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Memorandum

TO: Wellesley Natural Resources Commission

FROM: Fuller Brook Park Project Design Team

DATE: April 18, 2013 (updated; original submittal January 15, 2013)

RE: Invasive Species Management – Herbicide Use Memorandum and Waiver Request, Fuller Brook Park Preservation Project, Wellesley, MA

I. Introduction

Invasive species within Fuller Brook Park pose a threat to the ecological and cultural integrity of the Park. Under current conditions, these non-native aggressive plant species threaten to degrade the functionality of the stream banks along Fuller Brook, while displacing the native plant communities that support local wildlife species. In addition, implementation of the Fuller Brook Park Preservation Project and the associated earth disturbance will provide opportunities for invasive plants to become further established and may even cause existing stands of invasive plants to spread. One of the primary goals of the Fuller Brook Park Preservation Project is to effectively manage existing invasive species encountered throughout the Park in order to preserve and enhance the native species diversity that provides the favored natural character of Fuller Brook Park. An integrated invasive species management plan has been designed to strategically manage (reduce or eliminate) invasive species in Fuller Brook Park. A description of the treatment areas and the locations for proposed treatment are shown in the 60% Design Plans, entitled "*Town of Wellesley, Massachusetts, Fuller Brook Park Coordinating Committee, Fuller Brook Park Preservation Project, Phase 3, March 13, 2013, Permitting Submission*," prepared by BETA Group, Inc. in association with Horsley Witten Group, Inc. and Park Planning Associates within the Site Preparation Plans and the Notes Sheets (N-3 and N-4), which have been submitted with the permit application to the Wellesley Wetlands Protection Committee.

The Project Design Team has reviewed available literature on each of the major invasive species identified at this site and has modeled certain elements of the management plan after methods recommended by The Nature Conservancy for land management, as well as other widely accepted guidelines for invasive species management. The management plan presents alternatives for both mechanical and chemical (herbicide) control methods, depending on the species, its location in the landscape, and the most effective means of managing the species.

II. Integrated Pest Management Policy

The Town of Wellesley maintains the position that all pesticides, including herbicides, are toxic to some degree, and that even at low levels, may cause serious adverse health and environmental effects. The "Integrated Pest Management Policy for Land Owned by the Town of Wellesley, Massachusetts," (IPM

Policy) developed and adopted by the Wellesley Natural Resources Commission (NRC), mandates the following:

- *The use and application of toxic chemical pesticides, either by the Town of Wellesley employees or by private contractors, is prohibited on all Natural Resources Commission lands, including school fields which shall comply with the School Children and Families Protection Act; except for certain exemptions and emergency waivers…*
- *Preemptive turf, landscape, and grounds cultural, biological and physical maintenance practices shall be undertaken to understand, prevent, and control potential pest problems.*
- *All control products used under the terms of the policy shall be in keeping with, but not limited to, those products on the preferred list of Northeast Organic Farmers' Association as stated in their Standards for Organic Land Care, and/or the Organic Materials Review Institute of Eugene, Oregon.*

In implementing this IPM Policy, the Wellesley Board of Health may grant a temporary, one-time Emergency Waiver permitting the use of pesticides if an emergency public health situation warrants the use of pesticides, which are otherwise not be permitted under this Policy. The standards for issuance of an Emergency Waiver are as follows:

1) *The pest situation poses an immediate threat to human health AND*
2) *Viable alternatives consistent with this IPM policy do not exist.*

Likewise, the Wellesley NRC may grant a temporary, one-time Emergency Waiver permitting the use of pesticides if an emergency environmental health situation warrants the use of pesticides, under the following conditions:

1) *The pest situation poses an immediate threat to environmental health AND*
2) *Viable alternatives consistent with this IPM policy do not exist.*

In this memo, the Fuller Brook Preservation Project Design Team outlines the invasive species identified for management at Fuller Brook Park, discusses various methodologies for managing each species, including alternatives to the use of pesticides, and finally, serves as a request for a waiver of the herbicide ban for specific species (only) as described below.

III. Background on Invasive Species and Overview of Management Techniques

Invasive plants are non-native species that have been introduced to areas outside of their native range, where they often thrive and out-compete / overtake endemic plant communities. Non-native plants are characteristically aggressive, have few natural enemies and/or limiting biological factors within their introduced range, and tend to have very effective reproductive abilities. The spread of such plants is a major concern in the United States, as they reduce the functions and values of habitat for native flora and fauna within both wetlands and uplands and are a nuisance to manage once they have become established within an area. Adverse economic and environmental impacts are also often incurred by the establishment of invasive species.

In Massachusetts, the Massachusetts Invasive Plant Advisory Group (MIPAG), a voluntary collaborative representing organizations and professionals concerned with the conservation of the Massachusetts landscape, has been charged by the Massachusetts Executive Office of Energy and Environmental Affairs (EEA) to provide recommendations to the Commonwealth regarding which plants are invasive and what steps should be taken to manage these species. MIPAG identifies invasive plants as follows:

Non-native species that have spread into native or minimally managed plant systems in Massachusetts. These plants cause economic or environmental harm by developing self-sustaining populations and becoming dominant and/or disruptive to those systems.

Non-native invasive plants often displace native species over a relatively short period of time, often resulting in monotypic plant communities that lack species diversity. Species diversity is essential to maintaining an ecological balance. As is true with most exotic or non-native species, those found within Fuller Brook Park are increasingly common throughout eastern North America, where their spread has lead to a decline in species richness and cover of the local native plant communities.

Most exotic species are adapted to a wide variety of habitats and climactic conditions and are free of known diseases and/or insects or other predators native to the U.S. These plants reproduce either by producing large amounts of seeds that are readily dispersed by birds or small mammals (as with buckthorn or Oriental bittersweet), spread through underground stems or rhizomes (e.g., *Phragmites*), or both (bittersweet). As such, invasive plants quickly establish within a landscape, grow, and spread rapidly. Non-native species aggressively out-compete native plants and can dominate a plant community within a short period of time.

In general, many of the introduced plants were widely cultivated in the past for their ornamental and perceived high wildlife values. Only in more recent years have conservationists and land managers come to realize the importance of preserving native plant communities.

MIPAG was instrumental in developing the Commonwealth's first list of invasive, likely invasive, and potentially invasive plants that have now been prohibited from importation, sale, or trade. As a result, future invasions by non-native species will be more likely due to the spread of naturalized populations, rather than new (accidental) introductions. MIPAG has also developed a list of early detection species for the Commonwealth. MIPAG has also published its strategic recommendations to prevent, control, and where possible, eradicate invasive plant species in the Commonwealth of Massachusetts. These recommendations complement efforts at both the regional and national levels to establish an early detection and rapid response system for invasive plants. Their recommendations are published in the "Strategic Recommendations for Managing Invasive Plants in Massachusetts." More recently, MIPAG has published both the "Massachusetts Invasive Plant Species: Early Detection Priorities," (March 16, 2011) and the "Guidance for the Effective Management of Invasive Plants, Version 2" (December 2012).

IV. Overview of Management Techniques

Selected management techniques are generally based upon the extent of a given species within the vegetation community at a site and employ a strategy that best controls the invasive species, while minimizing the potential for adverse impacts to other desirable (i.e., native) species. Invasive species are often difficult to completely eliminate from an area, and a practical management goal is to control, not necessarily eradicate, invasive species while simultaneously encouraging or even introducing a native plant community.

Methods for the management of invasive species fall into three basic categories:

- Mechanical (cutting, pulling, grubbing, covering, etc.),
- Chemical (use of herbicides), and
- Biological (using living organisms such as insects or domestic grazing animals).

In general, mechanical controls, such as cutting or pulling, have the least adverse impacts on the adjacent, native communities; however, mechanical methods are often not as effective in the control of certain plant species. When warranted and appropriate, chemical controls (through the use of herbicides) are most effective through modest applications of specific herbicides applied to cut stems. Selective application of herbicides also functions to reduce adverse effects on desirable native species from herbicide use. For this same reason, broad foliar spraying of herbicides is generally not recommended because of the potential for negative impacts to non-target plant and animal species, although foliar spraying may be effective in controlling larger, monotypic stands of invasive plants, such as the large swaths of Japanese knotweed found at this site. While not applicable for Fuller Brook Park, biological control, or use of living organisms as a control agent, has also been proven effective on certain species. Upon effective removal or control of invasive species, native plant species are then planted in order to restore a native plant community.

V. Various Management Techniques for Fuller Brook Invasives

Several non-native, invasive species are found at this site, and one of the goals of this plan is to control or manage populations of invasive species, while restoring native plant communities. Over time, these invasive plant species have colonized the wetland resource areas and adjacent buffer zones, have spread rapidly, and have come to dominate the vegetative community. These include the following:

Herbs
- Japanese knotweed (*Fallopia japonica* formerly *Polygonum cuspidatum*)
- Purple loosestrife (*Lythrum salicaria*)

Vines:
- Oriental bittersweet (*Celastrus orbiculatus*)
- Japanese honeysuckle (*Lonicera japonica*)

Trees
- Norway maple (*Acer platanoides*)
- Tree-of-Heaven(*Ailanthus altissima*)

Shrubs
- Japanese barberry (*Berberis thunbergii*)
- European buckthorn (*Frangula alnus*)
- Common buckthorn (*Rhamnus cathartica*)
- Multiflora rose (*Rosa multiflora*)
- Morrow's honeysuckle (*Lonicera morrowii*)
- Winged euonymus (*Euonymus alatus*)

In addition, poison ivy (*Toxicodendron radicans*) is proposed to be managed in certain locations where this species poses a threat to human interaction and/or where this species poses a threat to the integrity of mature native trees. While a native species, this woody vine can pose a significant threat to native trees, particularly in the floodzone, as it grows up the trunk and eventually can "strangle" the tree. Extensive amounts of poison ivy also can create a threat to human health and safety through contact with exposed skin, causing a rash that can sometimes be serious. The threat to human health from poison ivy is particularly evident in a park setting such as this.

Given the proximity of invasive species to Caroline and Fuller Brooks and other wetland resource areas, the Project Design Team recommends the use of primarily mechanical methods with only limited use of

chemical controls to achieve the restoration goals in the Park while minimizing potential water quality impacts. In addition, the use of herbicides is only proposed where deemed necessary, and only after mechanical methods have proven to be ineffective and where no other alternative exists. Herbicide application would only be applied by a certified Massachusetts State Pesticide Applicator. It is recommended that all invasive species management activities be overseen by an "Environmental Monitor," an individual who is familiar with the identification of invasive species, and whose responsibilities would include (but not necessarily be limited to) monitoring the effectiveness of the invasive species management plan and reporting the results of the management activities to the NRC. A discussion of the recommended management method for each of these species that is specific to the existing conditions at this site follows. In addition, please refer to the attached Invasive Species Management Techniques Matrix (Table 1) for more information on methods and timing.

A. Japanese Knotweed

Japanese knotweed is an upright, herbaceous, shrub-like perennial native to eastern Asia. Its stems are hollow, smooth, and swollen at the joints. The alternate leaves are broad and oval, triangular, or heart-shaped with a pointed tip and may become six inches long and three to four inches wide. It has greenish white flowers and can spread by seed as well as via rhizomes, runners, and stems (vegetative growth). Damaged stem segments are able to re-grow if the buds at the nodes are viable. Once a population of knotweed becomes established, it spreads primarily by growth along its large rhizomes, which can become up to 30 feet long. Japanese knotweed flowers in August and September, with seeds emerging two weeks following flowering. Japanese knotweed requires high amounts of sunlight and normally does not establish within forest understory.

Japanese knotweed is one of the most prevalent invasive species within the Park. It occurs in large, monotypic stands along the stream banks, as well as in upland locations throughout the Park. Different control methods are recommended for the control of Japanese knotweed, depending upon the location of the plant population, and are described below. However, it is generally acknowledged by land managers that the use of herbicides is necessary to control this particular invasive species. Herbicides are only recommended for the upland stands.

Manual and Mechanical Control Alternatives for Japanese Knotweed

Manual and mechanical management techniques are most appropriate for smaller stands of knotweed and young plants. These techniques are also more feasible in environmentally sensitive areas where limitations on herbicide application exist.

- Pulling is considered effective for removing and controlling juvenile Japanese knotweed.
- Digging may be used to control growth of very small populations of young plants. This technique is incredibly labor intensive and generally ineffective when applied to large stands and mature plants. If this technique is utilized, the entire plant, including the roots and runners, must be removed. This is generally done with a mechanical excavator.
- Cutting is another viable mechanical control technique for this species. Shoots are cut as close to the ground as possible, reducing the viability of the rhizomes. Cutting may be done at any point during the growing season before senescence. Cutting is most successful when conducted three times or more per growing season. All cut plant parts must be bagged and sealed and disposed of properly in a landfill to prevent spread. Any stem fragments left behind have potential to re-sprout.
- Repeated cutting can also be used in conjunction with covering this plant with a heavy-gauge black plastic for 2-3 growing seasons to essentially smother the plant.

Chemical Control Alternatives for Japanese Knotweed

Large monotypic stands of Japanese knotweed also occur outside of highly sensitive areas. As these populations are located farther from surface water, chemical control would be the most effective method for management of this species in these areas.

- A "weed glove" is recommended as an option for applying the herbicide solution in dense areas with desirable neighboring vegetation to avoid herbicide application on non-target plants.
- Cut-stem herbicide application should be utilized when the knotweed is in close proximity to non-target desirable vegetation. The method is effective even in colder temperatures, as long as the ground has not frozen. Prior to applying herbicide, stems should be cut down to about two inches above the ground, between the lowest nodes along the stem. Five milliliters (5 ml) of undiluted herbicide may then be poured into the hollow stem. Foliar applications may be required as follow-up treatment for continued management. This method may not be ideal for large stands with high stem density.
- Stem injection applications are another successful management technique, albeit laborious. Herbicide is injected into the stem in the lower portion of the knotweed in the first few internodes above the ground level. An injector tool that delivers about five milliliters of solution is required for this method. The needle is inserted perpendicular to the stem, midway between the nodes (internodes), whereupon the predetermined amount of herbicide will be delivered to the plant. Knotweed generally takes up the chemical within 20 minutes of treatment. This technique causes minimal harm to nearby plants and is generally not affected by weather conditions, as the herbicide is inside of the plant. This method also eliminates the need for cutting prior to herbicide application and may be conducted at any point during the growing season. Early June is the best time for this method. Stem injection does take multiple seasons to achieve success, and becomes difficult once the knotweed stems become too small for needle insertion.
- Foliar spraying is an effective control strategy for large populations of Japanese knotweed. Glyphosate (2% solution) and triclopyr (3-4%solution) are most commonly used in foliar spraying. Foliage should be sprayed generously until wet without dripping. A low pressure sprayer and coarse spray pattern should be used when foliar spraying. Foliar spraying should be conducted when knotweed shoots are one to two meters tall during non-windy conditions when the two-to three-day extended weather forecast does not call for precipitation. If larger plants exist, they must be cut to a height of approximately 1.5 meters (about 5 feet) prior to applying foliar herbicides.

Of note, a monotypic stand of this species may require anywhere from three to five years of repeated chemical treatment before the Japanese knotweed population is effectively controlled. Quickly establishing native plant vegetation in place of eradicated knotweed will help prevent the reestablishment of the invasive.

Recommended Control of Japanese Knotweed Populations

Based upon the location and land use, the control of Japanese knotweed has been split into three different types of treatment areas (T2A and T2B). In all cases where Japanese knotweed has created a near monoculture, once these areas are effectively managed, they will require revegetation with native plant species.

For Japanese Knotweed Populations Adjacent to Fuller Brook (Treatment Areas T2A)

Large stands of knotweed are located along the banks of Fuller Brook, and in some areas, comprise the only root system to stabilize the embankment. Given the potential for water quality impacts, herbicide use is not recommended as a control method for these areas, due to the proximity to open water.

Accordingly, these populations are recommended to be managed through the following combination of mechanical methods.

Knotweed in these areas will be subjected to repeated cutting (a minimum of 2-3 times during the early growing season) in order to deplete the plants' energy stores. All cuttings will be bagged and disposed of off-site. Following the series of repeated cuttings, the cut Japanese knotweed populations along the banks will then be covered with a 20-millimeter impermeable geomembrane liner, designed to smother any new growth from the cut plants. The geomembrane liner will be trenched in at the top and base of the slope to a depth of one foot and staked in place. The liner will remain in place for at least one growing season, and may need to remain in place for up to three (3) growing seasons depending upon the success of the knotweed removal. Once the liner has been removed, the area may then be revegetated with native species.

For Japanese Knotweed Populations Outside of Wetland Areas (T2B)

As these populations are located farther from surface water (i.e., not within wetland areas), chemical control is a more effective method of management in these areas. In these locations, and particularly for densely vegetated areas where desirable neighboring vegetation must be avoided (e.g., native plant species), the use of a "weed glove" is recommended for applying the herbicide solution in dense areas to avoid herbicide application on non-target plants.

B. Purple Loosestrife

Purple loosestrife is a perennial herb with a strongly developed taproot, which ranges in height from 0.5 to 2.0 m and is easily recognized when in flower by its bright pink inflorescence. This species is native to Eurasia, but now forms large, monotypic stands throughout the temperate regions of the U.S. and Canada, with some of the heaviest concentrations in the glaciated wetlands of the northeast. Purple loosestrife blooms from July through September or October and produces copious seeds, with estimates of more than 2.5 million seeds annually per mature plant. Seeds can remain viable even after 20 months of submergence in water. Purple loosestrife can spread vegetatively by re-sprouting from cut stems and regenerating from pieces of root stock.

Infestations of purple loosestrife appear to follow a pattern of establishment, maintenance at low numbers, and then dramatic population increases when conditions are optimal due to its high seed viability and prolific seed production. Purple loosestrife flourishes in wetland habitats that have been disturbed or degraded. Loosestrife crowds or shades out native species and eventually becomes a virtually monotypic stand.

Several control methods for purple loosestrife have been attempted with varying degrees of success, including mechanical, chemical, and biological methods. It is recommended that any control effort be followed up during the same growing season and for several years afterwards since some plants will be missed, new seedlings may sprout from the extensive seed bank, and a few plants will survive the low-dosage treatment.

Manual and Mechanical Control Alternatives for Purple Loosestrife

Hand-removal is recommended for small populations and isolated stems. In small populations, younger plants (1-2 years old) can be pulled by hand. Plants more than 2 years old should be dug out with special care to include the entire rootstock. Use of tools, such as a "Weed Wrench," on plants once they have developed a woody cane can be an effective way to remove this rootstock. Ideally, the plants should be pulled out before flowering. The entire rootstock must be pulled out since regeneration from root fragments is possible, with care taken to minimize disturbance to the soil and native vegetative cover.

Uprooted plants and broken stems must be removed from the area since the broken stems can re-sprout. All plant parts should be carefully bagged, removed from the site, and placed in approved landfills or preferably burned to prevent escape to other non-infested sites. In addition, it is recommended that clothing, boots, and equipment be properly cleaned to ensure that no seeds are transported to other wetland areas. Follow-up treatment of these sites is recommended for 3 years to eliminate re-sprouting from fragments left behind. Where practicable, native plants should be restored to the control area by seeding or planting to encourage re-establishment of native vegetation and deter new loosestrife seedling development.

Cutting of stems has demonstrated to be somewhat effective, but because cutting leaves the root structures intact, it allows the plant to regenerate, so repeated cuttings may be necessary over the course of a growing season. Again, all plant parts should be removed immediately from the site and disposed of properly. Cutting and removing of the flowers may be an effective means of controlling or slowing the spread of this species in areas where this plant is expanding and removal is not feasible. Again, all plant parts that are cut should be bagged and removed from the site to prevent re-sprouting.

Mowing is not recommended for purple loosestrife because it can further spread the species by distributing plant stems that will sprout vegetatively.

Chemical Control Alternatives for Purple Loosestrife

The herbicide glyphosate, which contains a non-ionic surfactant (such as Rodeo®) and has been approved for use over water, is most commonly used to control purple loosestrife. Spot application of Rodeo® directly onto individual plants would ensure that only target species were affected. The safest method of applying glyphosate herbicide is to cut off all stems at about 6 inches and then paint or drip onto the cut surface a 20-30% solution of glyphosate.

Broadcast spraying with a 1-2% solution of Rodeo ® done after the period of peak bloom (usually late August) has proven effective in some monotypic stands of purple loosestrife, with care taken to not over saturate the area to avoid spraying non-target species. For larger infestations where spot application of glyphosate is not practical, broadleaf herbicides, such as triclopyr, have been proven effective when applied in late May or early June; although the disadvantage of treating early in the season is that purple loosestrife plants are easily overlooked when not in flower.

Biological Control Alternatives for Purple Loosestrife

Several insects that feed specifically on purple loosestrife in Europe have undergone intensive laboratory and field tests in the U.S. The most notable species used in New England are two leaf-eating beetles, *Galerucella calmariensis* and *G. pusilla* which defoliate purple loosestrife, leaving behind dried out skeleton of the leaves, impacting the plants' ability to photosynthesize. This also reduces the ability of the plant to store reserves for overwintering and limits its capacity to form flowers. However, the use of biological controls is only effective when the extent of the purple loosestrife population is large enough to sustain the released beetles as a food source.

Recommended Control Methods for Purple Loosestrife

Since the presence of purple loosestrife is limited at present to individuals or small patches within the wetland plant communities along Fuller Brook, only mechanical methods are recommended for this site following the methods outlined above for hand pulling or digging (as necessary). While ideally, the plants should be pulled out before flowering, extending these removal efforts into the early flowering season (late June/July) will increase the chances of eradication of this invasive species when conducted for several years. Care must be taken to carefully bag all plant parts and removed these from the site, and

either placed in an approved landfill or burned to prevent further infestation into other sites. It is also recommended that clothing, boots, and equipment be properly cleaned to ensure that no seeds are transported to other wetland areas. Follow-up treatment of sites is recommended for a minimum of 3 years, and where wetland disturbance occurs, it is recommended that removal efforts be followed by seeding with a native wetland plant seed mix, several of which are available commercially.

C. Oriental Bittersweet

Oriental or Asiatic bittersweet is a perennial vine occurring in all regions of Massachusetts in uplands and wetlands that was introduced to the U.S. in the mid 1800s. This vine often reaches 60 feet in height, and stems may reach four to five inches in diameter. The leaves are opposite, round or elliptical, glossy, and finely toothed. Flowers appear in May. Mature fruit have bright yellow valves with one to three red seeds. This non-native species is wide-spread and produces abundant seeds, which are spread by birds and possibly small mammals and by humans (for instance, through the use of this plant in decorating). The stems of this non-native woody vine wrap around and girdle trees, shrubs, and other woody vines or may cause physical damage from the immense weight of its rapidly growing shoots. Oriental bittersweet may also spread laterally along the ground, forming an impenetrable tangled mass that smothers out all other vegetation.

Oriental bittersweet occurs in various locations throughout the Park. It is widely recognized that management of Oriental bittersweet is difficult due to its high reproductive rate, long range dispersal, ability to root sucker, and rapid growth rates. Mechanical and chemical management techniques are listed below. Management of this species requires extensive monitoring and often a multi-year commitment. While many mechanical and chemical methods are available, manual and mechanical methods are normally considered as temporary management strategies rather than a means for eradication. Due to the persistence of the seed bank and the ability to spread by root suckering, mechanical control of this species will require a long-term commitment. Chemical control methods are generally considered to be more effective than manual techniques and are the preferred strategy for management of bittersweet in certain locations. The preferred manual and chemical controls are as follows.

Manual and Mechanical Control Alternatives for Oriental Bittersweet

- Cutting over several growing seasons may help to control a population to a certain extent. Small shoots may be mowed or cut weekly for at least a year, although less frequent mowing (2 to 3 times a year) can stimulate re-sprouting from the roots. Larger shoots must be cut every two weeks down to the ground. It is important to cut vines as close to the root collar as possible. Cutting will eventually deplete the stored energy within the root stock, leaving only the seed bank to manage. Cutting can also result in vigorous re-sprouting from below-ground stems (rhizomes).
- Pulling or grubbing of larger plants including all roots and runners using a "Pulaski" or similar digging tool may also reduce a population, although re-sprouting is inevitable if not all the root material is removed. Even if all root material is removed, germination of seeds present in the seed bank will occur for several growing seasons. All plant parts (including fruits) should be sealed in bags and disposed of in a landfill to prevent reestablishment on a given site.

Mechanical control is most practical in small plots, or in areas where chemical control is not an option. Ultimately, manual and mechanical control is a means of restricting growth until the roots and seeds are no longer viable.

Chemical Control Alternatives for Oriental Bittersweet

Chemical control methods are preferred for management of Oriental bittersweet and are more effective than manual techniques. While both glyphosate and triclopyr have been used to control bittersweet, most

of the literature cites more effective control with triclopyr. Triclopyr specifically targets broadleaf plants, reducing the chances of impacting nearby monocots. Triclopyr may be applied using several techniques.

- Cut-stump (or cut-stem) applications are also effective and are preferred in environmentally sensitive areas. This method is also more appropriate for tall vines that have reached the tree canopy. The stems should be cut to approximately two inches above ground level, and then the cut surface should be immediately painted with concentrated herbicide (8% to 25% active ingredient for triclopyr). It is sometimes necessary to follow the cut-stump application with a foliar spray about two weeks after treatment.
- Basal bark application is another viable technique for controlling Oriental bittersweet. The foliage should be stripped from the stem in a band at a comfortable working height. A 20% triclopyr solution in a commercial basal oil should be applied to the stripped area, while avoiding contact with any trees or plants the bittersweet is entwining. This technique may be conducted year round as long as the temperature remains above 50 degrees Fahrenheit for several days.
- Foliar spraying may be very effective in areas where it is permitted. Low, monocultures of bittersweet may be sprayed directly. Triclopyr has been effective at concentrations as low as 2% to 5% active ingredient. A 0.5% concentration of a state-approved non-ionic surfactant is recommended in addition to the triclopyr so that the herbicide penetrates the leaf cuticle. While foliar spraying may be conducted at any point during growing season, it is preferable to spray in late fall while other non-target species are dormant. In addition, temperatures should be well above 40 degrees Fahrenheit, and rain should not be forecast within 24 hours of treatment. Both sides of the leaf should be sprayed liberally, but not to the point of dripping. A second application is often required after two weeks. For particularly large, dense stands, it may be more effective to cut the shoots before the foliar spraying. The stand may be cut or mowed to ground level in the spring then the new shoots may be spraying in the summer, prior to fruiting.

Recommended Control Methods for Oriental Bittersweet

Mechanical Methods

- Smaller plants and vines should be pulled or grubbed including all roots and runners using a "Pulaski" or similar digging tool. This should occur during the months of March and April. Some regrowth should be anticipated if not all of the root material is removed. Regrowth may also occur from germination of seeds present in the seed bank. Pulling or grubbing of larger plants including all roots and runners may also reduce a population, although re-sprouting is inevitable if not all parts are removed.
- For larger plants, it is recommended that the stems be cut every two weeks down to the ground and as close to the root collar as possible. Stems should be cut frequently (weekly or bi-weekly) throughout the year (from April through October), as cutting less frequently can stimulate vigorous re-sprouting from below ground stems.
- All plant parts, including fruits, should be bagged and disposed of in a landfill to prevent reestablishment on a given site.

Chemical Methods

Smaller populations have been successfully controlled by cutting and applying an herbicide (triclopyr) to the regrowth about a month later. Research has also demonstrated effective control by applying triclopyr to cut stems at the time of the first killing frost. Where warranted, and where mechanical methods have proven ineffective after several attempts, the use of herbicides is recommended. Large, dense populations (i.e., the most difficult to manage plants) will be cut down and then treated with triclopyr one month following the cutting. This technique may occur during April and May as well as during September to October.

Special Note on Oriental Bittersweet

It is noted that Oriental bittersweet near the Dover Road segment has completely taken over the trees along the northern slope, making it nearly impossible to control bittersweet at this location. It is likely that most, if not all of the trees in this area are dead and will need to be removed. A note to this effect will be incorporated on the final design plans. Given that most trees and stumps will likely be removed, hand pulling of any subsequent sprouting of Oriental bittersweet may be a better management option in this location.

D. Japanese Honeysuckle

Japanese honeysuckle is a perennial trailing or climbing woody vine with white tubular flowers that yellow later in the season prior to formation of purplish-black berries. Flowers are produced from late April through July, and sometimes through October; the fruits are produced September through November.

It is commonly found along roadsides, forest edges, and in abandoned fields, and like many invasive plant species, quickly invades natural areas after disturbances. Japanese honeysuckle creates dense tangled thickets by a combination of stem branching, nodal rooting (rooting from nodes along the stem), and vegetative spread from underground rhizomes, and can rapidly cover shrubs or small trees, either stunting their growth or killing them completely. Dense growth of the species will also reduce light available to other species, deplete soil moisture nutrients, and may cause trees to topple due to the weight of its vines.

In northern states, Japanese honeysuckle retains some leaves through all or most of the winter (semi-evergreen or evergreen), when most native plants have dropped their leaves, thus providing a window of opportunity from mid-autumn through early spring when it is easier to spot and treat this species with less risk of damaging native species.

Manual and Mechanical Control Alternatives for Japanese Honeysuckle

Small patches of Japanese honeysuckle can be eliminated by hand pulling and removal of trailing vines. However, all roots and shoots need to be removed from the site and disposed of properly. Mowing is typically not an effective control method for Japanese honeysuckle since removal of aboveground growth will stimulate additional regrowth (from underground stems), and therefore encourage the formation of dense mats. However, mowing twice a year can reduce vegetative spread although stem density may increase. Cut material must also be removed from the site to prevent rooting and additional spread.

Burning has also proven somewhat effective as a means of controlling Japanese honeysuckle because seedlings and young plants are most susceptible to fires.

Chemical Control Alternatives for Japanese Honeysuckle

The most effective treatment is a foliar application of a glyphosate or triclopyr herbicide, applied after native vegetation is dormant and when temperatures are near and preferably above freezing (November). Herbicide applications within 2 days of the first killing frost are more effective than applications later in the winter, since Japanese honeysuckle is less susceptible to herbicides after the first hard frost ($-4^{o}C$).

Combining fire and herbicides has proven to be more effective than either method by itself if late autumn or winter burns are used to reduce Japanese honeysuckle biomass, and all re-sprouts are then treated with a foliar application of glyphosate about a month after they emerge. Soil disturbance should be avoided in infested areas to minimize germination of seed in the seedbank.

Recommended Control of Japanese Honeysuckle

Given the limited extent of Japanese honeysuckle at Fuller Brook Park, hand removal by pulling and removing all plant parts from the site is recommended as an initial control method for this species. Given the public setting, burning is not recommended.

E. Tree-of-Heaven

Tree-of-Heaven is a fast-growing tree, which attains a height of 80 feet or more. Native to central China, it was first introduced into the United States in the late 1700s and was initially valued as a horticultural specimen and later as a street tree and shade tree. As such, it continued to be planted throughout the country well into the 20th century. This species has a tendency to spread rapidly by both seeds and root suckers, and seeds can germinate throughout the summer. Once established, it usually continues to dominate a site, primarily by producing root suckers. When cut, this species responds by rapidly sending out root suckers that can grow up to six feet per year. Tree-of-Heaven also produces a natural herbicide that is toxic to other species of plants, a biological process known as allelopathy.

Management alternatives for this species include both mechanical and herbicide methods and are described below. However, its particularly aggressive nature and its ability to create a toxic environment around it, make this particular species a candidate for limited herbicide use to achieve the project goals.

Manual and Mechanical Control Alternatives for Tree-of-Heaven

- Hand Pulling. Young seedlings of Tree-of-Heaven can be pulled by hand, but only when first discovered. After approximately 3 months of growth, they will develop a significant taproot and then will become very difficult to remove through hand pulling. Thus, plants should be pulled as soon as they are large enough to grasp. Seedlings are best pulled after a rain when the soil is loose. The entire root must be removed since broken fragments may re-sprout.
- Cutting. Larger trees may be cut at ground level with power or manual saws. Cutting is most effective when trees have begun to flower to prevent seed production. Because Tree-of-Heaven spreads primarily by root suckering, re-sprouts are common after treatment. Two cuttings per year may be necessary, one early in the growing season, and one late in the growing season. Although plants may not be killed after cutting, seed production will be inhibited and vigor will be reduced. If continued for several years, plants will be severely stressed by cutting and will eventually be killed.
- Girdling. Girdling is the most effective mechanical method for larger trees. This should be conducted using a hand-axe to make a cut through the bark approximately 15 cm (6 in) above the ground, and cut completely around the trunk. Be sure that the cut goes well into or below the cambium layer (essentially cutting through the bark and into the wood). This method will eventually kill the top of the tree but re-sprouts are common, and may require follow-up treatments for several years, as described above. Ultimately, the dead tree would also need to be removed if it poses a safety hazard.

Chemical Control Alternatives for Tree-of-Heaven

Often the only way to completely manage Tree-of-Heaven is through the use of herbicides. Tree-of-Heaven tends to be more susceptible to triclopyr than to glyphosate, especially prior to late summer. Where possible, foliar sprays are effective once the leaves are fully expanded. For larger trees, three approaches are possible: 1) Girdle the tree (see description above) with an axe, and apply undiluted triclopyr in the cut around the trunk; 2) Cut down tree and apply undiluted triclopyr into the freshly cut surfaces of the stump to prevent re-sprouting, or 3) Cut down tree and spray re-sprouts before they get too tall to spray.

Recommended Control of Tree-of-Heaven

Due to the aggressive and opportunistic nature of this species, a combined management strategy of both mechanical and chemical controls is necessary. Management techniques will differ, depending upon the growth stage and maturity of the tree. This species also requires a long-term monitoring commitment, as it tends to persist and re-emerge even after implementation of aggressive management strategies.

Mature Trees

Mature trees should be cut at the base. Managers should anticipate the emergence of root suckers and treat them with techniques prescribed for seedlings and root suckers (described below). The timing of cutting is integral to successful control of this species; all cutting should be conducted in June and early July. Alternatively, cutting may occur in late July to August or late May, if necessary. It is important to note that cutting in the early spring, fall, or winter, especially for the first cutting, is not effective as a means of control. In order to ensure optimum absorption of the herbicides, typically within five minutes of cutting, the stump should be painted with a concentrated herbicide solution (triclopyr or glyphosate) to prevent sprouts and discourage the emergence of root suckers. Time lapses between cutting and herbicide application of greater than 10-15 minutes, will prevent the effective uptake of the herbicide as the plant seals off the cut area off.

Seedlings and Root Suckers

All seedlings and root suckers should be pulled by hand upon detection and disposed of in a sealed bag and transported to a suitable off-site location. It is important to remove as much, if not all, of the root structure and residual root fragments as possible. Root suckers that emerge from cut stumps should be cut frequently, as much as once a week, during the growing season to discourage new growth over the long-term. Root suckers may be controlled by shading from new plantings, and introducing dense plantings of native vegetation near cut stumps will help to shade out recurring grow of Tree-of-Heaven. Root suckers may also be controlled with an application of herbicide (triclopyr) wiped along the foliage, if conditions allow.

F. Norway Maple

Norway maple is a tall deciduous tree that had been planted extensively as an ornamental tree, and is now found invading natural areas where it often outcompetes native sugar and red maples and other deciduous trees. Similar to other deciduous woody invasive trees and shrubs, it leafs out earlier in the spring and its leaves typically remain green longer into the fall thereby extending its ability to photosynthesize longer than other plants. Norway maple reproduces by seed, which it produces prolifically, and seedlings and saplings are shade tolerant. Once established in a forested area, the seedlings can quickly dominate the forest understory. Management options for Norway maple include both mechanical and chemical methods as described below.

Manual and Mechanical Control Alternatives for Norway Maple

Mechanical control methods include hand pulling, mowing or cutting, or girdling, depending on the size of the individual.

- Hand Pulling. Seedlings can easily be hand-pulled in their first year of growth. Beyond that, the root system becomes too elaborate to make pulling feasible.
- Mowing/Cutting. Large areas dominated by young seedlings can be easily controlled by mowing. Larger trees and saplings may be cut at ground level with power or manual saws. Cut stumps may re-sprout, and therefore follow up maintenance may also be required for several years. Mature individuals in the vicinity of natural areas should also be removed to remove potential seed sources.

- Girdling. Girdling has proven effective for larger trees where removal of large trees is not practical. Similar to the methods described for Tree-of-Heaven, girdling should be conducted using a hand-axe to make a cut through the bark approximately 15 cm (6 in) above the ground, and cut completely around the trunk. Be sure that the cut goes well into or below the cambium layer.

Chemical Control Alternatives for Norway Maple

It has been demonstrated elsewhere that young seedlings can be easily controlled with herbicides (glyphosate or triclopyr). In conjunction with girdling, herbicide application can be painted on the surfaces of the trunk to aid in destruction of the tree and to prevent re-sprouting.

Recommended Control of Norway Maple

Norway maple is another tenacious tree species that the Project Design Team believes will likely require the use of herbicides for effective control. Mature trees should be cut at the base in spring/early summer, and cut stumps should be hand-painted with a concentrated herbicide solution (glyphosate) to prevent sprouts from emerging. Seedlings and sprouts should be removed via digging or pulling by hand when possible, taking care to remove as much of the root structure as possible along with any root fragments; any regrowth should be cut and then wiped with herbicide in late summer/early fall.

G. Invasive Woody Shrubs

Several additional invasive shrub species, including European buckthorn, multiflora rose, honeysuckle, winged euonymus, and forsythia occur throughout Fuller Brook Park, and are discussed individually below. These species are found in relatively small concentrations in the Park. As such, and in general, mechanical control methods are anticipated to be sufficient to manage these species. For each of these species, glyphosate is most effective and should be applied according the timeline attached to this memo, when warranted.

European Buckthorn

European buckthorn is a deciduous shrub that inhabits typically wetter, less shaded areas with acidic soils. Fruit production of European buckthorn is abundant, and seeds are dispersed usually by birds and small mammals. This non-native shrub rapidly germinates in a variety of soil conditions, but germination is most successful in open areas where soils have been disturbed. Additionally, this species will re-sprout vigorously following top removal. In one study, researchers observed that mature shrubs cut near the base can send up sprouts nearly 2 m tall in the same year (Wyman, 1971; Andreas, 1983; and Brue, 1980; as cited in Converse, 1984). This species is a huge threat to native wetland communities, where it can form dense stands that cause the growth of other species to be suppressed. European buckthorn is most successful under drier conditions in wetlands.

Methods to control this species include manual and chemical management. Burning has been demonstrated as ineffective, particularly when burns are done on open land near a Buckthorn population, as fire-exposed soils are more vulnerable to seed dispersal.

Manual and Mechanical Control Alternatives for European Buckthorn

- Studies have shown that cutting back larger plants twice in a single growing season for 2-3 consecutive years results in fewer and shorter stems and reduced plant vigor. This is best done twice a season (June and August). Plants with stem bases less than 4.5 cm (2 inches) in diameter can be successfully girdled (a 2- to 3-cm wide cut) during the winter months. Girdling does not disrupt soils and would not disrupt sensitive wetlands.

- Individual seedlings can be hand pulled or removed with a grubbing tool; however, this technique is only effective in areas of low buckthorn density.

Chemical Control Alternatives for European Buckthorn

- Using glyphosate without a surfactant has been reported to have the greatest control with little or no harm to non-target vegetation. Herbicide application of glyphosate has been effective on cut stumps or along girdled stems.

Recommended Control Methods for European Buckthorn

Given the extent of European buckthorn at this site, the recommended method for control of this species is mechanical: cutting back larger plants and girdling of large-stemmed individuals. While the use of herbicide (Rodeo®) has proven effective elsewhere, it is not recommended at this site, where the majority of the European buckthorn plants are located within or immediately adjacent to wetlands.

Multiflora Rose

Multiflora rose is a large, thorny perennial shrub that can reach over 10 feet in height. Native to Asia, this species was introduced to the United States in the mid 1800s as rootstock for ornamental roses. As with many non-native species, *Rosa multiflora* tolerates a wide range of soil, moisture, and light conditions. It is dispersed by birds and by low-lying branches which then develop roots and spread vegetatively. Both mechanical and chemical methods have been used to control this species by land managers.

Manual and Mechanical Control Alternatives for Multiflora Rose

- Young plants may be removed by hand, but caution must be taken to ensure the entire root system has been removed.
- Mature plants may be "controlled" by repeated cutting and mowing (3 to 6 times a year). Cutting is best when the population is small and the use of herbicides is not an option due to the sensitivity of the overall habitat. Stems must be removed at least once per growing season as close to the ground level as possible.
- Cutting and clearing down to the stumps is another option, though traditionally not executed due to the vast number of thorny branches. This method is best executed through the use of a hedge cutter.

Chemical Control Alternatives for Multiflora Rose

- Treatment through the repetitive use of herbicides has proven to be an effective control method. Triclopyr may be applied in the early spring before or during flowering. Glyphosate is most effective when applied during the early summer, and can be used through the early fall.

Recommended Control Methods for Multiflora Rose

The extent of multiflora rose at this site is limited to a few individuals. Since hand removal of smaller individuals of this species and cutting of mature shrubs are effective methods of managing this species, the preferred method will be through the use of mechanical measures as discussed above. With only a few individuals of this species identified at this site, it is not anticipated that a brush mower will be necessary. Likewise, use of herbicides is not recommended for management at this site

Winged Euonymus

Winged euonymus is a medium-tall, deciduous shrub native to Northeast Asia, Japan, and Central Asia. It was introduced in the mid-1800s. *Euonymus alatus* is tolerant of a wide range of habitats from full sun

to full shade, from open undisturbed areas to forests understory, and can tolerate a variety of soil types and acidity (pH) levels. This species thrives in well-drained soils but does not tolerate water-logged soils as readily. The fruits of winged euonymus are usually dispersed by birds. However, seeds often drop just below the plant, creating a "seed shadow" that suppresses the growth of all other species in the immediate vicinity. Due to the excessive amount of seeds produced, it is difficult to control this species. Methods of control include both manual and chemical management practices.

Manual and Mechanical Control Alternatives for Winged Euonymus

- Seedlings up to two feet tall may be pulled from the ground, particularly when the ground is moist. Larger plants and their root systems may be dug out through the use of a weed wrench or spading fork.
- Larger shrubs may be cut, but the stump must be ground out or the re-growth cut repeatedly.
- An alternative mechanical method is to trim off all of the flowers as to prevent the spread of the seeds, although this is extremely labor intensive and often not practical.

Chemical Control Alternatives for Winged Euonymus

- Cut stumps may also be painted with glyphosate (Roundup®). When the population is beyond manual treatment, glyphosate may be applied as a foliar spray, which is most effective during the summer months.

Recommended Control Methods for Winged Euonymus

The extent of winged euonymus is limited to a few individuals at this site. Hand removal of smaller individuals of this species when the ground is moist, and digging of mature shrubs are effective methods of managing this species. Therefore, only mechanical methods are proposed for the control of this species.

Bush Honeysuckle

Bush honeysuckles include a group of non-native species that have generally escaped from cultivation. These shrubs, including Belle, Amur, Morrow's, and Tatarian honeysuckle, often hybridize, and as such, identification to species level is often difficult. Non-native bush honeysuckles leaf out earlier and retain their leaves later into the growing season, creating denser shade than native shrubs, and reducing plant diversity within a given community. Reproduction of bush honeysuckles is almost entirely by seed and these plants consistently produce an abundant seed crop with high germination rates. The seeds are mainly dispersed by birds, which eat the fruits that ripen in mid-summer, and then disperse the seed. As a result, non-native honeysuckles are wide-spread.

Management techniques for bush honeysuckles include mechanical measures (pulling, cutting, or controlled burning), as well as chemical control. The literature notes that if management of this species is attacked during the early stages of colonization, the potential for successful management is high.

Manual and Mechanical Control Alternatives for Bush Honeysuckle

- Grubbing or pulling of seedlings and mature shrubs and repeated clipping of mature shrubs should be done with the aid of a "weed wrench" or spading fork. Pulling should be done when soil conditions are moist. This practice is best done during the growing season[1] (for populations growing in more open settings such as Fuller Brook Park) – generally once in early spring and again in late summer,

[1] The growing season for Norfolk County is April 30 through October 7 (USDA, 2002).

since winter clipping encourages vigorous re-sprouting. Care should be taken to not disturb the soil any more than necessary, as this can result in vigorous re-growth.

- Bush honeysuckles growing in a more open setting can also be managed by clipping twice a year; once in the early spring and the other in the later summer or early fall.
- Prescribed burning has been somewhat successful, though manual removal of the bush honeysuckles is more widely recommended.

Chemical Control Alternatives for Bush Honeysuckle

- Treatment with herbicides such as glyphosate or triclopyr is best used for bush honeysuckles growing in full sun, and for larger honeysuckle populations, although somewhat greater management of this species has been reported with the use of glyphosate. Herbicides should be applied to the foliage in the late growing season and to the stumps of cut bush honeysuckles during the late summer and extending into the dormant season.

Recommended Control Methods for Bush Honeysuckle

Non-native honeysuckles within Fuller Brook Park are limited to a few smaller individuals, located primarily in the northeastern section of the open field. In the literature, most land managers report that treatment with herbicides may be necessary for control of larger populations of bush honeysuckles. However, since only a few individuals of this species were identified during the field survey, the use of herbicides is not the preferred method for management at this site.

Since grubbing or pulling by hand is considered an effective method of management for small populations, proposed method of control for bush honeysuckle at this site includes mechanical controls only. Smaller plants and seedlings will be grubbed or pulled by hand as necessary on an annual basis, until re-sprouting no longer occurs. Larger shrubs will be clipped twice yearly (early spring and again in late summer/early autumn) until eradication of this species is achieved. Winter clipping should be avoided as it is noted within the literature that this can promote vigorous re-sprouting.

H. Poison Ivy

Poison ivy is a native, woody vine that is often found within damp areas, although it is tolerant of a wide range of fertility, moisture, and other soil conditions. This plant is best known by its characteristic three shiny leaflets, which flowers from May through July, and develops white papery fruits from August to November that persist into the winter season. This plant is considered to be a noxious weed, and all parts of poison ivy plants contain a resinous oil, urushiol, that causes an irritating rash through skin contact. As such, it poses a particular threat to human health, particularly in a park setting.

Poison ivy is also classified as a “mechanical parasite” in that it sometimes depends upon trees to provide support as it grows from the forest floor to better lit areas in the forest canopy. Climbing poison ivy stems may negatively affect forest tree species by direct physical suppression, shading, or via competition with roots for water and nutrients. This species spreads primarily through vegetative methods.

Demonstrated control methods include mechanical and chemical, and biological removal. However, caution must be taken to avoid skin contact with any part of the poison ivy plant or its oils that may contaminate clothing.

Manual and Mechanical Control Alternatives for Poison Ivy

Smaller plants and seedlings in small infestations may be controlled by carefully digging out plants; however, all stems and roots must be removed for this technique to be effective. Cutting stems during the non-growing season has also demonstrated to be an effective method of controlling this species. However, other mechanical removal methods, such as such as hand-pulling, may stimulate growth of plants from fragments left in the ground.

Chemical Control Alternatives for Poison Ivy

It has been reported that small vines can be controlled with the use of herbicides. Triclopyr is most effective when applied throughout growing season; glyphosate is most effective when applied in late summer to early fall. Larger vines that are wrapped around trees may be cut and the freshly-cut ends painted with either glyphosate or triclopyr.

Biological Control Alternatives for Poison Ivy

Some land managers have reported that poison ivy can be partially controlled by livestock browsing, particularly by domestic goats and cattle, but there is often a resurgence of growth after browsing stops.

Recommended Control Methods for Poison Ivy

Given its presence in a park setting where human interaction with this species is a threat, the Project Design Team recommends the use of a limited amount of herbicide application in specific locations as described above. Cutting during the non-growing season should be done in areas where the presence of poison ivy does not pose an immediate threat to humans or to the environment. Although somewhat effective, the use of biological controls using livestock within a park setting would not be recommended, as the animals may graze on plant species non-selectively unless carefully controlled themselves. As a result, they would need to be confined (fenced in) to the area where poison ivy control is proposed, which may be more disruptive to the environment, and in turn, may result in the further spread of undesirable plant species.

VI. Additional Justification for the Use of Herbicides

The Project Design Team is recommending limited herbicide use for the extremely aggressive invasive species in the Fuller Brook Park based on research and experience of other land managers on what methods are the most effective to reach the project goal. However, there are other reasons that limited herbicide use should be considered for this project. These reasons are described below:

- Invasive species management is just one component of a much larger capital improvement project in the Park. Using limited herbicide control of extremely aggressive species is much more effective and less disruptive than constant cutting and attempting to dig up every root, runner, and rhizome. Once the capital improvement project is complete, it will then be the Town's responsibility to continue to manage the invasive species as part of the long-term maintenance program. Thus, the more successful the efforts of removal are during the implementation of the capital project, the easier and more cost effective it will be for the Town to continue the invasive species management.
- Due to the large scale and specific timeline of this Town project, limited herbicide control is the most cost-effective and efficient way to undertake the recommended invasive management. This is an important distinction as compared to a home owner managing species on a single lot.
- The use of herbicides will reduce visual impacts to Park users in some cases. For example, the method proposed for areas of Japanese knotweed along the streambank includes leaving black plastic over the area for a minimum of 1-2 years. This would be extremely disruptive to the Park if used for all upland (e.g., outside of aquatic areas) stands of knotweed as well.

VII. Emergency Waiver Requests

According to the IPM Policy, the Wellesley NRC may grant a temporary, one-time Emergency Waiver permitting the use of pesticides if an emergency public health or environmental health situation warrants the use of pesticides, which would otherwise not be permitted. The Project Design Team believes that the conditions within Fuller Brook Park meet the criteria for an Emergency Waiver for the following reasons.

The native plant and animal communities within Fuller Brook Park have evolved over time, resulting in unique ecosystems that are particular to the influences of climate and geologic and hydrological processes that have shaped these ecosystems for thousands of years. Human influences have impacted the natural environment with both intentional (e.g., the development of communities, infrastructure, etc.) and unintentional consequences (e.g., the spread of non-native invasive species). For example, within Fuller Brook Park, some of the plant species perhaps intentionally introduced as part of the Park development, were introduced into the native environment changing the ecological balance. Some of these ornamental species have since been determined to be more aggressive in occupying the ecological niches for which they were intended. This has resulted in the unintentional spread of non-native species that have begun to overtake native plant communities, resulting in a reduced ecological diversity that in turn no longer can effectively support the suite of native wildlife that has co-evolved with the plant community.

Over time, several non-native invasive plant species, which have either colonized or spread within Fuller Brook Park, have perhaps spread even more aggressively in more recent years, a phenomenon that is not unique to the Park, and has been observed and reported by land managers across the country. This has resulted in a severe decline in the native plant communities within the Park and its associated wetland resource areas, which in turn, has lead to a decline in native habitat that supports native wildlife in the area. Left unchecked for so many years, this decline in native species diversity has risen to the level of an environmental threat and would constitute an ecological emergency situation if allowed to continue.

The Project Design Team, while developing the proposed invasive species management plan, has had the challenge of balancing the environmental risks while adhering to the IPM Policy. Based upon the available literature and experience of other land managers, it has been determined that several of the invasive species at this site, given their growth habits, can simply not be effectively managed without at least the limited use of herbicides, even when considering alternative mechanical controls. These include:

- Japanese knotweed,
- Tree-of-Heaven,
- Norway maple, and
- Oriental bittersweet.

Another species, poison ivy, while a native plant species, poses a dual threat, both to the environment and to human health. Its ability to aggressively climb and ultimately strangle mature trees within the floodplain, poses a threat to the forest canopy; while its presence in a park setting where poison ivy-human interaction can occur, poses a threat to human health and safety. As such, the Project Design Team believes that a limited amount of herbicide application in specific locations will reduce those threats.

The Project Design Team believes that other species discussed here, due to their limited presence within the Park and our understanding of alternative and demonstrated mechanical control methods, can

be effectively managed without the use of herbicides with a commitment to long-term maintenance and monitoring. A maintenance and management plan has been developed for Fuller Brook Park and this waiver request memo will be referenced within that document.

We respectively request that the NRC consider granting a waiver request for the limited purpose of addressing the environmental and human health threats that we believe constitute an emergency situation as described herein.

VIII. Notes on Herbicide Use

Various groups, including the Nature Conservancy (TNC), MIPAG, and the National Park Service (NPS) strongly recommend non-chemical methods of control wherever feasible. However, for large infestations, and for a few plants specified above, non-chemical methods are inadequate. Any herbicide use permitted within Fuller Brook Park would be applied only by a Massachusetts' Licensed Pesticide Applicator and in accordance with all State regulations pertaining to herbicide application, and would not be applied within any aquatic area (e.g., within BVW).

The two main herbicide treatments considered in developing this management plan include glyphosate and triclopyr). Glyphosate (e.g., Round-up® or Rodeo®) is a non-selective, systemic herbicide that kills both grasses and broad-leaved plants. Triclopyr (e.g., Brush-B-Gone™, Garlon™, Pathfinder™) is a selective herbicide that kills broad-leaved plants but does little or no harm to grass species. Applied carefully to avoid non-target plants, glyphosate is the least environmentally damaging herbicide in most instances. Round-up® contains a petroleum-based sticker-spreader that allows the herbicide to cling to the target species to ensure its absorption into the plant's tissues. Rodeo®, the glyphosate formulation for use in wetlands, does not contain any sticker-spreader, and thus is considered to be safer for the wetland environment. However, this is not proposed for this project.

Where appropriate and considered necessary for the successful management of the invasive species at this site, specifications for the type of herbicides will be provided. As with the timing for mechanical methods for management of invasive species, non-specific use of herbicides or use of a specific herbicide at incorrect times or in incorrect concentrations can actually lead to spreading of invasive species.

Other considerations for herbicide use include avoiding inclement weather conditions such as wind, which could result in herbicide application to non-target, possibly native species, or rainy conditions, which could dilute or wash away applied herbicides, rendering them ineffective.

The Project Design Team anticipates that the limited use of herbicides under the emergency waiver clause would be subject to strict conditions, including, but not limited to:

1. No pesticides shall be used within aquatic resources (wetlands).

2. The area treated shall be conspicuously sign-posted as soon as possible after application and for a period of at least 48 hours. Furthermore, the IPM committee shall be notified as soon as practical and a specific IPM plan developed to prevent further such emergencies.

3. Pesticide applications must be conducted by an individual who is properly licensed in Massachusetts. If Town employees are to implement the recommended use of pesticides for certain species under this management plan, then they must be certified as a Massachusetts' Licensed Pesticide Applicator. All use of herbicides should be supervised by the recommended "Environmental Monitor."

4. Use of herbicides under this waiver request will be limited to a one-time application for each species, whether a one-time application or a series of successive applications to occur over a single growing season, as described. It should be noted, however, that the proposed project will likely be constructed in phases, and that herbicide application as it applies to this memo, may occur in different years, depending on the construction schedule. The Environmental Monitor shall assess the relative success of the various recommended chemical management techniques, and will provide recommendations for possible repeat applications of herbicides for consideration by the NRC.

5. The Environmental Monitor shall also assess the relative success of the recommended mechanical control methods. Should these methods prove to be ineffectual following the third growing season of treatment, the Environmental Monitor may make specific recommendations for the limited use of herbicides on a case-by-case basis. This would require the project Proponent to approach the NRC for consideration of an amendment to the emergency waiver request.

IX. Conclusion

The Project Design Team feels strongly that limited herbicide use is necessary to meet the goals of the Fuller Brook Park Preservation Project. If allowed under the emergency waiver clause, herbicides will be specifically targeted to the species listed above, and applied by certified applicators who follow a strict methodology to minimize, if not eliminate, impacts to surrounding native vegetation and water resources.

Thank you for considering this request, and please contact the Project Design Team, if you have any questions or need additional information.

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Attachments

February 6, 2013 Response to NRC Waiver Request Memo comments from NRC (response Jan_28_13)

Herbicide Fact Sheets for Glyphosate and Triclopyr