harrow, lime and seed drive and west field areas.
- Apply lime annually, 2-3 weeks prior to fertilizing.

2003 or 2004 and beyond

- When fields are well established, mow fields once annually. A late fall mowing is preferable (before Thanksgiving).
- Fertilize fields annually. When wood chips have fully decayed, obtain new soil samples and adjust fertilization accordingly.
- Apply ground limestone every 3 to 5 years as determined by soil tests to bring lawn areas to the preferred 6.0 - 6.5 pH level. If a lime application is necessary apply 2-3 weeks prior to fertilizing.

May 5, 2000

Ann Clifford, Director  
 The Robert Treat Paine Estate  
 100 Robert Treat Paine Drive  
 Waltham, MA 02452

Re: Meadow Restoration of the South and West Fields

Dear Ann,

Based on our discussion last week and the site walk, I have developed the following recommendations for the reseeding of the cleared areas at the Paine Estate. There appears to be two distinct seeding treatments based on my observations from the site visit. In some areas that had lesser tree cover prior to clearing, there is sufficient regenerative turf to only warrant overseeding. Other areas that were much more wooded prior to clearing show little or poor regenerative turf growth and warrant reseeding. I remember there are approximately 2 acres to be seeded and approximately half would be appropriate for reseeding and the other half requires reconstruction. In terms of timing, the seeding should be done as soon as possible to limit weed seed exposure and to take advantage of the cooler days.

I would recommend installing a line of haybales to prevent siltation of the adjacent wetland during ground disturbing operations and until a grass cover is established.

I have summarized the recommendations below for the two seeding operations.

in areas that are showing good regenerative grass growth:

1. Grind remaining stumps flush with the surrounding grade
2. Remove and discard of large (1" diameter and greater) twigs, branches, wood chips, and other debris.
3. Remove heavy deposits of wood chips and place around the existing beech trees (to the drip line). This is appropriate for other specimen trees as well.
4. Lime at the UMASS recommended rate (4 tons/acre). 8-9 tons/acre are required, but only 4 tons/acre can be applied and "taken in" by grass per year.

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CAROL R JOHNSON ASSOCIATES INC

Landscape Architects	:	Environmental Planners
1100 Massachusetts Avenue	:	P 617 868 6115
Cambridge MA 02138	:	F 617 864 7890
www.crja.com	:	E info@crja.com

5. Overseed with a seed drill or slice seeder. Overseeding should be performed in two operations. The second operation being at a 45 degree angle to the first operation. Seed at a rate of 100 pounds/acre.

Seed mix should be:

- 50% Chewings Fescue (Jamestown II)
- 20% Hard Fescue (Reliant II)
- 20% Creeping Red Fescue (Pennlawn)
- 10% Perennial Ryegrass (Palmer)

This seed mix has been selected based on our discussion on site. You mentioned you are interested in establishing a meadow that is lawn-like, but less intensively maintained. Your hope was that the height would be between 6 and 12 inches. This seed mix is adaptable to sun and shade, and can live in the acid soils that you have on site. A good turf cover will be achievable that will be very green in spring and will turn brown in summer drought (as it goes into dormancy). The Contractor recommended a seed mix of brome grass, orchard grass and clover. This seed mix is much taller and coarser in texture. It is more suited to livestock pastures.

6. Fertilize with UMASS recommended mix and rates when the grass is 3 inches tall.

In areas that have no or very poor grass regeneration:

1. Grind stumps flush with the surrounding grade
2. Remove and discard of large (1" diameter and greater) twigs, branches, wood chips, and other debris.
3. Remove as many wood chips as possible because they take a very long time to decay and require a considerable amount of nitrogen in the decaying process. Any remaining wood chips should be evenly distributed so no area is deeper than 1/2".
4. Lime at the UMASS recommended rate (4 tons/acre) (See note above)
5. Till/cultivate soil to a depth of 6 inches until remaining wood chips are completely mixed into soil.
6. Fine grade seedbed and roll with 100lb roller.

7. Seed at a rate of 170 pounds/acre. Seed mix shall be as described above for overseeding. Seed can be broadcast or hydroseeded. If broadcast the area should be mulched with clean grain straw or salt marsh hay. If hydroseeded, the hydromulch shall be 100% wood fiber mulch.
8. Fertilize with UMASS recommended mix and rates when grass is 3 inches tall.
9. The Contractor is responsible for providing a good stand of turf with bare patches no greater than 3 inches in diameter over 10% of the area. The Contractor shall reseed as necessary to meet this requirement.

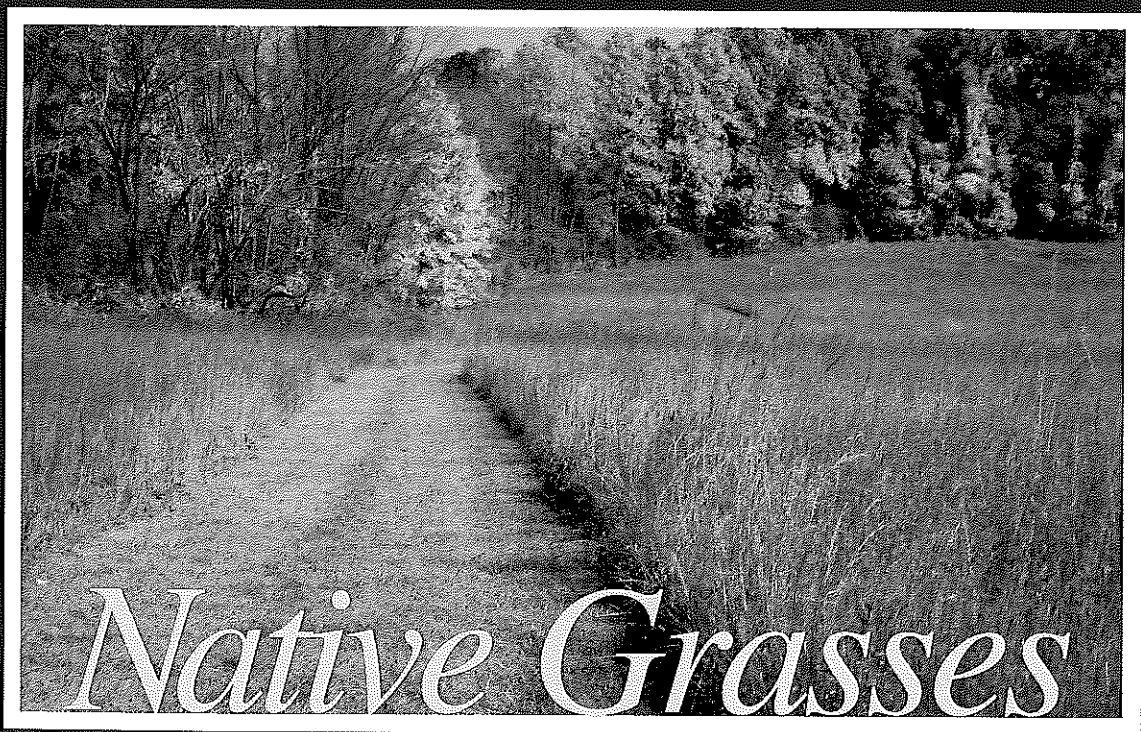
Aftercare/maintenance (outside the scope of the construction contract):

1. I recommend mowing the areas one time per year to prevent regeneration of woody plant materials. A fall mowing/cutting is preferable (before Thanksgiving). This area can be mowed to a six inch height.
2. Lime lawn area annually.
3. Fertilize annually to UMASS recommended rates to offset nitrogen uptake by decaying wood chips.

If you have any questions regarding these recommendations, please feel free to call.

Sincerely,

Kyle S. Zick  
Associate



*Where Great Grass Begins™*



## **Preserve Trees and Shrubs**

In conjunction with the Historic Landscape Preservation grant, Carl Cathcart, Consulting Arborist, provided a detailed Tree Inventory and Management Plan and tree preservation specifications. All major trees in the historic core were pruned in 1999 and 2000. High priority trees identified in the plan were fertilized as recommended for 2000. The beeches and large sugar maple were mulched in 2000. Conditions of trees in the historic core should be reassessed every five years.

### **Standards**

- Refer to Tree Inventory and Management Plan for a full description of maintenance procedures and recommended schedule.
- Standards for tree fertilization: Tree, Shrub and other Wood Plant Maintenance Standards Practices ANSI A 300 (Part 2) - 1998 National Arborist Association.
- Standards for tree pruning: Tree, Shrub and other wood Plant Maintenance Standard Practices ANSI A300-1995. National Arborist Association.
- Cabling, Bracing and Guying Standard for Shade Trees (Revised 1985) National Arborist Association.
- Lightning Protection Installation Systems Standard (Revised 1970) National Arborist Association.

### **Procedures and Schedule**

#### **Annually**

- Monitor trees for storm damage. Prune as needed.
- Monitor for Hemlock Woolly Adelgid and gypsy moth and treat as necessary (treat for Woolly Adelgid in early spring and fall and for gypsy moths in mid-May to early June)
- As funds allow, fertilize, mulch and excavate roots of as many high priority trees as possible.

#### **2001-2002**

- Install support systems in Priority I trees (1, 5, 22, 43, 51, 68, 78, 79, 86, 120, 212, 152)
- Assess for hazardous conditions the following trees: 11, 19, 79 and 94.
- Assess health of copper (22) and American beeches (138, 140) and other important trees in poor condition. Treat as needed.
- Install lightning protection for trees 79 and 102

#### **2002-2003**

- Install support systems for Priority II trees (21, 128, 134, 135, 140, 149, 150, 151).

PRESERVATION GUIDELINES  
FOR MUNICIPALLY OWNED  
HISTORIC BURIAL GROUNDS AND CEMETERIES

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL MANAGEMENT  
HISTORIC CEMETERIES PRESERVATION INITIATIVE



WALKER-KLUESING DESIGN GROUP

SARA B. CHASE  
OCMULGEE ASSOCIATES, INC.  
CARL A. CATHCART

JOYCE CLEMENTS  
SUZANNE SPENCER-WOOD

CANDACE JENKINS  
SHARY PAGE BERG

Trees that require increased maintenance or present potential hazards to historic resources, like Poplar and Willow, should be used sparingly. Trees that are subject to storm damage should not be planted in the historic burying grounds and cemeteries because of the potential damage to historic artifacts with falling limbs, etc. This includes Ailanthus, Ash, Black Cherry, Cucumber tree Magnolia, Poplar, Red Maple, Silver Maple, Tuliptree and Willow. White Pine, White Ash and Tuliptrees are also struck more often by lightning than most other trees.

Trees that grow fast like Willow, Poplar and White Pine break up easily and have one of the highest failure rates. Most White Pines have codominant branching from White Pine Weevil invasion when they were young. This type of growth is prone to large branch failure facilitating the entrance of decay within main stems. Trees that are subject to wind throw have had their surface roots damaged from vehicles or lawn equipment. Root failure occurs more readily on trees that have root decay or other root problems. Up to 75% of all tree failures are due to root problems. Tall trees with large upper crowns are more subject to wind throw with root loss. Trees that have vertical cracks and decay throughout the lower and upper stems are prone to failure.

Trees with a dense surface feeding root system make it difficult to grow turf in the same area and should also be avoided. These include Beech, Honeylocust, Linden, Norway Maple, Poplar and Willow. Trees that have annual problems with insects such as aphids on Lindens should be avoided because of the staining and mess it causes on the grave markers.

Trees that create significant litter due to fruit and/or seed production should be used sparingly because of the additional cleanup work required by maintenance staff. This includes Ash, Black Cherry, Catalpa, Corktree, Ginkgo, Horsechestnut, Mulberry, Planetree and Sweetgum. Many fruits cause staining on grave markers, pavements, walls, etc. Flowering trees of choice should have small fruits and be disease resistant to leaf and stem disease like fire blight, leaf spot and apple scab. Crabapple and Red Cedar should not be on the same site as they have diseases that require both hosts to cause leaf and stem damage.

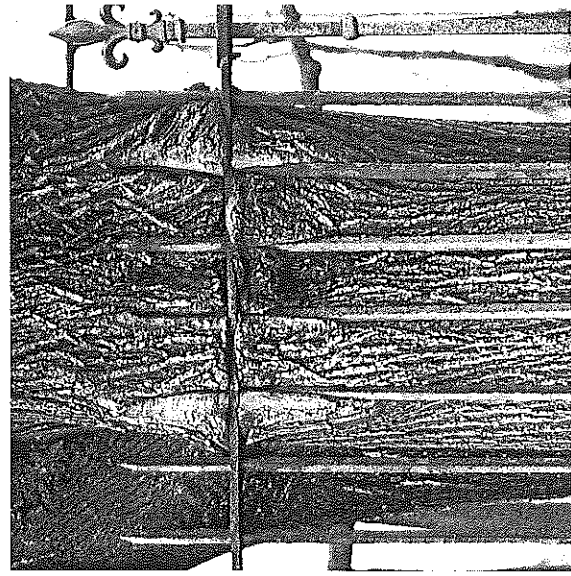
The dropping of sap on gravestones and tombs is also a particular problem when the preservation of gravestones is of prime importance. Linden and Norway Maple should be avoided because of this undesirable trait. Both also create a dense shade that inhibits the establishment of a stabilizing ground cover beneath them. Their tendency to develop basal sprouts is unattractive and blocks views. The heavy pruning requirements for Zelkovas to allow sufficient light penetration for lawn development should limit the use of this tree.

## Vegetation Management

### Issues

The goal of tree maintenance is to maintain healthy trees free of dead wood which could fall on people or gravestones and tombs. The reasons for pruning trees may include reducing hazards, maintaining or improving tree health and structure, improving aesthetics, or satisfying specific needs such as: removing or satisfying disease; removing dead, dying, interfering or obstructing branches; training young trees; eliminating screened areas to discourage loitering; and providing clearances for utility lines. The uncontrolled growth of trees and weeds hides vandals and can cause toppling of stones and widening of cracks in already damaged stones.

*Tree growth at iron fence,  
Glenwood Cemetery, Everett*



Trees require pruning on a regular basis to protect historic resources from damage by falling limbs. Too many trees or trees of the wrong type can create shade that is too dense to support and maintain a stabilizing ground cover which makes the surface subject to erosion. Too much shade can also be detrimental to particularly slate and marble grave markers in that moisture could be retained for long durations, increasing the probability of biological growth on important historic artifacts.

#### *Recommendations*

Inspect trees to safeguard against threats to stones and tombs from root systems and falling or scraping branches. Inspections should be made on a yearly basis and after each storm where winds exceed 55 mph. Ideally trees should be pruned to remove potentially hazardous dead wood on a yearly basis, but safety pruning every 5 years by certified arborists is acceptable. A 5 year cycle of pruning will help maintain and preserve large old trees. Provide plywood shelters as necessary to protect stones and monuments until pruning operations are complete.

Trees should be pruned in such a manner as to preserve the natural character of a plant and in accordance with ANSI 300 standards. All pruning cuts should be made outside the branch collar. Remove all dead wood, suckers and badly bruised or broken branches to reduce potential injury or damage to people, grave markers, vehicles and structures. Remove branches to provide 8 foot overhead clearance.

The pruning of trees should only be performed or supervised by a certified Arborist. It should be done by nonprofessional crews only during an emergency situation or when there is an immediate issue related to public safety. The removal of dead trees should be done by certified arborists, preferably concurrent with a pruning contract. In cases where gravestones are impinged upon by tree trunks or roots, the gravestones should be temporarily moved to a new location to prevent additional damage to them, but only if it is safe to move the gravestone. If growth is in conflict with gravestones or tombs extreme care should be exercised. Cut trunks as close to the soil as possible and leave the stump in place to decay. After a stump has decayed sufficiently, topsoil fill should be added to blend in with surrounding grades, and the area should be reseeded.

Root collars should be cleared of soil, mulch, stones, brush and other items that could hide or cause decay which could cause a tree to fail. Keeping root collars clean helps control girdling roots and decay that leads to tree decline and failure. Questionable trees with cavities, cracks or seams in main stems or branches, or fungi fruiting bodies on or around the root area should be assessed for potential tree failure.

Failure prediction with any sort of accuracy is difficult. However, performing a systematic approach of evaluating each part of a tree with proven procedures that the International Society of Arboriculture has adopted through the guide known as "A Photographic Guide to the Evaluation of Hazardous Trees in Urban Areas" will help to eliminate most of the suspected hazards. Remedial action such as pruning, installing support systems and removal will help reduce the failure percentages and the damage or injury to property or persons.

## **Volunteer Growth**

### *Issues*

It is essential to maintain a landscape with an appropriate historic character. The character of a landscape is dynamic compared to the relative stasis of other historic components like grave markers and structural elements. Natural forces like landscape succession will change an unmaintained lawn into a forest in a relatively short period of time. The undeniable results of these forces can be seen in Littleton, Mashpee, Newton, Peabody and Sturbridge. Many of the older burial grounds have large trees that might appear as old as the sites themselves. However, most of them were not there before the turn of the century. Many are volunteers, developed from seed blown in from outside areas.

### *Recommendations*

Most, if not all, volunteer species should be removed. Vegetation control programs are actively pursued in many communities, removing undergrowth, many of the smaller volunteer species and selected trees. Volunteer growth should be removed on a yearly basis during the summer months when frequency of mowing is reduced and maintenance crews have time to remove it. Because lawn areas and edges attract volunteer growth, lawns must be mowed on a regular basis to keep this under control. The edges of a property and individual elements like markers and tombs must also be constantly monitored to keep volunteer growth in check.

Hi Ann  
Just picked this  
up from a lecture  
by Mark McClure

2-10-2001

Carl

## Hemlock Woolly Adelgid, *Adelges tsugae* (Annand)

By Mark S. McClure

Valley Laboratory  
Connecticut Agricultural Experiment Station  
153 Cook Hill Road  
PO Box 248  
Windsor, CT 06095

Voice: (860) 683-4979 Fax: (860) 683-4987  
E-mail: mmcclure@caes.state.ct.us

### What it is and How to Stop It

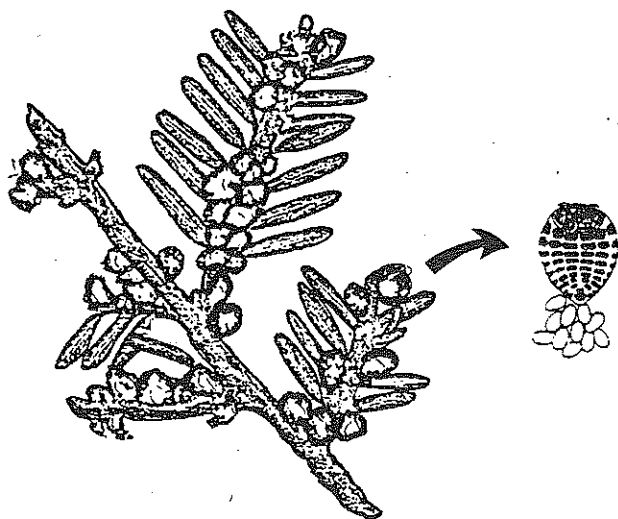


Figure 1. Egg masses and adult of hemlock woolly adelgid on eastern hemlock.

Hemlock woolly adelgid is a small aphid-like insect from Japan that has become a serious pest of eastern hemlock, *Tsuga canadensis*, in the eastern United States. Even though the adelgid is smaller than a period at the end of this sentence, it is easily recognized on the new growth by the presence of a dry, white woolly substance that covers its body and egg masses. Hemlocks are injured when the insects feed on the sap and inject toxic saliva into the tree. This dries out the needles turning them a grayish-green color. They then drop from the tree usually within a few months. Most buds are also killed, so little if any new growth is produced on infested branches.

Death of major limbs usually occurs within two years and progresses from the bottom of the tree upwards, even though the infestation may be evenly distributed throughout the tree. Trees often die within four years, but some survive longer in a severely weakened condition with only a sparse amount of foliage at the very top of the crown. These weakened trees are unsightly and have little chance for recovery. They often fall victim to wood-boring insects, diseases and are easily damaged by the wind.

Hemlock woolly adelgid at this time, can not be managed in the forests. However, hemlocks growing in nurseries and ornamental landscapes can be saved by carefully monitoring for the presence of the adelgid. Implementing various cultural practices to enhance tree vigor, to discourage pest invasion, and by using mechanical and chemical measures as needed can bring the adelgid under control.

## Biology

The hemlock woolly adelgid is parthenogenetic. That means all individuals are female. It completes two generations of development each year. During March and April, adults of the overwintering generation lay about 100 eggs each in a cottony mass on the young twigs. Nymphs (called crawlers) hatch from these eggs during a period of several weeks from April to May. Within a few days, they either disperse from the tree or settle on the twigs near the base of the needles where they insert their piercing and sucking mouth parts. There they feed and remain throughout their development. The spring generation matures by mid-June. Some of the adults produced at this time have wings and are unable to reproduce on hemlocks. They leave the hemlock tree in search of spruce. There is no suitable spruce host in the eastern United States, so they soon die. Other adults produced at this same time are wingless and are able to reproduce on hemlock. In the middle of June these wingless adults lay about 100 eggs each in a cottony mass on the twigs. Crawlers, which hatch in early July settle on the new growth and soon become dormant until the middle of October when feeding resumes. Nymphs feed and develop during the winter and mature in the spring.

### How to Monitor the Pest

It is important to detect infestations early, because the hemlock woolly adelgid can damage trees so quickly. Frequent visual inspection is the most effective means of determining whether or not a hemlock is infested. For most of the year the dry, white "wool" produced by the adelgid on the twigs is quite conspicuous. It is particularly noticeable in spring on the undersides of new growth. Further evidence of hemlock woolly adelgid infestation is the thinning or grayish-green (not red or yellow) color of the needles on some branches. Usually by the time these symptoms appear, the tattered "wool" of a previous adelgid generation is also present on the branches.

### Cultural Control Methods

*Reducing invasion by adelgids:* Birds, squirrels and deer are important dispersal agents. Thus any effort to discourage these animals from visiting hemlocks will reduce the risk of trees becoming infested. Care should be taken when moving plants, logs, firewood, or bark chips from infested areas into non-infested areas, especially from March to June when adelgid eggs and crawlers are present. Cleaning vehicles, clothing, etc. after visiting forests, recreational areas, parks or other properties with infested hemlocks is also advisable during this period. Hemlock woolly adelgid infestations often start in large mature hemlocks that intercept the wind or are especially attractive to birds and other wildlife. These trees serve as reservoirs for the adelgid and selective removal of them can retard the establishment of new infestations.

*Improving tree health:* The hemlock woolly adelgid infest and kill hemlocks of all sizes and ages, even in habitats with seemingly excellent growing conditions. Trees that grow in poor sites or experience stress from drought and other agents succumb to adelgid attack more quickly. Maintaining good growing conditions can play an important role in the survival of hemlock. The hemlock is a shallow rooted tree and is particularly prone to stress when there is little rain. Therefore, during periods of drought, trees should be watered as often as needed. Ensure that they receive 1 inch of water per week (including rainfall) over the area beneath the drip line of the crown. Water should be applied slowly so that the roots are well watered. Pruning may also be of some value in improving the health of hemlock. Remove dead and dying branches and limbs from hemlock will promote new growth by allowing more light to reach the foliage. It will reduce the likelihood of attack by insect pests and diseases. Although applying fertilizer may improve the growth

and vigor of non-infested trees, fertilizing infested hemlocks with nitrogen enhances adelgid survival and reproduction. As a result, a fertilized hemlock becomes more heavily infested and more severely injured than an unfertilized one. Nitrogen fertilizer should not be applied to an infested hemlock. Fertilizing a tree after adelgids have been controlled may encourage growth and stimulate recovery. The potential risks and benefits of applying fertilizers which do not contain nitrogen to adelgid-infested hemlocks are unknown.

*Mechanically removing adelgids:* Eggs and crawlers are easily dislodged from trees by the wind and rain. Most of these individuals are unable to find their way back onto the tree and die. Therefore, intentionally dislodging eggs and crawlers by directing a strong stream of water at infested branches periodically during April through June may be of some value in reducing adelgid numbers. Clipping the more heavily-infested twigs from hemlock branches will also reduce adelgid density on a given tree. However, extensive clipping may have undesirable effects on the general appearance and health of the tree.

*Planting resistant hemlock species:* Two Japanese hemlock species, *Tsuga diversifolia* and *T. sieboldii*, and two western North American hemlock species, *T. heterophylla* and *T. mertensiana*, are resistant to hemlock woolly adelgid. Although the adelgid infests these resistant species, it rarely reaches high enough densities to cause injury. Planting these resistant hemlocks may reduce the impact of the insect in the ornamental landscape. Of the four species, *T. heterophylla* is most similar to the eastern hemlock *Tsuga canadensis* in appearance, growth, form, and utility. However, the likelihood for long term success of these hemlocks in the eastern United States is unknown.

#### Chemical Control Methods

*Deciding whether or not to use pesticides:* The use of chemical pesticides is an important component of any control program for hemlock woolly adelgid. Even though cultural control measures can significantly reduce adelgid numbers on hemlock, infested trees are usually unable to survive for more than a few years without the help of chemical pesticides. It is important to understand that hemlocks need to be protected from the adelgid as often as necessary until the danger has passed. This may be for a period of several years until all the unprotected hemlocks in the vicinity have died and can no longer serve as a source for re-infestation. Therefore, the initial decision on whether or not to use chemical control measures should take into account, the value of the trees relative to the anticipated cost of protecting them over the long term. It may be advisable to identify individual trees or groups of trees that have special value or significance on the property and to concentrate control efforts on those trees. This may be more successful than the overly ambitious approach of trying to save everything at first, only to lose it all when resources have been depleted a few years hence.

*What you need to know about pesticides:* Several pesticides are registered for control. Some can be used by homeowners, while others are only available to licensed commercial arborists. Each of these pesticides have a relatively short life in the environment, so treating a non-infested tree with pesticide, offers little or no protection from invasion by the insect. Hemlocks should be treated only when an adelgid infestation is known to be present. Before applying any pesticide, read the product label carefully. It will provide important information on safety, toxicity, methods, and rates of application.

*Applying pesticide sprays:* The most common and effective method for control on ornamental hemlocks is to thoroughly drench infested trees with horticultural oil, insecticidal soap, or any one of several petrochemical insecticides that are specifically labeled for this use. Oil and soap are used most often because

they are highly effective in killing adelgids, and yet they are relatively safe to the applicator, beneficial insects, and the environment. Unlike the petrochemical insecticides which kill by contact or ingestion, the oil and soap selectively kill soft-bodied insects, such as adelgids, by "suffocation" rather than by poisoning. *It is essential that all parts of the infested hemlock be drenched thoroughly with insecticide.* This precludes control on very large trees (usually those greater than about 80 feet tall) and those in forest settings. A backpack or garden hose sprayer may be sufficient to drench trees less than 30 feet tall, but taller trees may require the services of a professional arborist using a hydraulic sprayer. Fortunately, it is unnecessary to target a particular life stage of the adelgid for control; all are equally susceptible. Therefore, pesticide sprays can be applied any time during the year, weather permitting. One thorough application each year may be enough, if there are no other infested hemlocks within 100 yards from which adelgids could readily disperse. However, two spray treatments each year are usually necessary for most situations. If two applications each year are needed, an effective strategy is to spray in early April and again during the first half of June. Another option is to substitute a spray during the last half of September for the April treatment. Either of these schedules will target both adelgid generations and minimize the impact of immigration. It is advisable to spray as soon as a new infestation is detected because the hemlock woolly adelgid propagates and injures hemlocks so quickly. Then if necessary, adopt one of the maintenance schedules described above.

*Applying pesticides by soil injection and drenching:* Introducing a systemic insecticide known as imidacloprid into the roots of infested hemlocks in April to May is another alternative to protecting trees that can not be sprayed thoroughly. The soil beneath the tree's crown can either be drenched or injected with a hydraulic injection needle. The imidacloprid is then taken up by the roots and distributed throughout the tree where it can control hemlock woolly adelgid for one year or more. However, trees must have a healthy sap flow for these soil techniques to be effective. Therefore, if infested trees have already declined significantly, pesticide sprays may be the better option.

*Evaluating the effectiveness of chemical controls:* One of the most difficult tasks confronting the homeowner is to evaluate the effectiveness of efforts to control hemlock woolly adelgid. Unfortunately, the "wool" can persist on the twigs for several months after the adelgid has been killed. Therefore, the presence of "wool" is not necessarily indicative of living adelgid and an unsuccessful control effort. The simplest way to determine if further control measures are needed is to disregard the tattered, off-color "wool" on the older twigs, and to look for the production of fluffy, white "wool" only on the very youngest twigs.

### Biological Control Methods

*Hope on the horizon:* Several native insects, including beetles, flies, and lacewings, are occasional predators of the hemlock woolly adelgid in North America. Unfortunately, none of these has had a significant impact on adelgid populations or has shown much potential for biological control. In Japan, however, there are several effective natural enemies. One species in particular, a ladybird beetle (*Pseudoscymnus tsugae*), is especially effective at locating and destroying infestations of the hemlock woolly adelgid in Japan. Hundreds of thousands of these beetles have been reared and released throughout Connecticut and in nine other eastern states. We are now evaluating the potential of *P. tsugae* for biological control the hope that someday this predator will be part of an integrated program for managing hemlock woolly adelgid in our forests, nurseries and ornamental landscapes.





## MANAGEMENT

- Monitoring for the presence of this pest should be performed at least twice a year on susceptible hosts. March is a good time to inspect for new egg masses.
- When an infestation is discovered, it must be managed and not ignored. The use of horticultural oils works extremely well; both dormant and summer oils are highly recommended.
- Several chemicals are also listed but will not be effective against the egg stage.
- Insecticidal soap is also labeled for this pest but recent work may suggest that, by itself, it may not be as effective as the other options.
- Complete coverage of the host must be achieved with whatever insecticide is chosen. Areas of the host plant missed by the foliar application will harbor adelgids and be a reservoir for a reinfestation of the entire plant.
- Micro-injection of certain insecticides has some effect but hemlocks are very slow to "take-up" the material in the capsule and it may require 10+ hours for the material to enter the tree.
- New, soil applied, systemics that are **imidacloprid**-based have shown great success against this pest but entry of this compound into and throughout the host may take many weeks. However, the residual activity of the compound may last into the next growing season. Carefully consult the label for information pertaining to groundwater concerns.
- It is advised that bird feeders not be placed in hemlocks; migrating birds can move this pest from one geographic location to another. This pest is primarily moved by wind and birds.

*Insect illustration courtesy of Dr. John A. Davidson, Entomology Department, University of Maryland.*

Robert D. Childs  
UMass Extension Educator  
5/96

# Natural Tree & Lawn Care

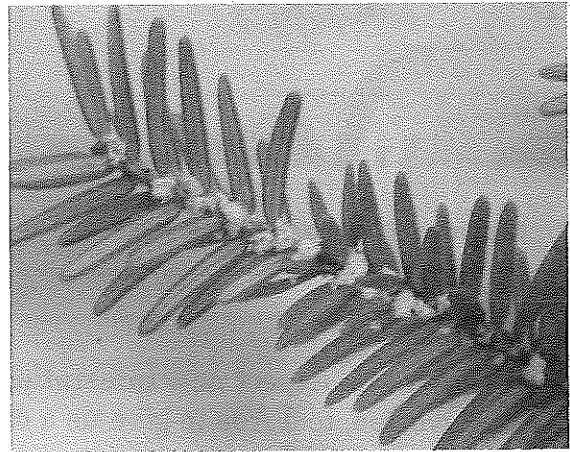
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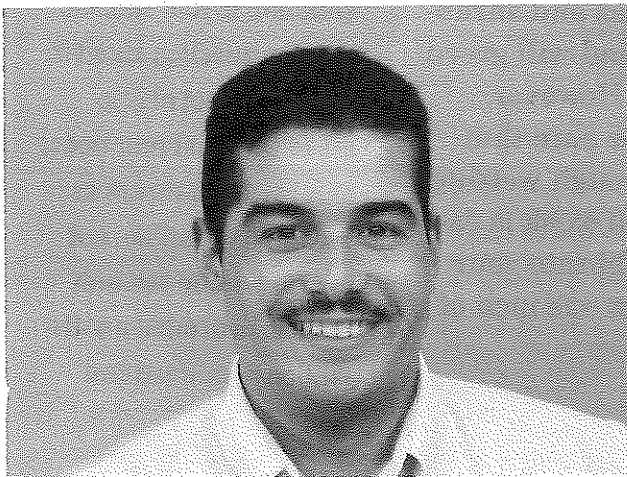
## !!! Good News about Hemlock Woolly Adelgid !!!

I recently attended a seminar given by Dr. Mark McClure, the expert on Hemlock Woolly Adelgid. Mark leads the effort at the University of Connecticut Extension to develop biological controls for this insect and has good news for lovers of hemlock trees. On an expedition to China, he found two species of ladybug beetles that are the natural predators of Hemlock Woolly Adelgid. Dr. McClure has developed successful breeding techniques for these beetles. Mark has now launched a full scale program to produce sufficient numbers to save our hemlock trees. Recent releases of these beneficial insects have been made at Hemlock Gorge in Newton, along with other key locations in the State. Although there are not presently enough of these beetles to replace other control measures, there is now a light on the horizon.



Over-wintering egg masses of Hemlock Woolly Adelgid on an infested Hemlock Tree

## Who We Are



A graduate of the UMASS Extension Green School, **Raphael Acevedo** has been in the tree and landscape industry for thirteen years. In addition to being a senior consultant and licensed pesticide applicator, Raphael is a champion tree climber. Last year, he won first in the Southeastern Massachusetts Tree Warden's climbing competition with a record setting time. He also placed second in New England, two years running, in the International Society of Arboriculture's tree climbing jamboree.

**City of Waltham  
Robert Treat Paine Estate  
Tree Preservation**

Major funding provided by Department of Environmental Management  
Historic Landscape Preservation Grant Program, 1999

## **Specifications**

1. General
  - 1.1 Scope of Work
  - 1.2 Supervision and Site Inspection
  - 1.3 Qualifications
  - 1.4 Safety
  - 1.5 Disposal
2. Fertilization
3. Pruning
4. Stump Removal
5. Site Preparation
  - 5.1 Damage to Trees and Shrubs
  - 5.2 Damage to Real Property
  - 5.3 Prevention of Damage to Vegetation and Landscape
  - 5.4 Provisions for Control of Erosion
  - 5.5 Work in Public Ways and Estate Drive
  - 5.6 Disposition of Existing Utilities
  - 5.7 Other Protection
  - 5.8 Equipment and Materials

# 1 General

## 1.1 Scope of Work

The scope of work under this contract includes providing all labor, equipment and supervision necessary as required to complete the work as per specifications. The Scope of Work consists of four tasks: 1) tree fertilization, 2) pruning, and 3) stump removal.

- **Fertilization of 16 trees**, as indicated on attached map and marked with colored tape
- **Tree Pruning.** All trees will be marked prior to commencement of work. Removal of dead and dying branches 2 inches and larger in diameter.
- **Stump and Surface Root Removal.** All stumps marked prior to commencement of work will be removed. All marked in lawn area and near building shall be ground 10-12 inches below grade for replanting purposes. All other marked stumps and surface roots in fields shall be ground 2 inches below grade. Marked stumps in wooded and other areas should be cut close to grade as possible and treated with Round Up to help suppress future growth. Holes shall be infilled with all soil and chip mix and leveled.

Work must be completed within 45 days of bid award.

All tree care operations for tree fertilization shall adhere to the following: Tree, Shrub and other Wood Plant Maintenance Standard Practices ANSI A 300 (Part 2) -1998 National Arborist Association.

All tree care operations for tree cabling and bracing shall adhere to the following: Cabling, Bracing and Guying Standard for Shade Trees (Revised 1985) National Arborist Association.

All tree care operations for tree pruning shall adhere to the following: Tree, Shrub and other wood Plant Maintenance Standard Practices ANSI A300-1995. National Arborist Association.

## 1.2 Supervision and Site Inspection

All work will be performed under the direction of a City of Waltham representative, hereinafter referred to as "Owner's Representative." If the project supervisor determines that ground conditions become such that unacceptable damage may occur to an area, the City of Waltham reserves the right to suspend operation until favorable conditions prevail.

Before any activities commence on-site, the Owner's Representative and contractor shall perform a detailed walk through of the project area.

It is understood that the Contractor has examined the site and has full knowledge of the conditions and difficulties to be met. No variations or allowances from the contract will be made due to lack of knowledge. Bidders are required to attend the pre-bid tour of the work area.

### **1.3 Qualifications**

Contractor shall use adequate numbers of skilled workmen who are thoroughly trained and experienced in similar work and who are completely familiar with the specified requirements and the methods needed for proper performance of the work.

All tree fertilization, cabling and bracing, and pruning shall be performed by experienced workmen in accordance with the National Arborist Association Standards under the immediate supervision of a licensed Arborist.

For a company to be acceptable as a bidder, it must have been in business for at least five (5) years. With the bid, Contractor must demonstrate at least five (5) years of prior experience in similar work and submit references for three related projects. References should include name, address and telephone number of contact person.

Each and every provision of the law and clause required by law shall be deemed to be inserted with these specifications. The successful bidder shall be required to follow all local and state ordinances and laws that apply to this project.

### **1.4 Safety**

All operations shall be conducted in a manner to prevent damage by falling trees and to provide for safety of workers and other persons.

Contractors are required to comply with current Massachusetts Occupational Safety and Health Standards. All workers are required to wear hard hats as well as any other protective equipment necessary.

Brush chippers shall not be unattended while operating and keys shall not be left in the ignition when unattended.

Ropes shall be pulled out of trees at the end of each day.

Each crew will have easy access to a fire extinguisher, first aid kit and a list of local emergency telephone numbers.

All safety regulations shall be adhered to as per the following: American National Standards Institute for Tree Care Operations Pruning, Trimming, Repairing and Maintaining. Removing Trees and Cutting Brush. Safety Requirements ANSI Z133.1-1994. National Arborist Association. Safety shall be of the utmost importance.

## **1.5 Disposal**

Remove debris from the Site and dispose of in a legal manner. No material or debris may be dumped within the limits of the site or abutting property except where specifically authorized by owner. A small portion of material may be used as mulch for shallow-rooted trees.

All downed and cut plant material together with miscellaneous debris from this work shall be removed by the Contractor from the project site in an acceptable time limit. Do not store or permit debris to accumulate on the Site.

Under no circumstances will burning of materials or debris from this work be allowed.

## **2. Tree Fertilization**

All trees will be sub-surface liquid fertilized with a slow release fertilizer with a ratio of 3:1:1 or 3:1:2. The application rate of 4 lbs of nitrogen per 1000 square feet is to be followed. Holes shall be evenly spaced beneath the branch spread (dripline) of the canopy of the tree. Injection sites shall be 12 to 36 inches apart and 4 to 12 inches deep. Pressure must not exceed 200 lbs per square inch. Fertilizer shall be evenly distributed among the injections sites.

## **3. Pruning**

All pruning shall consist of removing dead and dying branches 2 inches in diameter and larger to improve health and safety of trees.

When removing a branch, pruning cuts shall be made in bark tissue, close to, but outside of the branch bark ridge and the collar, which is trunk tissue (fig. 1, Appendix A). If no collar is visible, the angle of the cut shall approximate the angle formed by the branch bark ridge and the trunk (fig. 2, Appendix A.)

When removing a dead branch, the final cut shall be made outside the collar of live tissue. If the collar has grown out several inches around the branch stub, only the dead stub shall be removed, the live collar shall remain intact and uninjured (fig. 3, Appendix A). The finish cut surface must be smooth and intact with no jagged edges or torn bark.

When pruning back ends of large branches, all cuts are to be made to a healthy lateral branch approximately three (3) times the size of the branch being removed. In removing the end of a limb to a large lateral branch, the final cut is made along a line that bisects the angle between the branch bark and a line perpendicular to the limb being removed (fig. 4, Appendix A)

Pruning shall encourage the development of the natural shape of the plant. Where crown reduction is necessary, a tree-like form shall be maintained with the top higher than the sides.

Excessive thinning of the interior portions of the crown should be avoided. Instead, emphasis shall be given to removing branches from the ends of the limb and leaders. One half of the foliage must be maintained to the lower 2/3 of the limb or leader. Selective thinning of the ends of the limbs will reduce the weight of the crown, which will help prevent breakage during storms. This form of pruning also tends to discourage sucker growth on the interior portion of the limbs.

Removing major limbs or leaders (more than 6 inches in diameter) should be avoided unless declined or storm damaged beyond repair. Subsequently, large pruning wounds will not callus rapidly and severe decay in the remaining limb or trunk will result.

#### **4. Stump removal**

All stumps in lawn area and near building shall be ground 10-12 inches below grade for replanting purposes. All other stumps and surface roots in fields shall be ground 2 inches below grade unless otherwise instructed. Stumps in wooded and other areas shall be cut as close to grade as possible and treated with Round Up to help suppress future growth. Holes shall be infilled with all soil and chip mix and leveled.

#### **5. Site Preparation**

##### **5.1 Damage to Trees and Shrubs**

It is the objective of this contract to preserve, enhance and to provide a safe environment in the landscape. Therefore damage to any tree or shrub, lawn or real property will not be tolerated. The Contractor shall be liable for all damage and/or disturbance to trees and shrubs. Actual penalties for damage to plants shall be in accordance with the schedules defined herein, with assessed damages to be deducted from sums payable under the Construction Contract.

Trees which become damaged as a result of the Contractor's operations and can, in the opinion of the Owner's Representative, be restored through corrective maintenance, shall be repaired immediately following any evidence of damage to the satisfaction of the Owner's Representative.

Trees which become irreparably damaged as a result of the Contractor's operations shall be assessed at full replacement costs, or if not applicable as determined by the Owner's Representative, at a minimum cost of one hundred and fifty dollars (\$150.00) per caliper inch, or greater in accordance with the "Guide for Establishing Values of Trees and Other Plants", published by the International Society of Arboriculture, Urbana, Illinois.



## **5.2 Damage to Real Property**

In the event that damage occurs to real property, notification will be given to the Contracting Agent before leaving the grounds that day. This damage shall be required by the Contractor at his expense to the satisfaction of the Contracting Agent. Unless otherwise arranged, repair to real property will be completed before payment is made to the Contractor.

## **5.3 Prevention of Damage to Vegetation and Landscape**

Whenever possible, equipment shall be kept on roads and driveway to minimize damage to plants. Contractor shall not disturb earth below and within drip line of any tree. Vehicles shall not be parked where damage may result to trees. Construction materials shall not be stored beneath trees.

Limbs cut from the tree, which may cause damage to lower limbs while falling must be lowered from the tree on a rope.

Climbing spurs (gaffs) shall not be used to climb trees, except for removals and as emergency measures to rescue an injured climber.

Limbs more than 3 inches in diameter shall be precut to prevent splitting or peeling of the parent branch. Plants to be saved shall not be used for guys or other fastenings.

Do not damage plants to remain by burning, by pumping of water, by cutting of live roots or branches, or by any other means.

Maintain current grade lines and undulations of terrain. Protect ledge outcroppings, boulders and naturally weathered surfaces of exposed rock from scraping or other damage.

## **5.4 Provisions for Control of Erosion**

The Contractor shall take sufficient precautions, as approved by the Owner's Representative during construction to minimize the run-off of polluting substances such as silt, clay, fuels, oils, bitumens, calcium chloride, or other polluting materials harmful to humans, fish, or other life, into the water supplies and surface waters.

## **5.5 Work in Public Ways and Driveways**

All work in Public Ways shall conform to the City Public Works Department Standards and State Standards for materials and construction as applicable. Such work shall be included in the Contract Sum and shall be done without additional cost to the Owner.

All roads and driveways will be kept clear of logs, brush or other obstructions.

Any damage to roads or driveways resulting from this work will be promptly repaired at the contractor's expense.

### **5.6 Disposition of Existing Utilities**

Protect existing underground and overhead utilities indicated or made known. Consult Digsafe and the City of Waltham to verify location of same.

Active utilities existing on the Site shall be carefully protected from damage to assure an uninterrupted service. If service or utilities must be interrupted, the Owner's Representative and Utility Owner must be notified at least 8 days in advance so that all necessary arrangements can be made. When an active utility line is exposed during construction, both the Owner's Representative and the Utility Owner shall be notified in writing.

Active utility lines damaged in the course of construction operations shall be repaired or replaced as determined by the Owner's Representative without additional cost to the Owner or the Utility Owner. The Contractor shall assume all responsibility for damage to existing utility lines.

### **5.7 Other Protection**

Project areas shall be protected until accepted. No storage of construction equipment or vehicles shall be allowed in the area without the express permission of owner.

Use means necessary to prevent dust from becoming a nuisance to the public, to neighbors, and to other work being performed on or near the Site.

Maintain access to the Site at all times. Access route must be approved by Owner's Representative.

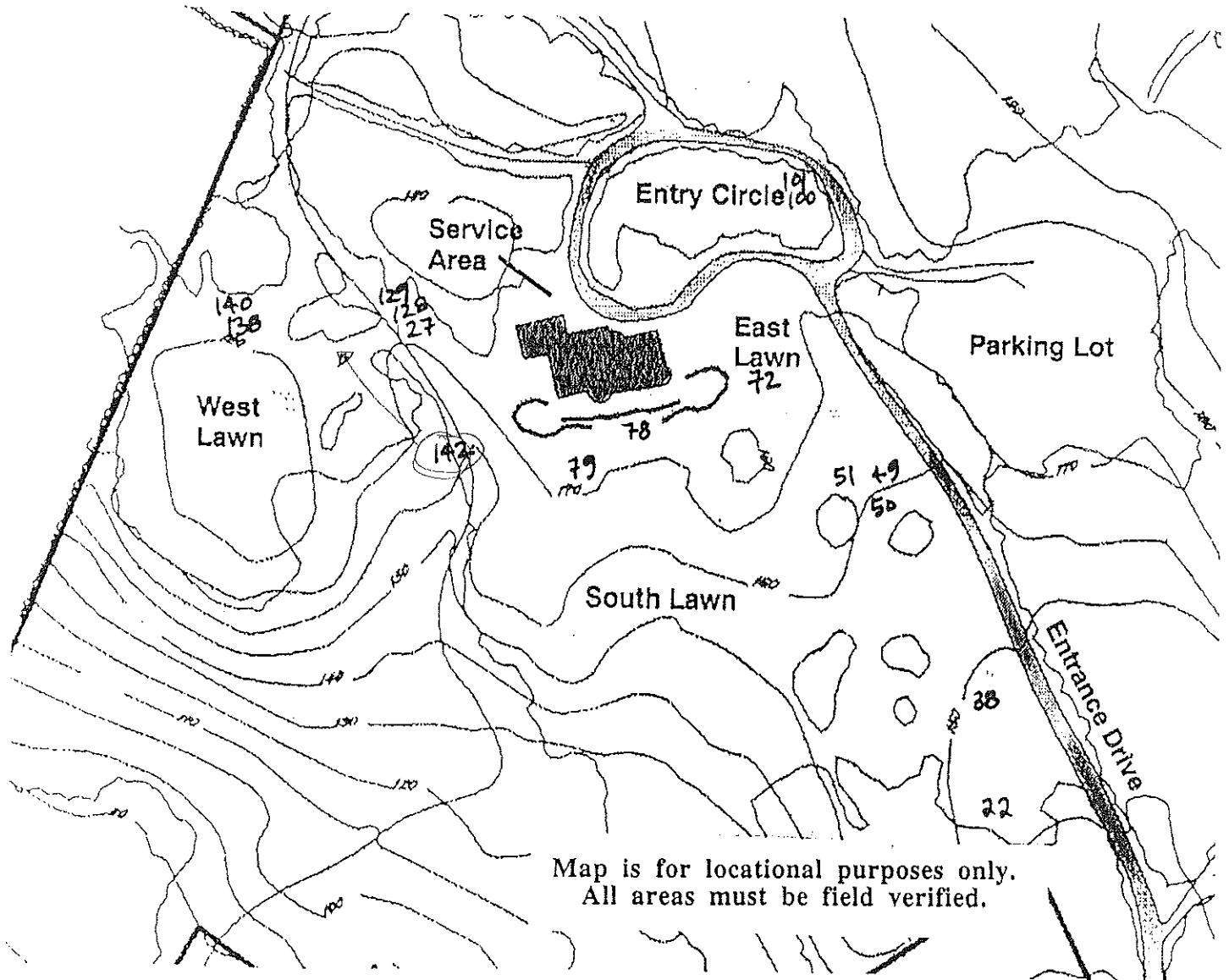
Work hours must be limited to weekdays between 7:00 am and 6:00 pm.

### **5.8 Equipment and Materials**

Equipment shall be such that will not damage topography and shall not be used in wet weather.

Provide other materials not specifically described but required for proper completion of the Work subject to the approval of the Owner's Representative.

**City of Waltham  
Robert Treat Paine Estate  
Tree Preservation**



Map is for locational purposes only.  
All areas must be field verified.

**Tree Fertilization**

The following trees shall be fertilized:

- |                          |                  |                |
|--------------------------|------------------|----------------|
| ✓ 22 Copper Beech        | ✓ 72 Dogwood     | 128 White Pine |
| ✓ 38 Sugar Maple         | ✓ 78 White Birch | 129 White Pine |
| ✓ 49 Black Walnut        | ✓ 79 White Pine  | 138 Beech      |
| ✓ 50 Ginko               | 100 Sourwood     | 140 Beech      |
| ✓ 51 Carolina Silverbell | 101 Sourwood     | 142 Black Oak  |
|                          | 127 White Pine   |                |

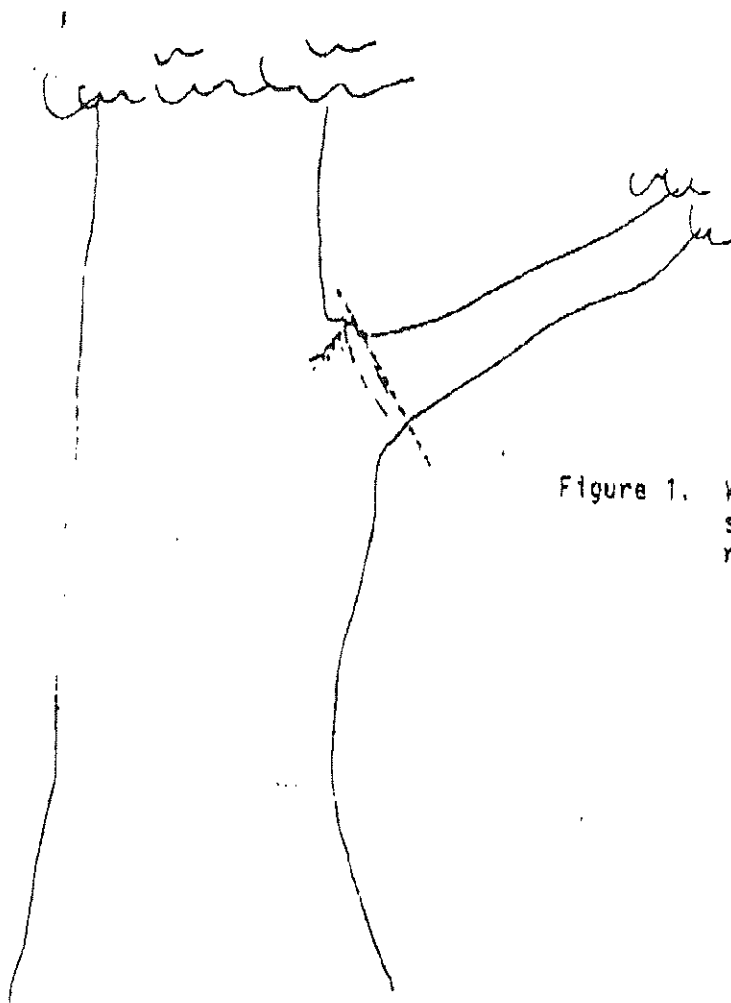


Figure 1. When removing a branch, the final cut should be just outside the branch bark ridge and collar.



Figure 2. In removing a limb without a branch collar, the angle of the final cut to the branch bark ridge should approximate the angle the branch bark ridge forms with the limb. Angle AB should equal angle BC.

**City of Waltham  
Robert Treat Paine Estate  
Tree Preservation**

Major funding provided by Department of Environmental Management  
Historic Landscape Preservation Grant Program, 1999

**Bid Sheet**

Contractors shall supply bids for each of the following categories.

No.	Action	Amount
Base Bid	Fertilization of 16 Trees (as indicated on attached map)	Lump sum
Alternate 1	Pruning	per 2-man crew plus equipment per day
Alternate 2	Stump removal	per 2-man crew plus equipment per day

## **Prune Vines Attached to the House**

There are three kinds of vines which were historically encouraged to grow on the house. These vines have informally been identified as follows: 1) wisteria on a cable trellis system on the south and west facades of the 1866 wing, 2) actinidia arguta or hardy kiwi on a cable on the north facade of the 1866 wing and 3) ivy growing directly on the boulder walls of the Richardson addition. Charles Pepper of the Frederick Law Olmsted National Historic Site knows of only one other example of Olmsted's use of this system of cables and vines: Fairsted, his own home in Brookline. Although vines can cause and have caused damage to vulnerable wooden and brownstone surfaces of the house, they are a rare surviving example of this system devised by Olmsted and are character defining feature of the 1886-1910 target era.

These vines require vigilant maintenance. Neglect has contributed to the deterioration of the building.

### **Standards for creeping vines (ivy)**

- Refer to attached Old House Journal article.
- Limit creeping vine growth to boulder walls, preventing it from encroaching on more vulnerable building elements composed of brownstone and wood.
- In order to minimize damage to building elements, never pull live vines from the walls.

### **Procedures and schedule for creeping vines (ivy)**

- Prune vines twice annually
- Clip vine at new shoot and allow the severed part to dry for 2-3 weeks
- Pull dried vine carefully away from the building in sections.

### **Standards for twining vines (wisteria and actinidia)**

- Refer to attached Garden Design article and Preservation Tech Notes.
- Limit twining vine growth to the cable trellis system, with one main trunk.

### **Procedures and Schedule for twining vines (wisteria and actinidia)**

- Two months after vines leaf out (or bloom) and again in late winter or early spring, cut each side shoot back to its sixth leaf. The shoots should be about 12 inches long.
- As needed, remove smaller branches that are twisting around the large ones.
- Once annually, dig up errant roots, tracing them back to the main root and clipping them at the source.

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# Vines for Town and Country

BY JO ANN GARDNER

**W**HETHER SHADING A RURAL PORCH OR CLINGING to urban brickwork, vines have lived in harmony with old houses for centuries. Two hardy native vines are the hop and Virginia creeper. Both have been grown in North America since the 17th century. As vigorous as they are, vines require a supplementary structure—a trellis, fence, or the house itself—in order to grow upright. Some historic supports, as well as careful placement, will keep them on the climb.

## A Pioneering Vine

TRADITIONALLY A COUNTRY VINE, the hop (*Humulus lupulus*) has an affinity for informal cottage gardens. Nothing so quickly or generously clothes a rough wooden arbor: the hop's rough stems can grow as much as 6" to 12" in a single day, reaching up to 20'. Its dark green leaves are almost heart-shaped, similar to small grape leaves. In late summer, the vine's loose flower clusters turn a bronzy amber. Orange fruits deep within the papery petals of the flowers give off the bitter yet pleasant aroma hops are known for.

As early as 1648, imported hops were in commercial production as a flavoring and preservative for beer. Settlers must have been relieved to discover the species growing wild, since the hop vine was indispensable for making barm, a yeasty residue of fermentation used to leaven bread. The flowers of this natural sedative were often stuffed into little "sleep pillows"; George Washington reputedly used one. So important was the hop vine in colonial life that when a family moved, the treasured vine moved with them. Even after its use as a household staple fell into decline, the adaptable vine's dense foliage was prized for shading verandahs from Maine to California.

To establish a screen or cover an arbor, plant roots 18" apart in loose, rich soil, in a sunny site. The hop's lax stems need support, anything around which the vines can

wrap themselves. Some old-timers grow this twining vine on a tall pole close to the side of the house, just as their parents and grandparents did. Hop vines also make an effective ground cover.

To maintain vigorous growth and discourage overwintering insects, cut the vine back and clear away debris in late fall, after several hard frosts. In early summer, spray the undersides of leaves with an insecticide once a week for three weeks. Alternatively, treat repeatedly with

a detergent spray (1 teaspoon detergent and a few drops of cooking oil to 1 quart of water) until insects disappear. To keep the hop vine from spreading on the ground, mow around it and place the vine where it cannot overrun other plantings.

## High Climbers

THE TENDRILS OF THE VIRGINIA creeper (*Parthenocissus quinquefolia*) are best suited to the sides of masonry buildings, city or country. Climbing as high as 60', Virginia creeper is similar in habit to the grapevine or clematis. In early fall, the long, coarsely toothed leaves change from

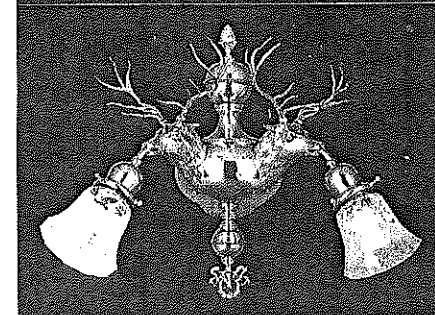
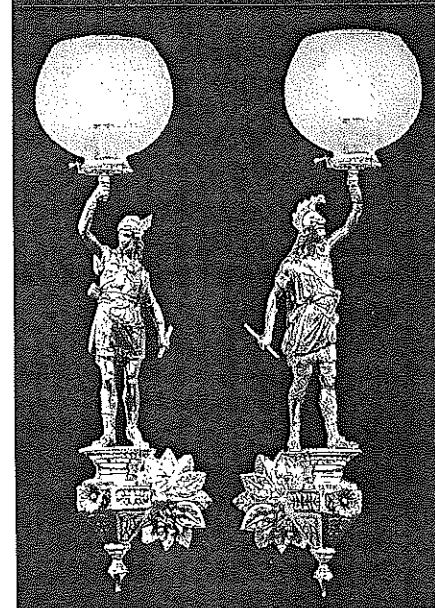
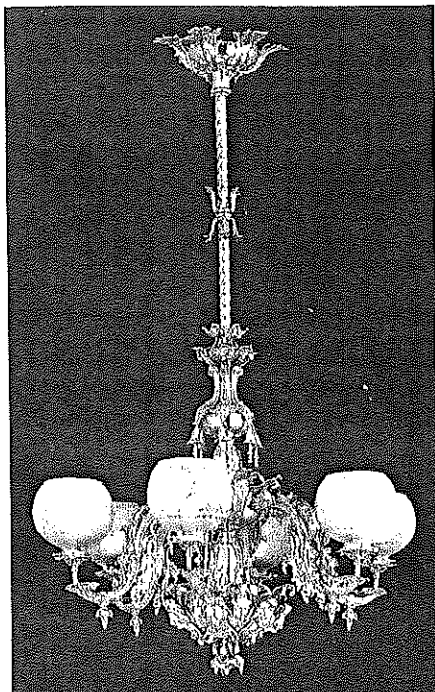
green to brilliant scarlet, creating a flaming backdrop for clusters of blue-black berries. This bright accent lasts into late fall, when most other plants have faded. Like the hop, Virginia creeper makes an excellent ground cover when not supported.

Two close relatives, Engelmann's ivy (*P. quinquefolia* 'Engelmannii') and Boston ivy (*P. tricuspidata*), are full-fledged town vines, favored for their ability to cling to stone or brick. Engelmann's ivy, an elegant variant first introduced in the late 19th century, bears smaller foliage than its wild cousin and is leathery in texture. The plant's tighter, less relaxed habit of growth gives it a more refined appearance. Less vigorous than Virginia creeper, Engelmann's ivy shows its versatility as a ground cover, a screen, and as a climber over stone walls or trellises.



Like many climbing vines, Virginia creeper turns vivid red in the fall. Inset: Birds are partial to the native vine's blue-black berries.





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The densely overlapping leaves of Boston ivy make it a city vine *par excellence*. Unaffected by dirt and pollution, it grows best on stonework and bricks, clinging tightly by means of small adhesive suckers. Introduced from Japan in 1862, Boston ivy's glory is its fall appearance, cloaked in a harmonious mixture of crimson and gold. Its purple-blue fruits are especially attractive to birds.

All of these climbing vines tolerate dry or wet conditions, sun



The fruit of the hop exudes a beery aroma.

or partial shade. For best results, set roots in moist but well-drained loamy soil, 3' apart. Prune woody stems in early spring to restrain or redirect growth, or to induce side branching. Propagate new vines from spring cuttings or from self-rooted stems.

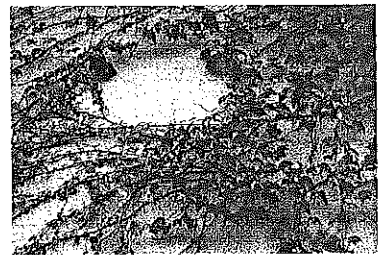
JO ANN GARDNER is the author of *The Heirloom Garden (Garden Way, 1992)*. She tends vines in rural Orangedale, Nova Scotia.

## VINES ON BUILDINGS

While vines can complement the old-house landscape, plantings should be carefully considered and controlled. Twining vines, like the hop, and vines with tendrils, like Virginia creeper, should be encouraged to grow on lattices anchored to the house, or on free-standing trellises or fences.

Climbing vines that attach themselves using adhesive suckers or root-like anchors should never be used on painted wood, clapboards, or shingles. Even if the vine is pulled away, these anchors will remain, weakening the integrity of the wood surface.

Most clinging vines are less of a threat to masonry buildings. Relatively harmless to sound brick or stone, the adhesive suckers on vines such as Boston ivy rarely attach permanently to mortar joints because of the vine's subtle movements. Vines that gain hold through root-like anchors, such as



Climbing vines can coexist for years with brick and mortar.

English ivy, should be kept off brick because they may penetrate and eventually split the mortar. Stone walls with relatively few mortar joints make the most durable surface for climbing vines. Assuming the foundation is sound, a stone wall will support a thriving vine forever.

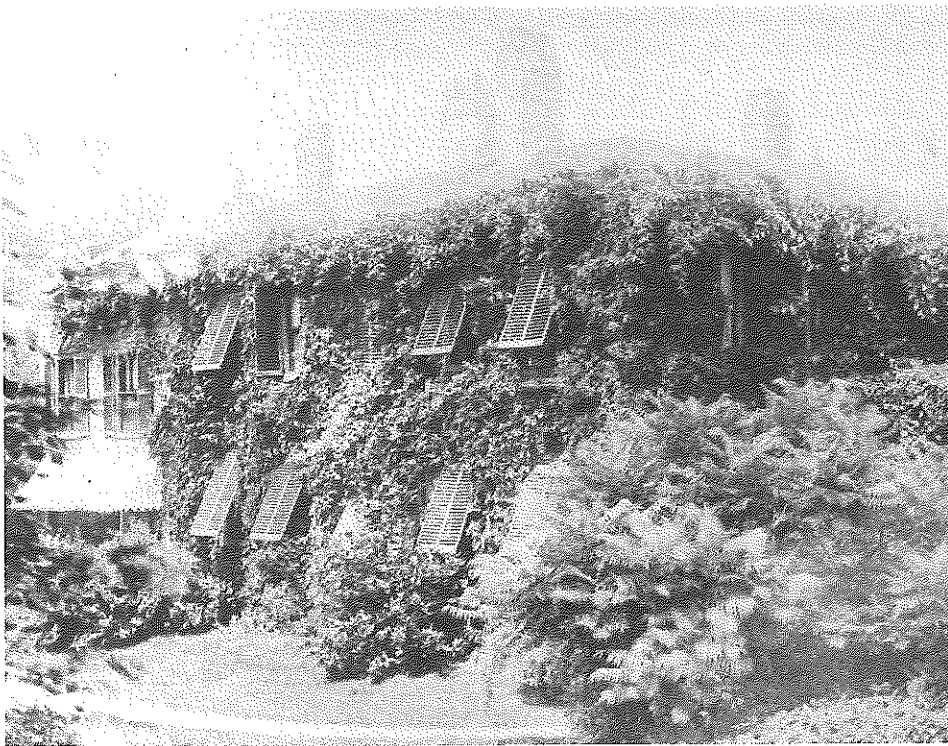
To remove a vine such as ivy safely from a wall, first cut the plant at the roots and allow it to dry for two or three weeks. Pull the dried vine carefully off in sections. Never pull live vines away from the wall, since this may damage the brick or mortar.

## SUPPLIERS

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## FAIRSTED

Frederick Law Olmsted  
National Historic Site  
Brookline, Massachusetts

In 1883, Frederick Law Olmsted Sr., noted landscape architect and planner, established his home and office in Brookline, Massachusetts. Olmsted's improvements to the two-acre site transformed the farm into a picturesque suburban estate, which he called Fairsted. Olmsted employed elements from the picturesque and pastoral styles, including an abundance of climbing vegetation on stone walls, trees, and buildings.

To help unify the architecture and the landscape Olmsted planted two twining vines, *Wisteria sinensis* (Chinese Wisteria) and *Actinidia arguta* (Bower Actinidia), which would cover the house. The vines masked the angularities of the building, and thus accomplished Olmsted's intent of obscuring the distinction between the natural and the manmade. The vines climbed profusely on the south side of the house, twining around waterspouts, window boxes, and shutters. Olmsted installed strapping to provide vine support, that ran vertically and horizontally along the facade.

The vines that covered Fairsted are an important visual and historic feature, reflecting Olmsted's interpretation of the ideal garden suburb and his landscape design principles. Unfortunately, the vines eventually contributed to the dete-

rioration of the clapboard house, necessitating that some alternative method be found to protect the building facade from future damage and while still supporting the historic plant material.

**Problem**

Vines can damage historic clapboard or masonry buildings in a number of ways. Roots growing near buildings retain moisture and can put pressure on foundations, displacing materials and providing entry points for water, insects, and rodents. The primary damage caused by all vines is due to moisture. The shade created by extensive vegetation cover prevents the sun from drying the covered wall, and also reduces the drying effect from air circulation. Moisture from condensation, rain water, and plant transpiration is thus slow to evaporate and creates an environment conducive to paint failure, wood rot, and deterioration of soft masonry. The continuous presence of moisture on masonry buildings can weaken mortar and cause structural deterioration. When water trapped in cracks and openings freezes, the ice expands—pressure that can further damage the masonry.

In addition, vines cause other forms of damage depending on their individual

*Where vegetation is essential to the integrity of a historic property, historically significant plant materials and other landscape features should be preserved and maintained while taking steps to protect and maintain historic buildings.*

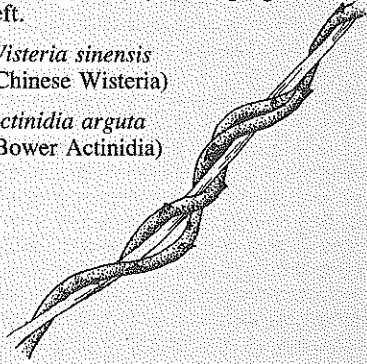
## Vine Types

### Twining

Vines may climb by twining from left to right or by twining right to left.

*Wisteria sinensis*  
(Chinese Wisteria)

*Actinidia arguta*  
(Bower Actinidia)

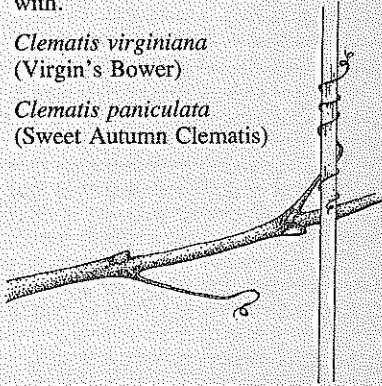


### Tendrils

The tendrils wrap themselves around anything that they come in contact with.

*Clematis virginiana*  
(Virgin's Bower)

*Clematis paniculata*  
(Sweet Autumn Clematis)

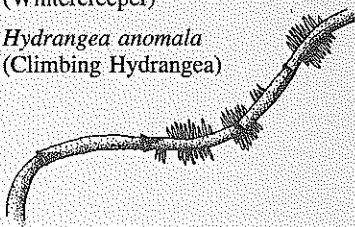


### Aerial

Small roots firmly attach the vine to either wood or masonry.

*Euonymus fortunei*  
(Wintercreeper)

*Hydrangea anomala*  
(Climbing Hydrangea)

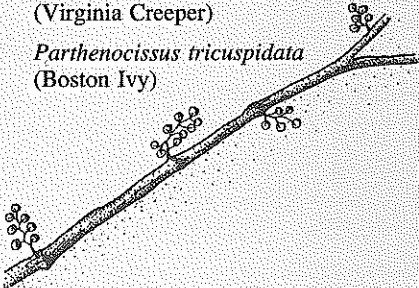


### Creeper

This vine clings by sending out small tendrils with adhesive discs that attach themselves to surfaces.

*Parthenocissus quinquefolia*  
(Virginia Creeper)

*Parthenocissus tricuspidata*  
(Boston Ivy)



growth habits. *Twining* vines climb by sending out shoots that wrap around objects and grow in both length and width. As the vine grows thicker, it can constrict these objects, causing features such as louver shutters to snap under the increasing pressure. Furthermore, the spreading shoots penetrate openings and crevices. In time, the growing vine can loosen and separate building materials.

Like twining vines, *tendrils* wrap around objects for support. Because they are actually extended leaves, tendrils do not grow in width, only in length. Both twining and tendril vines, however, can break weather seals on wooden facades, separating wood shingles and siding, as well as fascia and soffit boards on porches. Other vine types include *Aerial* vines which grow small roots along the length of the stem. These rootlets cling to the wall and can force their way into crevices. The fineness and density of the rootlets makes

removal difficult. *Creeping* vines have tiny adhesive pads that cling to the building surface. Commonly found on masonry brick buildings, creeping vines do not generally cause extensive damage to structures while growing, although they may abrade softer mortar. However, they attach themselves so thoroughly to the building surface that paint, mortar, and brick are likely to be damaged when the vines are removed.

In 1980, The National Park Service began structural restoration of the house at Fairsted. To facilitate this work, the historic vines were removed from the facade and cut back to the ground. Since the vines were both historic plant material and an important feature of the property, complete removal was avoided. The vines were kept at ground level, but pruned frequently to prevent reattachment to the house. This situation resulted in weakened plant growth and an appearance quite different from



Figure 1. Historic plant materials can be retained while restoration of the historic structure is underway. The *Wisteria* and *Actinidia* vines that were historically used by Olmsted, were cut back during the restoration of Fairsted in 1988. Photo by Charles Pepper, courtesy of the Olmsted National Historic Site.

Olmsted's intention (*see figure 1*). Furthermore, long-term frequent pruning risked a higher incidence of pest-related problems to the plants and restricted their natural climbing habit. It was therefore important to the public site that a new trellis system be devised that would protect both the historic vegetation and the historic structure, while reestablishing the appearance of a "vine clad mansion."

### Historic Fairsted Trellises

Development of a new trellis system began with research into the materials, techniques and hardware used in New England between 1880 and 1930, as well as specific investigation into the various techniques used at Fairsted during those years. Historically, the east elevation of the house had two trellis structures supporting *Wisteria sinensis* (Chinese Wisteria). Photographs from as early as 1884 show a wooden trellis system at the entry porch and a spiraled steel strapping system along the house facade (*see figure 2*). Remnants of these

systems, such as eyebolts and hooks, were found intact at several locations on the structure. The kitchen wall had an interesting trellis consisting of posts with protruding pegs located between windows. Holes in the post indicated that pegs could be added or removed depending on the growth of the plant.

### Solution

After investigating the various types of historic trellis systems at Fairsted, four criteria for the new trellis systems were established to address particular preservation issues. An ideal system would:

1. provide an appropriate historic appearance;
2. suit the specific vine growth characteristics;
3. minimize the impact of the anchorage and support structure of the trellis to the historic building facade; and,
4. provide direct access to the building for preservation and maintenance purposes.

In order to meet both the above criteria and also to test alternative solutions, four different trellis systems were designed and installed for use in a two-year test phase (*see figure 3*). The first system used spiraled steel strapping; the second, aircraft cable; and the third modular pipe. The fourth system combined strapping and piping.

### Installation and Monitoring

The experimental trellis systems were constructed and installed on the south and west elevations (where the historic plant material is located) in 1989, and have been monitored for the past two years (*see figure 6*). Plant growth and development, ease of removal, appearance, and effect on the historic structure are being observed and documented regularly. Some recommendations for modification have already been made.

The steel strapping system (system 1), although painted, has shown a great amount of rust. The use of galvanized steel, painted with a zinc oxide primer and a finish coat would have discour-



Figure 2. View of the west elevation at Fairsted which shows a steel strapping trellis system built as early as 1884. Photo courtesy of Olmsted National Historic Site.

Figure 3. The four experimental systems developed at the Olmsted National Historic Site, and some advantages and drawbacks to each.

### System 1—Spiraled Steel Strapping

#### Fabrication

Materials:  $\frac{1}{8}$ " x  $\frac{1}{2}$ " spiraled steel strapping, hooks, snap hooks, eyebolts, and F & M rings. The steel strapping trellis is modeled after the historic design (c. 1885) developed by Olmsted. Spiraled metal strapping were attached to the house by a series of hooks and metal eyebolts. The eyebolts for this system, as well as the attachment devices for the other trellis systems, are held at least 6" away from the house to allow for air circulation between the plant material, trellis system and building facade. The strapping was fed through intermediate F & M rings located at regular intervals vertically and horizontally along the side of the house.

#### Maintenance

The ends of the spiraled strapping are fitted with snap hooks so that the trellis system can be removed for maintenance purposes, thus creating a flexible trellis system.

#### Evaluation

The spiraled steel strapping is an appropriate support for the growth habit of twining vines. The metal strapping is also effective in recreating the historic appearance of the trellis, and is also the least visible of the systems. The steel, although treated with paint, has already shown a great amount of rust, so an alternative material should be considered.

### System 2—Aircraft Cable

#### Fabrication

Materials:  $\frac{3}{8}$ " aircraft cable, eyebolts, and hooks.  $\frac{3}{8}$ " aircraft cable was substituted for the spiraled strapping in the first system. A system of eyebolts and hooks was used to secure the aircraft cable to the house.

#### Maintenance

The cable system is similar to the spiral strapping system in that it is flexible. The aircraft cable is attached to the eyebolts with snap hooks that allow the wire and vine to be removed from the building facade without damaging the trellis system, the building, or the historic vegetation.

#### Evaluation

The texture and twist of the cable support and guide to the twining vines. Like the spiral strapping, the vines grow around the cable, so the structure is not visible. The weight of a mature vine growing on the cable will make removal and replacement difficult for one person on a ladder. A temporary pulley system might be used to aid in hoisting the vines back into place.

### System 3—Modular Pipe

#### Fabrication

Materials: galvanized metal pipe, fittings, eyebolts, and swivel sockets. This modular pipe system is composed of galvanized metal pipe and a series of pipe fittings. This system was hinged at the base to allow the rigid trellis structure to be tilted away from the house. The support pipes were anchored in the ground by inserting them in galvanized metal sleeves that were placed 4' below the ground surface and 6" away from the house. The top portion of the trellis structure was secured to the house by a bolt and clamp combination.

#### Maintenance

More than one person is required to remove this system. The rigid system folds out away from the house on the swivel sockets near the base of the house (see figure 4).

#### Evaluation

Although the rigid system allows the vegetation to remain stable, the pipe structure may also have problems with the weight of fully mature vines. The tilting frame may prove to be difficult to lift back into position. The twining vines do not provide enough coverage to conceal the structure completely.

### System 4—Combination

#### Fabrication

Materials: spiraled steel strapping, galvanized metal pipe, fittings, eyebolts, and swivel sockets. This solution is a combination of spiraled strapping, galvanized metal pipe and fittings. Eyebolts will separate the strapping from the supporting pipe structure. Swivel sockets near the base of the pipe structure allow the trellis to be tilted away from the house. This combination system provides a historic trellis appearance with the addition of rigid support. The vines are physically separated from the house, thus reducing potential damage to the facade.

#### Maintenance

The spiraled strapping can be unhooked from the pipe system for limited maintenance or the entire structure can be removed for more extensive repair.

#### Evaluation

The weight of a mature vine must also be considered in this solution. This pipe and strapping combination is not historically accurate in appearance. The twining vines cover the strapping, but the pipe structure behind is exposed.

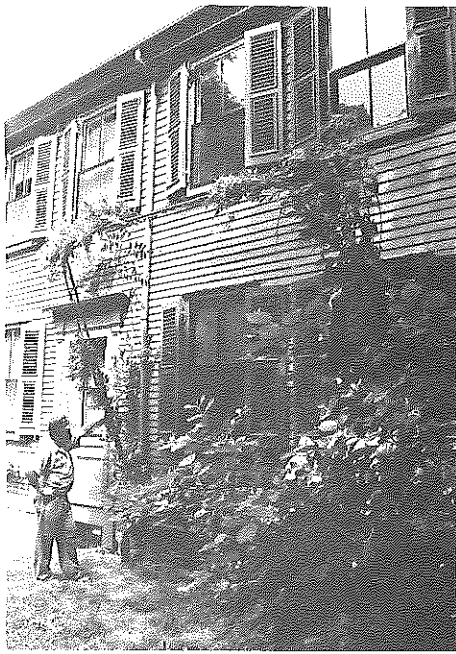


Figure 4. The pipe and strapping system, constructed with swivel sockets, allows the rigid support system to fold down away from the house. The strapping can also be removed from the pipe support for limited maintenance. Photo by Karen Day.

aged rapid rusting. The flexible aircraft cable (system 2), with the added weight of a mature vine will make removal and replacement difficult for one person. A temporary pulley system is recommended to aid in hoisting the vines back into place. The third design is a rigid modular pipe system (system 3). Although the rigidity of the system is advantageous to the stability of the vegetation, the weight of the vines may also be prohibitive for easy removal and replacement. The combination strapping and pipe system (system 4) does not recreate a historically accurate appearance. The system was designed in order to remove the vines on the strapping without removing the pipe supporting system. The vines growing on the strapping do not provide sufficient coverage to hide the pipe system behind. Furthermore, additional maintenance is required to keep the vines from growing on the pipe. After the multi-year test period is complete, one of the four systems will be selected, modified as needed, and installed to the east, south and west facades of the house (see figure 7).

## Conclusion

The trellis system solution will restore a feature that contributes to the unique character and appearance of the historic suburban estate, and thus reinforces the interpretation of the Olmsted National Historic Site. The systems discussed here were developed individually to meet the unique requirements of the property. This trellis development process, which considered the building appearance and historic character of the site in addition to the growth habits of the plant, historical trellis materials, and maintenance needs, can be applied to other sites with different needs and considerations. However, climbing vegetation should not be added to historic buildings if it did not occur historically since careful management and maintenance is required. The vines that covered Fairsted were an integral part of the historic character of the site. When vegetation is essential to the integrity of a historic property, historically significant plant materials and other landscape features should be preserved and maintained while taking steps to protect and maintain historic buildings.

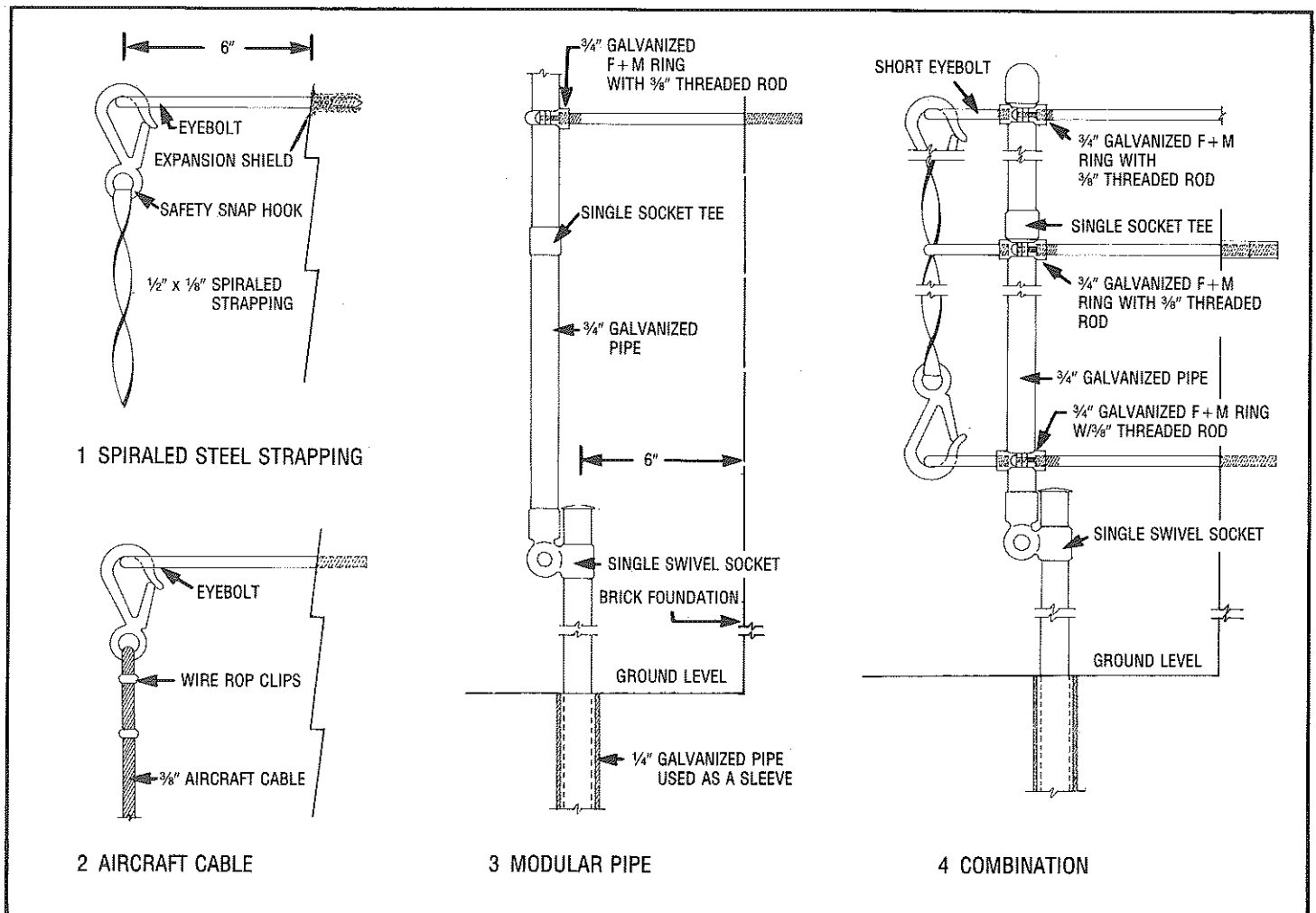


Figure 5. Details of the four experimental trellis systems. Drawings by Sharon Runner, National Park Service.

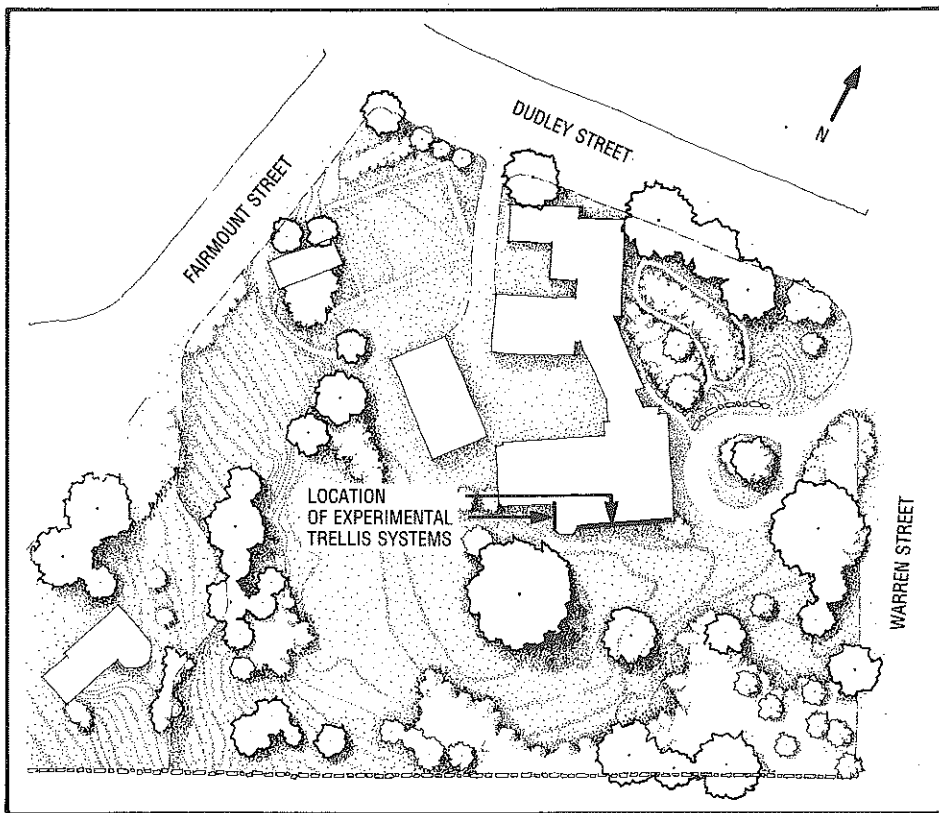


Figure 6. Site plan of Fairsted; the experimental trellis systems were installed on the south and west elevations. Drawing by Karen Day.

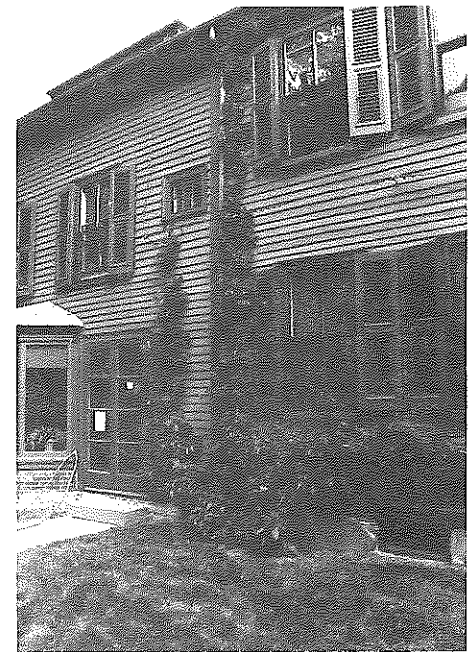


Figure 7. View of south facade, the experimental trellis systems have been in place for two growing seasons. Photo by Karen Day.

## PROJECT DATA

### Site:

Frederick Law Olmsted National  
Historic Site  
99 Warren Street  
Brookline, MA

### Owner:

National Park Service  
U.S. Department of the Interior  
Washington, DC

### Project Dates:

Spring 1989-Fall 1991

### Project Supervisor:

Charles Pepper  
Supervisory Horticulturist

### Project costs:

Materials: \$5,000

### Materials:

**System #1**  
spiraled steel strapping  
hooks  
snap hooks  
eyebolts  
F & M rings

### System #2

air craft cable 3/8"  
eyebolts  
hooks

### System #3

galvanized metal pipe  
pipe fittings  
galvanized metal sleeves  
bolt and clamp combo

### System #4:

spiraled steel strapping  
galvanized metal pipe  
fittings  
eyebolts  
swivel sockets

This PRESERVATION TECH NOTE was prepared by the National Park Service. Charles E. Fisher, Preservation Assistance Division, National Park Service, serves as Technical Editor of the series. Thanks go to Charles Pepper, Supervisory Horticulturist, Frederick Law Olmsted National Historic Site, for providing information on the project and reviewing the draft. Special thanks go to Lauren Meier, Ward Jandl, Michael Auer, and Tom Jester, of the Preservation Assistance Division, National Park Service, for their review and comments on the draft. Cover Photo: Historic view of south facade of "Fairsted". Courtesy of the Frederick Law Olmsted National Historic Site.

Preservation TECH NOTES are designed to provide practical information on innovative techniques and practices for successfully maintaining and preserving cultural resources. All techniques and practices described herein conform to established National Park

Service policies, procedures and standards. This Tech Note was prepared pursuant to the National Preservation Act Amendment of 1980, which direct the Secretary of the Interior to develop and make available to government agencies and individuals information concerning professional methods and techniques for the preservation of historic properties.

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ACTINIDIA SP. (HARDY KIWI)

KIWI FAMILY

VINE on north facade of Mansard  
ELONG also has this vine on house

via Charlie Pepper  
12 Sept 2000



## SOLUTIONS

# WAYWARD WISTERIA

Cutting back isn't hard: Define the structure, and leave the flower buds

Nothing goes from restrained order to raging chaos faster than a wisteria vine. And come spring, few plants disappoint us more than a wisteria that won't bloom. Fortunately, both problems have a remedy: Regular pruning makes for better-looking vines, and it's probably the single most important factor in helping—or hindering—flowering. When treated to seasonal trims, young plants will come into bloom earlier in life (though many can take seven or more years to do it), and established vines will have larger, more visible flower trusses that are not lost in a tangle of last year's new growth.

Pruning wisteria is easy to understand (and to do) if you stop worrying and just adopt two rules. Number one: Don't be timid with your vine. Wisteria is a rambunctious plant and needs to be cut back several times a year, not just once. Rule two: If you've missed a pruning opportunity, or several, you'll need to do a little catch-up work. Now is the time to start.

PHOTOGRAPHS BY DAN BIGELOW



**A CUT ABOVE** At the Brooklyn Botanic Garden, Daniel Ryniec prunes 60-year-old wisteria in January. Those with less experienced eyes can wait until flower buds are easier to see. Below: Before pruning.

### Make big cuts early

If the top of your plant has become seriously overgrown, it's best to prune it in winter, at the latest early spring, before new leaves cover the vines and obscure the stems and branches. Remember, you're creating structure, and a good model to follow is one main central trunk, topped with just a few fairly straight main branches, spaced at least a foot apart. Remove any smaller branches that are twisting around the larger ones you've chosen to let grow. For big branches you'll need a saw, but for most of the cuts a lopper will do.

If the tangle is hopeless, you can simply start over, cutting it all back to the main trunk and rebuilding your structure from scratch. A severe pruning like that may terrify you, but the plant will reestablish itself with astonishing vigor (although it may take

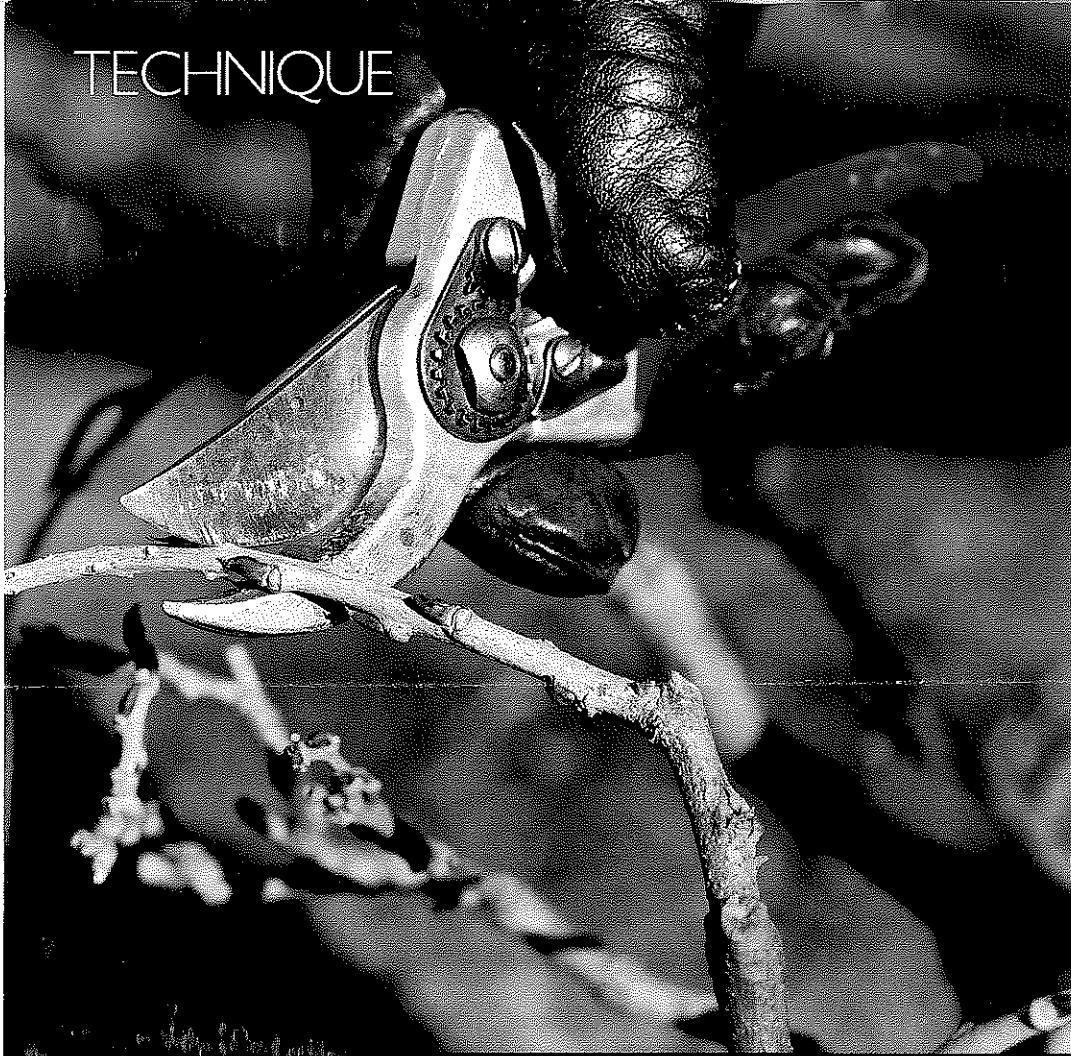
two to three seasons to flower again). Now you can train the new limbs to grow where you want them, cutting everything else off.

### Spadework

Spring is also the time to dig out errant root sprouts. The roots of some wisteria plants are very unruly. If your plant sends up lots of shoots from the base of the trunk, don't just clip or mow them—that only aggravates the problem. You must dig them up, tracing the

Wisteria is a rambunctious vine that truly needs to be cut back at least several times a year—starting now

■ Edited by Jack Ruttle



**THIS BUD'S FOR YOU** Pruning all but three to five of the fat flower buds on each branch allows the vine to concentrate its energy on large clusters in late spring, below right. Below left: Removing seedpods.

shoots sometimes several feet back to the underground root; then clip them at the source. Unless you dig them out, the wisteria will just send up more shoots right behind your cut, and those shoots will continue to spread and send up more sprouts farther afield. After a few years you'll have a network of shoots running along at ground level or just below, with sprouts springing up at will, draining energy from the main plant. Not a pretty picture. Removing these shoots will scarcely slow the plant down. Doing the job halfway, however, will stimulate the sprouts that remain to grow even more vigorously. So root them out.

#### A summer shave

Regular maintenance is the key to peaceful cohabitation with wisteria. Once the top is under control, sum-

mer pruning keeps it that way; happily, pruning in future years amounts to pretty light work. Your saw and heavy loppers can stay clean and dry in the toolroom. Summer pruning is also the best way to push the plant into flowering at a younger age.

About two months after the wisteria



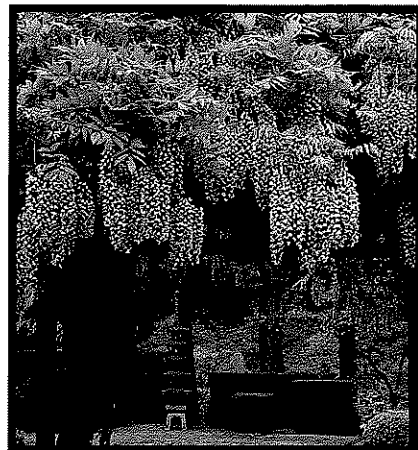
Once the top is under control, summer pruning will keep it that way. Future pruning is pretty light work

leaves out (or, if it's a mature, flowering plant, after it has bloomed), cut each side shoot back to its sixth leaf. That is, you should leave a stub—usually 10 to 12 inches long—with six leaves. Later in the summer, as new shoots become overly long and begin to get in your way or to twist around each other, shorten these as well. Leave a stub with only four to six leaves beyond the first cut.

#### A winter trim

In late winter or early spring, trim the plant again. Shorten the side branches back to the cuts you made in your first summer pruning; they should be no more than 12 inches long. These short side branches will have many fat flower buds if the plant is mature enough to start flowering. If you've planted the wisteria in a sunny spot and pruned wisely, you should be blessed with lovely lavender tresses in a few months. —JR

For information about pruning tools, see INFO, page 107.



ALLAN HANDELL

## **Eliminate Poison Ivy**

Rampant poison ivy will inhibit public enjoyment the newly reclaimed open spaces until it is brought under control. Vines growing on trees were cut at the base in the fall of 1999. With the permission of the Waltham Conservation Commission, areas of poison ivy throughout the historic core were treated with one application of foliar spray herbicide in July 2000.

### **Standards**

- Refer to the attached letter from Northern Tree Service which describes the make-up of the herbicide used. Round-Up is an acceptable alternative herbicide for the control of poison ivy.
- Use of herbicides at the base of beech trees is not recommended, for it could affect the health of the tree.

### **Procedure and Schedule**

2000-2002 or 2003

- Once annually, foliar spray should be applied to mature poison ivy leaves in a comprehensive application throughout the historic core, taking extreme care to prevent spray from affecting surrounding areas.
- As needed, spot treat poison ivy leaves with Round Up in the vicinity of the house
- Cut poison ivy vines at the base of trees as needed.

2003 and beyond

- As needed, spot treat with foliar spray poison ivy throughout the historic core.
- Cut poison ivy vines at the base of trees as needed.

# Northern Tree Service Inc.

P.O. BOX 790 - PALMER, MASSACHUSETTS 01069 - (413) 596-6132 (800) 232-6132 FAX (413) 283-5132

October 23, 1999

Anne Clifford  
Director, Robert Treat Paine Estate  
Robert Treat Paine Estates  
Waltham, Ma. 02452

Anne:

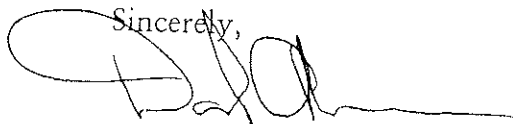
Below please find the specifications for the Foliar treatment of the resprout in the mowed areas at the Paine Estates in Waltham. The work will be performed late June or early July 2000. This will allow sufficient time for the plants to resprout so there will be enough leaf surface to be able to treat and get good control of the unwanted vegetation.

The Herbicides we will be using are Accord and Escort. These two herbicides are both approved by the EPA and Commonwealth of Massachusetts for use in sensitive areas. The rate these products will be used at are 4% Accord and 2oz. per 100 gals. for the Escort, a surfactant is also added to aid in absorption into the plant.

At present there are no regulations that require use to notify or post the area we will be treating. In my opinion it would be a good idea to post this area for a period of twenty-four hour with signs similar to the ones used by lawn care professionals. We put them up the day of application and ask one of your staff to remove them the next day.

The price for this work is 2,619.83. This will include labor, equipment, and material. If you have any additional questions please feel free to call.

Sincerely,



David O'Brien, MCA  
Vegetation Management Specialist

## **Maintain Lawns in the Vicinity of the House**

Lawns in the immediate vicinity of the house are intended to present a well-maintained appearance appropriate for a 19<sup>th</sup>-century country estate and for its current use as a museum and assembly space.

### **Standards**

- Follow lawn care recommendations in the Department of Environmental Management's Preservation Guidelines for Municipally Owned Historical Burial Grounds and Cemeteries.

### **Procedure and Schedule**

- Can be mown to an average height of 3 inches.
- Mow lawn weekly or biweekly as needed. Weed whips (rotating nylon filament trimmers) may be carefully used near house and stone walls of terrace to avoid damage.
- Water lawn as needed to maintain healthy appearance.
- Fertilize lawn twice annually according to soil tests.
- Overseed bare areas of lawn as needed
- Aerate lawn twice annually in spring and late summer or early fall. Do not aerate when the soil is extremely wet or dry.
- Apply ground limestone every 3 to 5 years as determined by soil tests to bring lawn areas to the preferred 6.0 - 6.5 pH level. If a lime application is necessary apply 2-3 weeks prior to fertilizing.

PRESERVATION GUIDELINES  
FOR MUNICIPALLY OWNED  
HISTORIC BURIAL GROUNDS AND CEMETERIES

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL MANAGEMENT  
HISTORIC CEMETERIES PRESERVATION INITIATIVE



WALKER-KLUESING DESIGN GROUP

SARA B. CHASE  
OCMULGEE ASSOCIATES, INC.  
CARL A. CATHCART

JOYCE CLEMENTS  
SUZANNE SPENCER-WOOD

CANDACE JENKINS  
SHARY PAGE BERG

## Lawns Issues

The primary ground cover on all sites is grass. It is often in poor condition with areas of erosion, sloughing, bare spots, weeds and depressions. Erosion and sloughing of some of the steep banks is apparently due to concentrated pedestrian circulation, sheet runoff, settlement of steep slopes and/or steep sloped mound tombs. Bare spots are typically related to concentrated pedestrian circulation, root competition from trees and/or dryness. Weed intrusion is primarily related to dryness and low fertility levels. Heavy shade conditions also impact lawn quality. Most depressions are related to earth settlement and tree removals.

Moss is present in the lawn areas on many of these sites. In lawns, the presence of moss is an indication of wet soil, poor soil in need of fertilizing, very acid soil or a combination of these factors. In the areas where it is present on these properties, wet soil does not appear to be the issue. Most New England soils are acidic, but not to the degree that moss is present. More often than not, moss on these sites is an indication that a soil has low light and fertility levels, particularly a nitrogen deficiency.

Most lawn areas need renovation, including proper pH level and fertilization. Maintaining a healthy lawn cover with adequate light, moisture and nutrients, and good maintenance procedures would reduce bare spots, weeds, moss and erosion on all sites.

## Recommendations

Rehabilitating existing lawn areas: The rehabilitation of lawn areas in historic burial grounds and cemeteries needs to be done with more care than any other lawn because of the grave markers and potential bone fragments at or just below the surface of the ground. Weeds and other undesirable species should be removed. The soil should be loosened by power rake or vigorous hand raking. Rototilling is not recommended because of potential damage. Fertilizer and lime should be added as recommended by soil analysis. The fertilizer choice should be checked with a stone conservator as recommended herein under the discussion of soils.

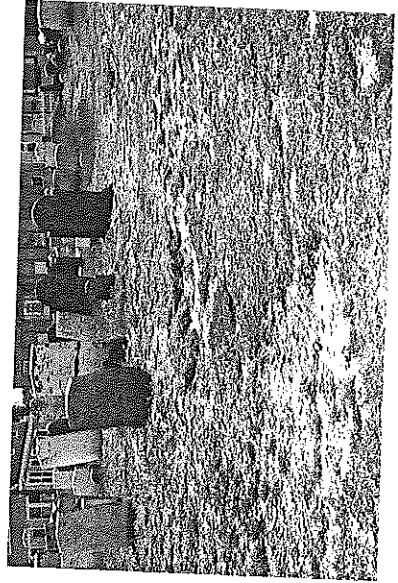
Depressions that inhibit proper drainage of an area should be filled with topsoil to blend smoothly into surrounding grades. Care should be exercised with mounded or raised areas and regrading should be avoided or limited to avoid potential damage to subsurface elements. Bare spots should be topdressed, seeded and rolled. Water must be provided to maintain a sufficient moisture level to establish grass. The best time to plant a lawn is between August 15 and October 1 to reduce weed infestation and maintenance requirements. If it is necessary to plant in the spring, plant as soon as the ground can be worked and when the soil is free of excess moisture.

Installation of new lawn areas: In general sod is recommended in areas that need immediate use and seed is recommended for all other areas. Most seed mixes should incorporate improved, low maintenance, slow growing, drought resistant and shade tolerant seed cultivar mixes of Kentucky Bluegrass and Fescue.

*Erosion, Old Parish Burying Ground, Rockport*

Watering: Water lawns as necessary to maintain normal growth and color. Soak the entire root area. Avoid light, frequent sprinklings. Watering lawns during the dry months of summer, does not appear to be a realistic possibility at this time given the current budget, maintenance crew size and limited sources of water at most sites.

Mowing: Mow to an average height of 3 inches. The most serious issue is the routine removal of grass in the immediate vicinity of gravestones and tombs. Power mowers can scar and break stones. The types of stone used in older gravestones tend to be softer and more easily damaged than granite. The best current solution is to mow with lawn mowers to within twelve inches of gravestones and tombs and then use weed whips [rotating nylon filament trimmers] to trim the remaining area. The use of weed whips is permissible at granite and brick, possibly slate, but not marble markers. Metal hand trimmers should not be used because they can abrade stone. At the marble gravestones, and perhaps slate, consideration should be given to removing grass from areas around the bases of the stones. With most maintenance crew staffing, hand trimming is not feasible nor is the removal of lawn by hand to maintain a vegetative free zone adjacent to gravestones.



**Frequency of Mowing:** An ideal schedule would include: mowing every 5 days from the beginning of the season to mid June; every 10 days from Mid June to mid August; and every 5 days from Mid August to the end of the season. Mowing just once or twice a year has some appeal in grounds with a low visitor population. However, the removal of grass adjacent to gravestones would be more difficult with longer and thicker grass blades, which in turn could potentially cause more damage to gravestones.

**Weed, Disease and Pest Control:** The use of salt, chemical weed killers as well as insect and disease sprays should be discouraged to prevent potential damage to gravestones. Many of these materials contain salts and acids which can be damaging to marble and limestone markers. When chemical controls are recommended, the formula should be checked with a stone conservator before use. Provide appropriate pesticide application in late spring and early fall, if necessary. Do not treat a new lawn until its second year of growth. Do not burn grass in a historic burial ground or cemetery.

**Rolling:** Roll lawn areas in the spring as necessary to repair frost heaving irregularities caused during the winter. Use a light roller and roll the lawn when the soil is fairly dry, and freezing weather has passed.

*Lawn mowed infrequently,  
East Parish Burial Ground, Newton*



**Aeration:** In sites with heavy visitation, aerate compacted lawn areas twice a year during the spring and late summer or early fall. Tines should not penetrate more than a 3 inch depth to protect buried resources. Do not aerate when the soil is extremely wet or dry.

#### **Soils Issues**

**Soil Tests:** Soil analysis and testing helps determine the proper quantity and ratio of nutrients and other additives to improve a soil. Tests for pH and fertility levels should be made every 3 to 5 years to determine fertility changes made with basic treatments and to give a bench mark for further soil improvements. It typically also takes 3 to 5 years for the soil and the basic treatments to reach an equilibrium. Testing can be performed at places like the soils laboratory at the University of Massachusetts.

**Liming:** Lime serves several important functions. It is of particular value in correcting the acidity of the soil. It also changes the structure of the soil, hastens bacterial action in the soil, aids in the liberation of plant foods which otherwise remain in the soil in unavailable form, hastens the decomposition of organic matter and supplies a small amount of calcium, which is one of the essential plant foods. By reducing the acidic nature of the soil, lime also helps protect in ground marble and limestone markers which are susceptible to acid damage.



#### *Recommendations*

Ground limestone should be applied every 3 to 5 years as determined by soil test results to bring lawn areas to the preferred 6.0-6.5 pH level. If a lime application is necessary, apply it 2 to 3 weeks prior to fertilizing. The soil pH must be at the proper level to make the benefits of a fertilizer available to plants. Lime should not be used in combination with animal manures or with nitrogenous fertilizers, as it causes the rapid release of ammonia. A fall application of lime provides time for it to break down in the soil before spring growth.

When applying lime for new lawn construction, it should be spread over the surface of the ground and thoroughly mixed with the upper few inches of soil. The rate of application depends upon the form in which the lime is applied and the texture of the soil. The rate of application of ground limestone should be determined by soil testing and should not exceed 75 pounds per 1,000 square feet at any one time. For new lawns lime should be applied either in early spring or late fall, with early spring [April] preferred. On established lawns or under trees, lime should only be surface applied so as not to disturb below ground elements or roots.

**Fertilizing:** Supplemental fertilizer improves vegetative health and vigor in a short period of time. Lawns and trees are both heavy consumers of nitrogen and they compete for it. Because nitrogen leaches from the soil, it should be applied annually. Application methods are different for trees and grass. If fertilizer is applied on the surface, the grass absorbs most of it.

Soil tests are required to determine fertilization needs. Lawn areas should be fertilized a minimum of twice a year to maintain a healthy lawn. Light, frequent applications of readily available Nitrogen fertilizers are preferred over heavy, infrequent applications. Lawns in this area generally require 0.5 pounds of Nitrogen per 1,000 square feet per growing month. Fertilizer should be applied with a mechanical spreader when turf is dry. This work could be either contracted out or performed by maintenance crews.

All trees should receive an annual application of fertilizer to sustain a reasonable level of health. Fertilizing with a slow release fertilizer with a ratio of 3-1-1 will not only improve the health but will also prolong the life of a tree. Trees should be subsurface fertilized to a depth of 12" at least every other year during the growing season, with Spring or Fall preferred. This could be contracted at the same time as pruning.

The chemical formulation of all fertilizers proposed for use should be checked by a stone conservator prior to use to prevent potential damage to gravestones and other artifacts. Many fertilizers are acidic which is detrimental to marble and limestone. Ideally a nonacidic, slow release, organic fertilizer should be used to reduce the potential conflict between stone conservation and the desire to obtain healthy vegetation.

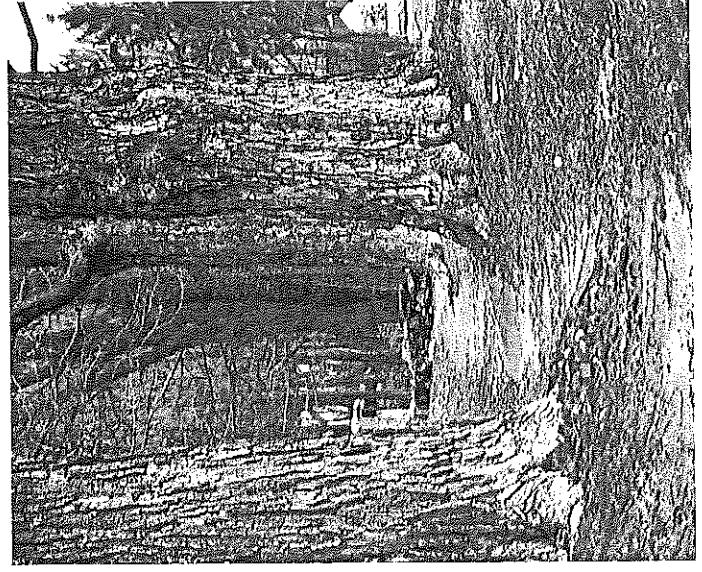
#### ACCESS AND SECURITY Pedestrian and Universal Access

##### *Issues*

All sites have pedestrian access, but few offer universal accessibility because of slope considerations, absence of paths, and/or the condition and narrowness of paths. The widths of paved paths vary, but tend to be in the 30 to 36 inch wide range. These and historic impediments make it virtually impossible for them to be completely universally accessible.

##### *Recommendations*

Universally accessible improvements should be made where feasible and where visitor demand merits such improvements. Gates need to have at least a 34" clear opening to be considered universally accessible and paths should be at least 48" wide to meet accessibility requirements.



*Deteriorated path, Old Cemetery, Spencer*

# Using Lime and Fertilizer in the Home Landscape

The recommendations provided on your soil test have hopefully been written in a way that is both understandable and convenient for you to use. It is difficult to express these in a way that matches every individual's preference. Some wish to use only natural soil amendments. Others request recommendations in terms of soluble synthetic fertilizers. Most soil tests state the number of pounds of nutrient to apply per given area (to be incorporated through a specified depth). In home gardens the small amounts recommended may be difficult to weigh accurately. It is often much easier to apply a volume of fertilizer (cup, liter, etc.). Your soil test will state the amounts of Nitrogen, Phosphorus, and Potassium recommended for your crop in terms of lbs per specified soil area (or volume). It will then provide you with one way of supplying these nutrients. Use the following tables as an aid in implementing this recommendation or to devise alternatives based on your basic N, P, K soil test recommendation.

## Fertilizer Products and Their Properties

Table 1 converts weights to volumes for several fertilizer groups. For example, if your soil test recommendation calls for 3 lbs Bone Meal, under Organic Meals and Blends you find that a one cup measure holds 1/3 lb of Bone Meal. That means 3 cups would hold 1 lb, and 9 cups would hold 3 lbs. One could measure out 9 cups or use a cut-off 2 liter soda container, which also holds 3 lbs of Bone Meal. When measuring volumes scoop the material and level the container top (do not pack).

Table 1. Density Equivalents

<u>Fertilizer Groups</u>	<u>Density Units</u>			
	grams/cc	lbs/cup	lbs/2 liters	lbs/gal (oz/cup)
Organic Meals, Blends, and Wood Ash	0.7	1/3	3	6
Ground Rock Dusts (ex. Lime, Rock Phosphate, Greensand)	1.4	3/4	6	12
Coarse and Medium Granulated Synthetic Blends (ex. 5-10-10 graden fertilizer)	1.0	1/2	4.5	8.5
Fine Granulated and Flaked Synthetic Blends (ex. many turf fertilizers)	0.7	1/3	3	6
Composts	0.35	1/6	1.5	3
Powdered Sulfur	1.0	1/2	4.5	8.5
Urea and Other High Nitrogen Fertilizers	0.80	1/3	3.5	7

### Some Convenient Containers for Measuring Fertilizers

12 oz Coffee Can = 1 liter

Cut-off 2 liter Soda Bottle = 2 liters

Dry Wall Compound Bucket = 5 gallons

Cut-off 1/2 gallon Milk Container = 1/2 gallon

Kitchen Measuring Cup = Graduated

## SUPPLYING INDIVIDUAL NUTRIENTS

If your soil test calls for a quantity of nitrogen, phosphorus, or potassium expressed in fractions of a pound per 100 square feet, you may use one of the combinations listed below to meet that recommendation.

### **1/4 lb nitrogen (N):**

1 bushel (1.25 cubic feet) well-rotted or composted manure plus 1 lb dried blood (12-0-0)

**OR**

3 to 4 lbs dried blood (12-0-0)

**OR**

1/2 lb urea (42-0-0)

### **1/4 lb phosphorus (P<sub>2</sub>O<sub>5</sub>)**

3 to 4 lbs bone meal (0-12-0)

**OR**

1/2 lb triple superphosphate (0-45-0)

### **1/4 lb potassium (K<sub>2</sub>O)**

4 to 5 lbs wood ash (0-0-5) (use only if soil pH is less than 6.3 and reduce lime recommendation by 3 to 4 lbs)

**OR**

1/2 lb muriate of potash (0-0-60) or potassium sulfate (0-0-50) (potassium sulfate is preferred but is more difficult to find)

If recommendation calls for 1/2 lb of nutrient, simply double the quantity recommended for 1/4 lb.

For annual flowers use 1/2 the amount recommended for vegetables.

## RESULTS AND INTERPRETATION OF SOIL TEST

The goal of soil testing is to provide guidelines for the efficient use of soil amendments, such as lime and fertilizer. Those provided with your soil test are the best now available for the crop chosen. Problems directly related to disease, insects, and to some extent weather and cultural practices can not be addressed by a soil test.

**The Soil Sample** - One of the most important steps in soil testing is obtaining the soil sample. It should represent the soil in which the plants are or will be growing. Randomly take several small samples across the area of concern, through a depth that contains or will contain the bulk of the plant's roots. A poor sample will result in bad recommendations.

### SOIL TEST RESULTS

**Soil pH, Buffer pH, and pH adjustments** - Soil pH is a measure of the soil's acidity and is a primary factor in plant growth. When pH is maintained at the proper level for a given crop, plants nutrients are at maximum availability, toxic elements are often at reduced availability, and beneficial soil organisms are most active. Most plants prefer a soil pH between 5.5 and 7.5 and the majority do best in the middle part of this range. Some notable acid-loving exceptions are blueberries, potatoes, and rhododendrons.

Due to the climate and rock-types in which the soils of New England have formed, soils here tend to be naturally very acidic (4.5-5.5). For this reason they must often be amended with materials capable of raising the pH. Many products are available to accomplish this, but ground limestone is the most common. Lime recommendations are made in its terms.

**Buffer pH** is a measure of the soil's capacity to resist pH change after lime has been added. Two soils with the same soil pH may have quite different buffer pH's, and thus one will require significantly more limestone than the other to obtain an optimal soil pH. The extent to which the buffer pH is lower than 6.8 is proportional to the amount of limestone needed.

Occasionally soil pH must be lowered, because either the plant requires acid soil, or the soil was previously over-limed. Incorporating elemental sulfur is the most effective way to lower soil pH. In the soil the sulfur oxidizes to sulfuric acid. One to two pounds of sulfur will lower the pH of most New England soils about 0.5 unit. Unfortunately, sulfur is rarely available in garden centers. Contact the Soil Lab for options.

**Cation Exchange Capacity and Percentage Base Saturation** - Cation exchange capacity (CEC) is an important measure of the soil's ability to retain and to supply nutrients. The bulk of this capacity in limed New England soils resides in finely divided soil organic matter. A smaller contribution comes from the soil's clay particles. The basic nutrient cations (positively charged ions) of Calcium ( $\text{Ca}^{++}$ ), Magnesium ( $\text{Mg}^{++}$ ), and Potassium ( $\text{K}^+$ ), and the acidic cations of Aluminum and Hydrogen account for nearly all the adsorbed cations in the soil. Very sandy soils, low in organic matter, commonly have CEC's less than 5. New England soils with very high CEC's (greater than 40) are invariably rich in organic matter. A CEC between 10 and 15 is typical and usually adequate.

CEC is important because it represents the primary soil reservoir of readily available Potassium, Calcium, Magnesium and several micronutrients. It also helps to prevent their leaching. The ease with which a plant gains access to these nutrients depends somewhat on the relative percentages of the adsorbed cations. For this reason it is suggested that percentage saturation levels be held within loosely defined ranges. For example, a soil with base saturations of Calcium 70%, Magnesium 12% and Potassium 4% would be considered balanced for most crops and has a soil pH of about 6.5.

### Individual Nutrients

**Nitrogen (N)** - Nitrogen is essential to nearly every aspect of plant growth. Nitrogen is absorbed from the soil as nitrate ( $\text{NO}_3^-$ ) and ammonium ( $\text{NH}_4^+$ ). This soil test estimates their current levels. Fertilizer recommendations are not generally made on the basis of these measurements because their levels can fluctuate greatly with soil and weather conditions over short periods of time. Instead, they are used to assess extremes of nitrogen fertility. For example, very high ammonium levels can be toxic to the roots of many plants, particularly if the soil pH is above 7. Very high levels of either form may coincide with fertilizer "burn." Recommendations are made on the presumptions that very little nitrogen remains in the soil after the growing season and that most crops require between 1 and 4 lbs of nitrogen per 1000 square feet per year. Adjustments are often made for soils recently or continuously supplied with manure or compost, which contain nitrogen that will be released during the growing season.

**Phosphorus (P) or Phosphorus Pentoxide ( $\text{P}_2\text{O}_5$ )** - Among other important functions, phosphorus provides plants with a means of using the energy harnessed by photosynthesis to drive its metabolism. A deficiency of this nutrient can lead to impaired vegetative growth, weak root systems, and fruit and seed of poor quality and low yield. Soil phosphorus exists in a wide range of forms. Some is present as part of soil organic matter and becomes available to plants as the organic matter decomposes. Most inorganic soil Phosphorus is bound tightly to the surface of soil mineral particles. Warm, moist, well aerated soils at about pH 6.5 optimize the release of both these forms. Plants require fairly large quantities of phosphorus, but the levels of phosphorus available to plant roots at any one time is quite low. Soil tests attempt to assess the soil's ability to supply phosphorus from bound forms during the growing season.

**Potassium (K) or Potash (K<sub>2</sub>O)** - Potassium rivals nitrogen as the nutrient element absorbed in greatest amounts by plants. Like nitrogen, a relatively large proportion of plant-available potassium is taken up by crops each growing season. Plants deficient in potassium are unable to utilize nitrogen and water efficiently, and are more susceptible to disease. Most available potassium exists as an exchangeable cation (see above). The slow release of potassium from native soil minerals can replenish some of the potassium lost by crop removal and leaching. The ability, however, is limited and variable. Fertilization is often necessary to maintain optimum yields.

**Calcium (Ca)** - Calcium is essential in the proper functioning of plant cell walls and membranes. Sufficient calcium must also be present in actively growing plant parts, especially storage organs such as fruits and roots. Properly limed soils with a constant and adequate moisture will normally supply sufficient calcium to plants. High humidity and poor soil drainage hinder calcium movement into these plant parts and should be avoided.

**Magnesium (Mg)** - Magnesium acts together with phosphorus to drive plant metabolism and is part of chlorophyll, a vital substance for photosynthesis. Like Calcium, Magnesium is ordinarily supplied through liming. Low magnesium levels in many soils will normally not cause problems, provided the exchangeable cations (see above) are in good balance. If Mg levels are low and lime is required, dolomitic lime (rich in Mg) will be recommended. If Mg is low and lime is not required, Epsom salt (magnesium sulfate) may be incorporated at a rate of 5-10 lbs/1000 square feet.

**Micronutrients** - The micronutrients are elements essential to plants, but required in very small amounts. In most properly limed soils they are available in sufficient quantities. Five of these (iron, manganese, zinc, copper, and boron) are tested routinely. Micronutrient fertilizer recommendations are not available. Extremely high values, however, are noted.

**Aluminum** - Aluminum is not an essential nutrient for plants. At elevated levels it can be extremely toxic to plant roots and limit the plant's ability to take up phosphorus. Extractable aluminum increases greatly at soil pH's below 5.5. Proper liming, however, will lower aluminum to acceptable levels. Aluminum sensitivity varies greatly with plant type. Acid-loving plants, such as rhododendrons, can tolerate very high aluminum levels. Lettuce, carrots and beets are very sensitive. Hydrangea, a non-sensitive plant, produces blue flowers at low pH and pink flowers at high pH due to the effect of aluminum on pigment formation.

**Toxic Heavy Metals** - This laboratory routinely tests lead (Pb) and cadmium (Cd). Lead is naturally present in soils in the range of 15 to 40 parts lead per million parts soil (ppm). At these levels it presents no danger to people or plants. Soil pollution with lead-based paints and the tetraethyl lead of past automotive fuels have increased soil lead levels to several thousand ppm in some places. Unless the total lead level in your soil exceeds 150 ppm, it is simply reported as low and can be considered safe (assuming the sample submitted was representative of the area of concern). Values above 300 ppm are potentially dangerous to people. In such cases consult the separate insert on soil lead levels.

Cadmium is extremely toxic to both plants and animals. It is naturally present in soils at safely low levels (less than 1 ppm). Industrial discharges of cadmium, however, often cause municipal sewage sludge to contain elevated levels of cadmium. Composted sludges are used as soil amendments. Although safe upper limits of cadmium for both plants and animals have not been established, monitoring soil Cd levels helps avoid excesses when such materials are used. Unless the cadmium in your soil exceeds 1 ppm it is not reported.

**Soluble Salts** - Soluble salts (SS), such as those used on roads to promote melting and those present in many commercial (and some natural) fertilizers, can cause severe water stress and nutritional imbalances in plants. Generally, seedlings are more sensitive than established plants to elevated SS levels and great variation exists between plant species. Most soils have values between 0.08 and 0.50 by the method used by this lab. The middle of this range is typical of most fertile mineral soils. Values higher than 0.60 may cause damage to sensitive plants (such as onions, etc.). A SS level can change rapidly in the soil due to leaching (washing out), so evaluating its significance must consider the effects of time and growing conditions. Excessive SS levels can often be corrected by leaching with liberal amounts (2 to 4 inches) of fresh water. Normal off season precipitation will usually correct salt problems resulting from over-fertilization.

**GENERAL COMMENTS**- Implementing the recommendations given in the enclosed report will correct the nutrient status of your soil for the plant type indicated. It may or may not solve a given horticultural plant growth problem. Other cultural factors may need to be evaluated. Many reports provide both "natural and organic" and "synthetic chemical" fertilizer alternatives.

The numerical results of this soil test reflect the properties of your soil and the analytical procedures used by the U Mass lab. One can not directly compare the extracted nutrient levels of one laboratory to those of another, because different labs may use different procedures. However, the evaluation of the results (whether they represent low, medium or high levels) and the accompanying recommendations should be consistent between labs if all other factors of crop production are the same.

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Questions regarding soil testing may be directed to the Soil and Plant Tissue Testing Laboratory at (413) 545-2311.

Email: [bodine@pssci.umass.edu](mailto:bodine@pssci.umass.edu)

URL: <http://www.umass.edu/plsoils/soiltest/>

# SOIL LEAD LEVELS

## Interpretations and Recommendations

**Soil Contamination by Lead** - Lead is naturally present in all soils, generally in the range of 15 to 40 parts lead per million parts of soil (ppm) or milligrams per kilogram (mg/kg). Pollution, however, can increase soil lead levels to several thousand mg/kg. The major cause of soil contamination by lead in populated areas is the weathering, chipping, scraping, sanding, and sand-blasting of structures bearing lead-based paint.

In the past the uses of tetraethyl lead as an anti-knock ingredient in gasoline and lead arsenate as an insecticide in fruit orchards were important causes of soil contamination by lead. Automotive lead emissions have effectively ceased with the phasing out of leaded fuels. With the development of more effective pesticides and Integrated Pest Management (IPM) lead arsenate is no longer in use. Unfortunately lead persists in soil many hundreds of years, so the past use of these products continues to present problems in some areas.

Soil lead becomes a health risk when directly ingested or breathed as dust. Garden produce, which has accumulated lead in its tissue or has soil particles adhering to it, can also be a hazard if eaten. Lead poisoning is a particular concern for young children (under 6) because their play habits tend to maximize exposure and their bodies' rapidly developing systems are very sensitive to the effects of lead.

**Soil Lead Levels, Distribution, and Sampling** - The procedure used by the UMass Soil Testing Lab to measure lead in soil is the same used to measure the various plant nutrients. The "extracting solution" removes a reproducible fraction of the total soil lead. This "extractable" lead is a measure of the reactive lead in the soil. By testing a large number of soils (>300) by both this routine extraction procedure and a more rigorous total soil digestion (to obtain an actual total lead result) a relationship between the two values has been established. Your test result also reports an ESTIMATED TOTAL LEAD level based on this relationship. This is a calculated value. Total lead levels higher than 1000 ppm are legally hazardous. Contact your state's Department of Environmental Protection regarding removal of contaminated soil materials. Information derived from a variety of sources has resulted in classifying soil lead levels as follows:

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Lead Level	Extracted Lead (ppm)	Estimated Total Lead (ppm)
Low	less than 43	less than 500*
Medium	43 to 126	500 to 1000
High	126 to 480	1000 to 3000
Very High	greater than 480	greater than 3000

\* At present total soil lead levels less than 300 ppm have not been associated with elevated blood lead levels in young children. If estimated soil lead levels are above 300 ppm, however, young children and pregnant women should avoid soil contact.

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Due to the nature of the contamination process, lead in soil may be very unevenly distributed. The lead in paint removed from a structure will usually be concentrated near the source, but levels may vary greatly over small distances (ex. one foot). Lead arsenate residues in old orchards closely reflect the locations of sprayed trees. Consider these facts fully when sampling. If the purpose of testing is to establish the extent of play-area contamination, combine several, small, randomly taken samples from the surface 1-2 inches to create one sample for testing. If the concern is for lead uptake by garden vegetables, combine several vertical slices from the top 7 inches of soil (root zone) to create a sample.

# Good Gardening Practices to Reduce the Lead Risk

1. Locate gardens away from old painted structures and heavily travelled roads.
2. Give planting preferences to fruiting crops (tomatoes, squash, peas, sunflowers, corn, etc.).
3. Incorporate organic materials such as finished compost, humus, and peat moss.
4. Lime soil as recommended by soil test (pH 6.5 minimizes lead availability).
5. Discard old and outer leaves before eating leafy vegetables. Peel root crops. Wash all produce.
6. Keep dust to a minimum by maintaining a mulched and/or moist soil surface.

## Recommendations

If your soil is contaminated with lead keep young children away from all garden areas and other exposed soil surfaces.

**LOW** - Follow the good gardening practices listed above.

**MEDIUM** - In addition to following good gardening practices:

- It is recommended that the blood lead levels of children under six be tested.
- Avoid growing leafy green vegetables and root crops if your children have above normal blood lead levels.
- Give planting preference to fruiting crops.

**HIGH** - In addition to following good gardening practices:

- It is strongly recommended that the blood lead levels of children under six be tested.
- Grow only fruiting crops or limit gardening to flowers and ornamentals.
- Replenish soil with clean topsoil; try to determine the depth to which soil is highly contaminated (it may be necessary to remove only a thin layer)
- Containerize garden in pots with clean topsoil; or create raised (or entrenched) beds lined in plastic and filled with clean topsoil to a depth of at least six inches.

**VERY HIGH** - Do not use this soil for vegetable gardening:

- Be certain to test the blood lead levels of children under six.
- Remove and replace soil; or grow only flowers and ornamental plants.
- Containerize garden in pots with clean topsoil; or create raised (or entrenched) beds lined in plastic and filled with clean topsoil to a depth of at least six inches.

If one has grown sensitive produce in a soil heavily contaminated with lead and wishes to know if lead has accumulated in the edible portion of the plants, a plant tissue test for lead can be performed at \$10 per sample. Please contact the lab before sending any plant tissue.

UMass Soil and Plant Tissue Testing Laboratory  
West Experiment Station  
University of Massachusetts  
Amherst, MA 01003-8020

Phone: (413) 545-2311  
FAX: (413) 545-1931  
Email: [soiltest@umext.umass.edu](mailto:soiltest@umext.umass.edu)  
URL: <http://www-unix.oit.umass.edu/~soiltest/>

Revised March 1997

# Lime and Fertilizer Recommendations for Turfgrass

Periodic soil testing is an important part of any successful turfgrass management program. Since soil type, grass species, and desired turf quality level vary among turf areas, lime and fertilizer recommendations must be generalized to some extent. One must remember that a soil test is not an exact recipe for success. It should be incorporated into a coordinated effort to provide the cultural conditions required for healthy turfgrass. This includes: (1) watering properly (amounts and timing); (2) insuring good drainage; (3) choosing seed carefully prior to establishment; (4) providing adequate light and air circulation; (5) using proper mowing techniques; (6) dethatching when necessary; and (7) preventing soil compaction. By liming and fertilizing properly and attending to the cultural requirements listed above one minimizes the chances for disease and weed problems and maximizes the likelihood of a healthy and attractive turfgrass.

**Soil pH & Lime Recommendation** - A soil pH of 4.0 is extremely acidic, while one of 8.5 is very alkaline. Though turfgrasses are adaptable to a wide soil pH range, they generally grow best at pH values between 6 and 7. Ryegrasses and bluegrasses prefer a soil pH near 7. Bentgrasses and fescues perform best at pH levels near 6. Since the climate and rock-types of New England tend to produce acid soils, limestone is commonly recommended to raise the soil pH.

It is unnecessary to lime turfgrass soils unless the soil pH is less than 6.4. Liming soils to pH levels above 7.5 can result in micronutrient deficiencies (particularly if certain woody ornamentals are part of the landscape). Lime according to your recommendation. Since dolomitic (high magnesium) lime is so commonly available in our area, many soil tests show high magnesium levels. In these instances, a calcitic (calcium-rich) lime is often recommended. This can be difficult to find at lawn supply dealers. In this case, simply use the best available product. Although lime can be applied at any time of year, early spring is best for turfgrass. Late fall applications have been associated with the development of snow mold. Ground limestone and pelletized lime are the two most common liming agents used on lawns. Ground lime is usually cheaper, but the dust it produces can be a nuisance. Pelletized lime is more expensive (although prices have dropped), but "cleaner" with which to work. The choice of which to use is a personal one. Claims of superiority of one over the other are exaggerated.

**Buffer pH, Cation Exchange Capacity, & Percent Base Saturation** - Buffer pH is a measure of the reserve acidity of the soil. A value higher than 6.8 indicates that very little or no acidity must be neutralized through liming. Values decreasing from 6.8 indicate increasing amounts of reserve soil acidity. An acid soil with a significant amount of organic matter and/or clay will have a lower buffer pH (thus a higher lime requirement) than a sandy acid soil (of the same soil pH) with little organic matter. This is because lime must neutralize acidity residing on the surfaces of the humus (organic matter) and clay, before one realizes a rise in soil pH to a desired level.

The surfaces of soil particles are often electrically charged. This results in a soil's capacity to attract oppositely charged substances in the soil water surrounding them. Most often the soil is negatively charged and attracts positively charged ions (cations) to its surfaces. Calcium, magnesium, and potassium are examples of plant nutrients held in this way. These basic (not acidic) cations are available to plants. Acidic cations (ex. Hydrogen and Aluminum) can also be adsorbed to the soil surface. The sum of these is referred to the Soil's **Cation Exchange Capacity (CEC)**. A CEC of 10 to 15 is typical and usually adequate. It indicates that the soil has either a sufficient amount of humus (organic matter) or reactive mineral material (silt and clay). Values below 6 may indicate that the soil will have trouble supporting good turf unless special management



techniques are employed. The proportion of base cations held by the soil is referred to as **Percent Base Saturation**. A good balance is recommended. For example, a soil with base saturations of calcium 70%, magnesium 12%, and potassium 4% is considered well balanced. There are no strict limits, but a properly limed and fertilized soil will approach these values.

**Organic Matter** - The percentage organic matter is determined only if requested. Organic matter in soils can improve nutrient and moisture retention, drainage, and aeration. It can also help prevent compaction. What level is appropriate will depend on the other characteristics of your soil and the turf management scheme chosen. Values between 7% and 10% are generally acceptable. Building organic matter to an acceptable level is best accomplished prior to establishment. Contact the lab for more information.

### **Nutrient Levels**

**Nitrogen (N)** - Nitrogen, as nitrate ( $\text{NO}_3\text{-N}$ ) and ammonium ( $\text{NH}_4\text{-N}$ ) are routinely measured as part of the soil test. The values, however, are not used to make nitrogen recommendations; but only to detect extreme soil conditions. This is because N is a very dynamic and easily transformed element in soil. The turf's actual need for N may bear little relation to soil test levels. The best way to determine N need is to observe the color, density, and vigor of the turfgrass. If it is green enough for your tastes, is fairly dense, and is growing rapidly enough to require mowing once or twice a week during spring and early fall, nitrogen is probably not deficient. However, turf requires a regular supply of N to maintain quality. We recommend that a total of 3 lbs/1000 square feet be provided each growing season to be split over 3 to 4 applications.

**Phosphorus (P)** - Phosphorus appears on fertilizer bags as  $\text{P}_2\text{O}_5$  (phosphorus pentoxide). Your recommendation is also expressed in this way. P fertility is most important during grass establishment, when good root development is vital. Since P does not move readily through soil, it is important to incorporate sufficient P into the top six inches of soil prior to seeding new turf or laying sod. Fertilization of established turf will not increase quality as noticeably as will N, but moderate P soil levels should be maintained.

**Potassium (K)** - Potassium appears on fertilizer bags as  $\text{K}_2\text{O}$  (potassium oxide). Your recommendation is also expressed in this way. Turf deficient in K is unable to utilize nitrogen and water efficiently, and is more susceptible to disease, heat, cold, and drought stress. When possible, choose fertilizers containing potassium as the sulfate over those containing potassium chloride (muriate of potash). Potassium sulfate is less apt to "burn" turf.

**Calcium (Ca) and Magnesium (Mg)** - Properly limed soils are seldom deficient in Ca and Mg.

**Aluminum (Al)** - Aluminum is toxic to some plants under acid soil conditions. It should not be a problem for turfgrass if the soil has been limed properly.

**Organic Lawn Care Maintenance** - Many have recently expressed interest in organic methods of lawn care. The recommendations provided with your soil test (lbs of N,  $\text{P}_2\text{O}_5$ , and  $\text{K}_2\text{O}$ ) still apply. It may be difficult to reach target nutrient levels quickly with organic amendments and the process is generally more expensive. We, however, encourage efforts in this area. Feel free to call us.

Micronutrients and heavy metals are not reported unless they are out of normal ranges. If soil lead is elevated, refer to the separate fact sheet enclosed with these results. If you have other questions, call the Soil Testing Lab at (413)545-2311. For detailed information on Turfgrass Management we suggest you contact the UM Extension Bulletin Distribution Center at (413)545-2717. Request information on **Turf IPM Facts** and **Professional Turfgrass Management Guide**.

SOIL AND PLANT TISSUE TESTING LAB  
WEST EXPERIMENT STATION  
UNIVERSITY OF MASSACHUSETTS  
AMHERST, MA 01003

LAB NUMBER: S000413-110  
BAG NUMBER: 44465

SOIL WEIGHT: 4.74 g/5cc  
CROP: TURF/GRASS

ROBERT TREAT PAINE ESTATE                    COMMENTS:  
100 ROBERT TREAT PAINE DR.  
WALTHAM, MA 02452

SAMPLE ID: EAST LAWN

-----  
LIMESTONE AND FERTILIZER RECOMMENDATIONS FOR ESTABLISHED TURFGRASS

Total lime required is 196 lb of calcitic limestone per 1000 sq ft.  
Apply 50 lb/1000 sq ft in early spring and mid-autumn.  
Do NOT surface apply more than 50 lbs/1000 sq ft at one time.  
Retest the soil next year.

Recommendation: 0 lb/1000 sq ft P2O5, and 6 lb/1000 sq ft K2O.

To provide the above recommendation you may follow the directions below,  
or you may devise your own fertilizer program using the  
recommended amounts of phosphorus (P2O5) and potassium (K2O) along with  
one pound of Nitrogen per 1000 sq feet. It may necessary to raise nutrient  
levels over several applications.

Apply a 20-3-12 fertilizer @ 5 lbs/1000 sq ft in late April, late June,  
and very late August.

If more convenient you may substitute the late April recommendation with  
the same application made 1 to 2 weeks after your last fall mowing.  
Follow these recommendations for three years; Retest the following year.

Consult the interpretation sheet enclosed or obtain one of the Turf Guides  
referenced on the backside of the interpretation sheet.

-----  
SOIL pH           5.0                            NITROGEN: NO3-N = 17 ppm                    NH4-N = 7 ppm  
BUFFER pH       5.5                            ORGANIC MATTER: 10.4 % (Desirable range 4-10%)

NUTRIENT LEVELS: PPM		Low	Medium	High	Very High
Phosphorus (P)	16	XXXXXXXXXXXXXXXXXXXXXXXXXXXX			
Potassium (K)	28	XXXXXX			
Calcium (Ca)	238	XXXXXXXX			
Magnesium (Mg)	29	XXXXXX			

CATION EXCH CAP                    PERCENT BASE SATURATION                    MICRONUTRIENT LEVELS  
19.5 Meq/100g                    K= 0.4 Mg= 1.3 Ca= 6.5                    ALL NORMAL

EXTRACTABLE ALUMINUM: 297 ppm (Soil range: 10-250 ppm)

EXTRACTED LEAD (PB) 37 PPM.                    ESTIMATED TOTAL LEAD IS 461 PPM.

THE LEAD LEVEL IN THIS SOIL IS IN THE LOW RANGE.  
READ THE ENCLOSED INFORMATION ABOUT LEAD IN THE SOIL.  
FOLLOW THE RECOMMENDATIONS FOR LOW LEAD LEVELS.

COMPUTER PROGRAM & RECOMMENDATIONS BY DEPT OF PLANT & SOIL SCI UMASS-AMHERST.  
For further information contact the Soil Testing Lab at (413) 545-2311.

SOIL AND PLANT TISSUE TESTING LAB  
WEST EXPERIMENT STATION  
UNIVERSITY OF MASSACHUSETTS  
AMHERST, MA 01003

LAB NUMBER: S000413-107  
BAG NUMBER: 44465

SOIL WEIGHT: 5.63 g/5cc  
CROP: TURF/GRASS

ROBERT TREAT PAINE ESTATE            COMMENTS:  
100 ROBERT TREAT PAINE DR.  
WALTHAM, MA 02452

SAMPLE ID: DR BAY DRAIN

-----  
LIMESTONE AND FERTILIZER RECOMMENDATIONS FOR NEW LAWN CONSTRUCTION

Total lime required is 376 lb of limestone/1000 sq ft.  
Incorporate thoroughly 100 lbs/1000 sq ft lime into the top 6  
inches of soil. Mix an additional 100 lbs/1000 sq ft into the top  
3 to 4 inches of soil along with recommended fertilizers.  
Retest soil early next fall.

Fertilizer (per 1000 sq ft): 1-2 lbs N, 1 lbs P2O5, and 6 lbs K2O.

Many fertilizer sources and rates may combine to provide acceptable  
turfgrass establishment either from seed or sod. One or two options  
based on this soil test follow:

Incorporate a 10-6-4 lawn fertilizer at 20 lbs/1000 sq ft plus 0-0-60  
(muriate of potash) fertilizer at 5 lbs/1000 sq ft into the top  
3 to 4 inches of soil. Retest soil early in the spring or autumn  
following seeding or laying of sod.

PLEASE read the enclosed fact sheets for more specific information on  
fertilization and liming procedures.

-----  
SOIL pH        4.9                    NITROGEN: NO3-N = 15 ppm            NH4-N = 3 ppm  
BUFFER pH    5.6                    ORGANIC MATTER: 7.6 % (Desirable range 4-10%)

NUTRIENT LEVELS: PPM		Low	Medium	High	Very High
Phosphorus (P)	14	XXXXXXXXXXXXXXXXXXXXXXXXXXXX			
Potassium (K)	19	XXXX			
Calcium (Ca)	133	XXXX			
Magnesium (Mg)	22	XXXXXX			

CATION EXCH CAP                    PERCENT BASE SATURATION                    MICRONUTRIENT LEVELS  
14.9 Meq/100g                    K= 0.3 Mg= 1.1 Ca= 4.0                    ALL NORMAL

EXTRACTABLE ALUMINUM: 202 ppm (Soil range: 10-250 ppm)

EXTRACTED LEAD (PB) 257 PPM.                    ESTIMATED TOTAL LEAD IS 1809 PPM.

THE LEAD LEVEL IN THIS SOIL IS IN THE HIGH RANGE.  
READ THE ENCLOSED INFORMATION ABOUT LEAD IN THE SOIL.  
FOLLOW THE RECOMMENDATIONS FOR HIGH LEAD LEVELS.

SOIL ANALYSIS REPORT FOR PERENNIALS

04/20/00

SOIL AND PLANT TISSUE TESTING LAB  
 WEST EXPERIMENT STATION  
 UNIVERSITY OF MASSACHUSETTS  
 AMHERST, MA 01003

LAB NUMBER: S000413-106  
 BAG NUMBER: 44465

SOIL WEIGHT: 5.11 g/5cc  
 CROP: FERNS/OLD

ROBERT TREAT PAINE ESTATE  
 100 ROBERT TREAT PAINE DR.  
 WALTHAM, MA 02452

COMMENTS:

SAMPLE ID: NORTH 1886

RECOMMENDATIONS FOR PERENNIAL HERBS AND FLOWERS:

SOIL PH ADJUSTMENT:

Soil pH is in the desired range. No adjustment required.

FERTILIZER:

The organic matter in this soil is adequate for many herbaceous perennials. The level should be increased for plants requiring humus-rich conditions.

NEW BED PREPARATION: In the fall preceeding planting incorporate 1 part finished compost or composted manure into 7 parts soil along with 8 cups bone meal and 8 cups wood ash per cubic yard of soil; OR in early spring incorporate 1 part peat moss into 2 parts soil along with 7 cups 5-10-10 fertilizer per cubic yard of soil.

ESTABLISHED BEDS: In the fall topdress soil with 1/2 inch finished compost 4 cups bone meal and 6 cups wood ash per 100 square feet and gently scratch into the soil surface; OR in early spring and early June sidedress 2.5 cups 5-10-10 fertilizer 100 square feet, taking care not to damage foliage and water afterward.

SOIL pH 6.3 NITROGEN: NO3-N = 22 ppm NH4-N = 2 ppm  
 BUFFER pH 6.4 ORGANIC MATTER: 8.3 % (Desirable range 4-10%)

NUTRIENT LEVELS: PPM	Low	Medium	High	Very High
Phosphorus (P) 6	XXXXXXXXXX			
Potassium (K) 43	XXXXXXXXXX			
Calcium (Ca) 1523	XX			
Magnesium (Mg) 117	XX			

CATION EXCH CAP 14.9 Meq/100g PERCENT BASE SATURATION K= 0.8 Mg= 6.4 Ca=50.2 MICRONUTRIENT LEVELS ALL NORMAL

EXTRACTABLE ALUMINUM: 97 ppm (Soil range: 10-250 ppm)

EXTRACTED LEAD (PB) 99 PPM. ESTIMATED TOTAL LEAD IS 833 PPM.

THE LEAD LEVEL IN THIS SOIL IS IN THE MEDIUM RANGE.  
 READ THE ENCLOSED INFORMATION ABOUT LEAD IN THE SOIL.  
 FOLLOW THE RECOMMENDATIONS FOR MEDIUM LEAD LEVELS.

COMPUTER PROGRAM & RECOMMENDATIONS BY DEPT OF PLANT & SOIL SCI UMASS-AMHERST.  
 For further information contact the Soil Testing Lab at (413) 545-2311.

SOIL AND PLANT TISSUE TESTING LAB  
WEST EXPERIMENT STATION  
UNIVERSITY OF MASSACHUSETTS  
AMHERST, MA 01003

LAB NUMBER: S000413-106  
BAG NUMBER: 44465

SOIL WEIGHT: 5.11 g/5cc  
CROP: FERNS/OLD

ROBERT TREAT PAINE ESTATE            COMMENTS:  
100 ROBERT TREAT PAINE DR.  
WALTHAM, MA 02452

SAMPLE ID: NORTH 1886

-----  
RECOMMENDATIONS FOR ERICACEOUS SHRUBS AND GROUND COVERS:

SOIL PH ADJUSTMENT:

Soil pH is too high. For new plantings you may incorporate sulfur at 4 cups per cubic yard of soil; OR consider plants better adapted to this soil pH. For established plantings you may carefully topdress soil with sulfur at 2 cups/100 sq ft and maintain an acidic organic mulch, such as pine needles.

FERTILIZER:

The organic matter level of this soil appears to be quite high. When properly fertilized and provided proper drainage it should provide a good growing medium for woody ornamentals which prefer a humus rich soil.

PREPLANT PREPARATION: In the early fall preceding planting incorporate 1 part finished compost or leaf mold into 10 parts soil along with 1 cup bone meal per cubic yard of backfill; OR in early spring incorporate 1 part finished compost or leaf mold into 10 parts soil along with 1 cup 10-10-10 per cubic yard of backfill.

ESTABLISHED PLANTINGS: In the early fall topdress with 12 cups cottonseed meal or millorganite-type fertilizer per 100 square feet and gently scratch into the soil surface; OR in early spring topdress 1 cup 12-4-8 fertilizer per 100 square feet.

-----  
SOIL pH        6.3                    NITROGEN: NO3-N =    22 ppm                    NH4-N =        2 ppm  
BUFFER pH    6.4                    ORGANIC MATTER:    8.3 % (Desirable range 4-10%)

NUTRIENT LEVELS: PPM	Low	Medium	High	Very High
Phosphorus (P)    6	XXXXXXXXXX			
Potassium (K)    43	XXXXXXXXXX			
Calcium (Ca)    1523	XX			
Magnesium (Mg)  117	XX			

CATION EXCH CAP            PERCENT BASE SATURATION            MICRONUTRIENT LEVELS  
14.9 Meq/100g            K= 0.8 Mg= 6.4 Ca=50.2            ALL NORMAL

EXTRACTABLE ALUMINUM:    97 ppm (Soil range: 10-250 ppm)

EXTRACTED LEAD (PB)    99 PPM.                    ESTIMATED TOTAL LEAD IS    833 PPM.

THE LEAD LEVEL IN THIS SOIL IS IN THE MEDIUM RANGE.  
READ THE ENCLOSED INFORMATION ABOUT LEAD IN THE SOIL.  
FOLLOW THE RECOMMENDATIONS FOR MEDIUM LEAD LEVELS.

SOIL ANALYSIS REPORT FOR PERENNIALS

04/20/00

SOIL AND PLANT TISSUE TESTING LAB  
 WEST EXPERIMENT STATION  
 UNIVERSITY OF MASSACHUSETTS  
 AMHERST, MA 01003

LAB NUMBER: S000413-105  
 BAG NUMBER: 44465

SOIL WEIGHT: 5.24 g/5cc  
 CROP: FERNS/NEW

ROBERT TREAT PAINE ESTATE                      COMMENTS:  
 100 ROBERT TREAT PAINE DR.  
 WALTHAM, MA 02452

SAMPLE ID: NORTH 1866

-----  
 RECOMMENDATIONS FOR PERENNIAL HERBS AND FLOWERS:

SOIL PH ADJUSTMENT:

Soil pH is in the desired range. No adjustment required.

FERTILIZER:

The organic matter in this soil is adequate for many herbaceous perennials. The level should be increased for plants requiring humus-rich conditions.

NEW BED PREPARATION: In the fall preceeding planting incorporate 1 part finished compost or composted manure into 7 parts soil along with 5 cups bone meal and 8 cups wood ash per cubic yard of soil; OR in early spring incorporate 1 part peat moss into 2 parts soil along with 7 cups 5-5-5 fertilizer and 7 cups wood ash per cubic yard of soil.

ESTABLISHED BEDS: In the fall topdress soil with 1/2 inch finished compost along with 2 cups bone meal and 6 cups wood ash per 100 square feet and gently scratch into the soil surface; OR in early spring and early June sidedress 2.5 cups 5-5-5 fertilizer and 2.5 cups wood ash 100 square feet, taking care not to damage foliage and water afterward.

-----  
 SOIL pH        6.2                      NITROGEN: NO3-N = 17 ppm                      NH4-N = 1 ppm  
 BUFFER pH    6.3                      ORGANIC MATTER: 10.1 % (Desirable range 4-10%)

NUTRIENT LEVELS: PPM	Low	Medium	High	Very High
Phosphorus (P)        9	XXXXXXXXXXXXXXXXXX			
Potassium (K)        37	XXXXXXXXXX			
Calcium (Ca)        1419	XX			
Magnesium (Mg)       57	XXXXXXXXXXXXXXXX			

CATION EXCH CAP                      PERCENT BASE SATURATION                      MICRONUTRIENT LEVELS  
 14.7 Meq/100g                      K= 0.7 Mg= 3.1 Ca=46.4                      ALL NORMAL

EXTRACTABLE ALUMINUM:        55 ppm (Soil range: 10-250 ppm)

EXTRACTED LEAD (PB)        367 PPM.                      ESTIMATED TOTAL LEAD IS        2396 PPM.

THE LEAD LEVEL IN THIS SOIL IS IN THE HIGH RANGE.  
 READ THE ENCLOSED INFORMATION ABOUT LEAD IN THE SOIL.  
 FOLLOW THE RECOMMENDATIONS FOR HIGH LEAD LEVELS.

COMPUTER PROGRAM & RECOMMENDATIONS BY DEPT OF PLANT & SOIL SCI UMASS-AMHERST.  
 For further information contact the Soil Testing Lab at (413) 545-2311.

SOIL AND PLANT TISSUE TESTING LAB  
WEST EXPERIMENT STATION  
UNIVERSITY OF MASSACHUSETTS  
AMHERST, MA 01003

LAB NUMBER: S000413-105  
BAG NUMBER: 44465

SOIL WEIGHT: 5.24 g/5cc  
CROP: FERNS/NEW

ROBERT TREAT PAINE ESTATE  
100 ROBERT TREAT PAINE DR.  
WALTHAM, MA 02452

COMMENTS:

SAMPLE ID: NORTH 1866

RECOMMENDATIONS FOR ERICACEOUS SHRUBS AND GROUND COVERS:

SOIL PH ADJUSTMENT:

Soil pH is too high. For new plantings you may incorporate sulfur at 4 cups per cubic yard of soil; OR consider plants better adapted to this soil pH. For established plantings you may carefully topdress soil with sulfur at 2 cups/100 sq ft and maintain an acidic organic mulch. such as pine needles.

FERTILIZER:

The organic matter level of this soil appears to be quite high. When properly fertilized and provided proper drainage it should provide a good growing medium for woody ornamentals which prefer a humus rich soil.

PREPLANT PREPARATION: In the early fall preceeding planting incorporate 1 part finished compost or leaf mold into 10 parts soil along with 1 cup bone meal per cubic yard of backfill; OR in early spring incorporate 1 part finished compost or leaf mold into 10 parts soil along with 1 cup 10-10-10 per cubic yard of backfill.

ESTABLISHED PLANTINGS: In the early fall topdress with 12 cups cottonseed meal or millorganite-type fertilizer per 100 square feet and gently scratch into the soil surface; OR in early spring topdress 1 cup 12-4-8 fertilizer per 100 square feet.

SOIL pH 6.2 NITROGEN: NO3-N = 17 ppm NH4-N = 1 ppm  
BUFFER pH 6.3 ORGANIC MATTER: 10.1 % (Desirable range 4-10%)

NUTRIENT LEVELS: PPM	Low	Medium	High	Very High
Phosphorus (P) 9	XXXXXXXXXXXXXXXXXX			
Potassium (K) 37	XXXXXXXXXX			
Calcium (Ca) 1419	XX			
Magnesium (Mg) 57	XXXXXXXXXXXXXXXXXX			

CATION EXCH CAP 14.7 Meq/100g PERCENT BASE SATURATION K= 0.7 Mg= 3.1 Ca=46.4 MICRONUTRIENT LEVELS ALL NORMAL

EXTRACTABLE ALUMINUM: 55 ppm (Soil range: 10-250 ppm)

EXTRACTED LEAD (PB) 367 PPM. ESTIMATED TOTAL LEAD IS 2396 PPM.

THE LEAD LEVEL IN THIS SOIL IS IN THE HIGH RANGE.  
READ THE ENCLOSED INFORMATION ABOUT LEAD IN THE SOIL.  
FOLLOW THE RECOMMENDATIONS FOR HIGH LEAD LEVELS.

SOIL AND PLANT TISSUE TESTING LAB  
 WEST EXPERIMENT STATION  
 UNIVERSITY OF MASSACHUSETTS  
 AMHERST, MA 01003

LAB NUMBER: S000413-108  
 BAG NUMBER: 44465

SOIL WEIGHT: 4.69 g/5cc  
 CROP: GRASSES/MEADOW

ROBERT TREAT PAINE ESTATE                      COMMENTS:  
 100 ROBERT TREAT PAINE DR.  
 WALTHAM, MA 02452

SAMPLE ID: UPPER S FIELD EAST

-----  
 RECOMMENDATIONS FOR GRASS-LEGUME HAY AND PASTURE:

Limestone requirement for grass-legume mixtures containing alfalfa is 9.4 tons per acre or 410 lbs/1000 sq.ft.

For grass and mixtures containing any other legumes, the limestone requirement is 5.8 tons per acre or 269 lbs/1000 sq.ft.

Recommended maximum economic rate is 4 T. Apply 4 T and retest next year. Limestone containing at least 5-10% calcium carbonate equivalence from magnesium sources is recommended.

\*\*\* RECOMMENDATION FOR GRASS-LEGUME ESTABLISHMENT \*\*\*  
 Apply 0-50 lb/acre nitrogen, using lower rate if legume is included.  
 Apply 50- 60 lb/acre P2O5 and 80- 90 lb/acre K2O. Recommended K2O for first year after seeding year 80 lb/acre. Use nitrogen rates below.

\*\*\* RECOMMENDATION FOR TOPDRESSING ESTABLISHED GRASS-LEGUME HAYCROP \*\*\*  
 Apply nitrogen if less than 50 percent legume: 50 lb/acre early spring, 50 lb/acre after first cut.  
 Apply 50- 60 lb/acre P2O5 and 50- 60 lb/acre K2O.

\*\*\* RECOMMENDATION FOR TOPDRESSING ESTABLISHED GRASS-LEGUME PASTURE \*\*\*  
 Apply nitrogen if mostly grass: 50 lb/acre early spring & again in August.  
 Apply 50- 60 lb/acre P2O5 and 10- 20 lb/acre K2O.

-----  
 SOIL pH        5.3                      NITROGEN: NO3-N =     6 ppm                      NH4-N =     10 ppm  
 BUFFER pH    5.6                      ORGANIC MATTER: 10.1 % (Desirable range 4-10%)

NUTRIENT LEVELS: PPM		Low	Medium	High	Very High
Phosphorus (P)	9	XXXXXXXXXXXXXXXXXX			
Potassium (K)	67	XXXXXXXXXXXXXXXXXX			
Calcium (Ca)	331	XXXXXXXXXXXX			
Magnesium (Mg)	43	XXXXXXXXXXXX			

CATION EXCH CAP                      PERCENT BASE SATURATION                      MICRONUTRIENT LEVELS  
 19.2 Meq/100g                      K= 1.0 Mg= 2.0 Ca= 9.2                      ALL NORMAL

EXTRACTABLE ALUMINUM: 307 ppm (Soil range: 10-250 ppm)

EXTRACTED LEAD (PB)     14 PPM.                      ESTIMATED TOTAL LEAD IS     199 PPM.

The lead level in this soil is low.



SOIL AND PLANT TISSUE TESTING LAB  
 WEST EXPERIMENT STATION  
 UNIVERSITY OF MASSACHUSETTS  
 AMHERST, MA 01003

LAB NUMBER: S000413-109  
 BAG NUMBER: 44465

SOIL WEIGHT: 4.27 g/5cc  
 CROP: GRASSES/MEADOW

ROBERT TREAT PAINE ESTATE                      COMMENTS:  
 100 ROBERT TREAT PAINE DR.  
 WALTHAM, MA 02452

SAMPLE ID: UPPER S FIELD WEST

-----  
 RECOMMENDATIONS FOR GRASS-LEGUME HAY AND PASTURE:

Limestone requirement for grass-legume mixtures containing alfalfa is 8.0 tons per acre or 350 lbs/1000 sq.ft.

For grass and mixtures containing any other legumes, the limestone requirement is 4.7 tons per acre or 218 lbs/1000 sq.ft.

Recommended maximum economic rate is 4 T. Apply 4 T and retest next year. Limestone containing at least 2-5% calcium carbonate equivalence from magnesium sources is recommended.

\*\*\* RECOMMENDATION FOR GRASS-LEGUME ESTABLISHMENT \*\*\*  
 Apply 0-50 lb/acre nitrogen, using lower rate if legume is included.  
 Apply 50- 60 lb/acre P2O5 and 70- 80 lb/acre K2O. Recommended K2O for first year after seeding year 70 lb/acre. Use nitrogen rates below.

\*\*\* RECOMMENDATION FOR TOPDRESSING ESTABLISHED GRASS-LEGUME HAYCROP \*\*\*  
 Apply nitrogen if less than 50 percent legume: 50 lb/acre early spring, 50 lb/acre after first cut.  
 Apply 50- 60 lb/acre P2O5 and 40- 50 lb/acre K2O.

\*\*\* RECOMMENDATION FOR TOPDRESSING ESTABLISHED GRASS-LEGUME PASTURE \*\*\*  
 Apply nitrogen if mostly grass: 50 lb/acre early spring & again in August.  
 Apply 50- 60 lb/acre P2O5 and 0- 10 lb/acre K2O.

-----  
 SOIL pH            5.4                      NITROGEN: NO3-N =    22 ppm                      NH4-N =    15 ppm  
 BUFFER pH       5.8                      ORGANIC MATTER: 13.1 % (Desirable range 4-10%)

NUTRIENT LEVELS: PPM		Low	Medium	High	Very High
Phosphorus (P)	9	XXXXXXXXXXXXXXX			
Potassium (K)	85	XXXXXXXXXXXXXXXXXXXXXXX			
Calcium (Ca)	819	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			
Magnesium (Mg)	95	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			

CATION EXCH CAP                      PERCENT BASE SATURATION                      MICRONUTRIENT LEVELS  
 21.8 Meq/100g                      K= 1.2 Mg= 4.2 Ca=22.1                      ALL NORMAL

EXTRACTABLE ALUMINUM: 221 ppm (Soil range: 10-250 ppm)

EXTRACTED LEAD (PB)    19 PPM.                      ESTIMATED TOTAL LEAD IS    255 PPM.

The lead level in this soil is low.