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Department of
Agriculture

Forest
Service

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# Non-native Invasive Species Best Management Practices

## Guidance for the U.S. Forest Service Eastern Region

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# Preface

WI DNR Preface - In 2002, the Wisconsin Council on Forestry—comprising representatives of private and public forestry professionals, timber and forest product industries, conservation organizations, forestry schools and other interested groups—was created by state statute to advise the Governor, Legislature, the Department of Natural Resources and other State agencies on issues affecting forests in the state. In 2004, the Council sponsored the Governor's Conference on Forestry. The 64 participants who attended these discussions, again, representing a range of interested groups, concluded that "*invasive exotic* [non-native] *species may present the greatest threat to the long-term health and sustainability of Wisconsin's forests*" and reached "*a clear consensus on the need for voluntary forestry/invasive best management practices and a commitment to a partnership-based process for creating them*." In response, the Council created the Forest Invasives Leadership Team to help guide these efforts.

**Guidance for the U.S. Forest Service Eastern Region Non-native Invasive Species Best Management Practices** assists the Eastern Region National Forests in the implementation of FSM 2900 below. Forests may adapt these NNIS BMP guides for their specific scenarios as necessary. Forests should become familiar with the contents of the new FSM 2900.

**Forest Service Manual 2900 – Invasive Species Management**
Amendment no. = 2900-2011-1 Effective Date = 12/5/2011
Digest: 290 zero code – Establishes code and new manual, FSM 2900, Invasive Species Management, which sets forth national Forest System policy, responsibilities, and direction for the prevention, detection, control, and restoration of effects from aquatic and terrestrial invasive species ( including vertebrates, invertebrates, plants, and pathogens). This new chapter replaces FSM 2080 (noxious weed management). 2902 - Objectives. Management activities for aquatic and terrestrial invasive species … will be based upon an integrated pest management approach on all areas within the NFS and on areas managed outside of the NFS under the authority of the Wyden Amendment (P.L.109-54, Section 434), prioritizing prevention and early detection and rapid response actions as necessary. All NFS invasive species management activities will be conducted within the following strategic objectives: 1) Prevention 2) Early detection & rapid response 3) Control & management 4) Restoration 5) Organizational collaboration. The document discusses in detail: 2903/ Policy and 2904 /Responsibility. Most relevant to our Forests may be the discussion about Regional Forester, Forest Supervisor, and District Ranger responsibilities.

# Purpose and Scope Statements

## Purpose Statement

Non-native invasive species (NNIS) pose a threat to forest ecosystems and forest productivity. Managers can play important roles in slowing the spread of NNIS. This guide describes practices to aid in those roles. The goal is to provide practices that prevent the inadvertent spread of NNIS, reducing the impacts of NNIS. In the management of NNIS, an ounce of prevention is worth more than a pound of cure.

## Scope Statement

The best management practice (BMP) statements in this guide are intended to apply to forest stewardship activities. This guide is intended to help managers make the most efficient use of limited resources to combat NNIS.

### *How will this be implemented?*

The BMPs in this document cover a wide variety of situations, including field activities of agency personnel. Practitioners who develop management plans, prescriptions, and timber sale documents (including contract language) are encouraged to identify specific BMPs within this guide that address their circumstance. Some managers will have more resources than others; goals and objectives will vary; therefore, the scale and intensity of implementation for each BMP may vary with individual situations.

Who is this for?

Foresters, landowners, and loggers can play important roles in slowing the spread of NNIS, and they may all play different roles in different circumstances. Practitioners should also clarify who has the primary responsibility to implement BMPs.

To what extent should this be implemented?

Initially, we expect these BMPs to apply to a short list of priority NNIS in forested landscapes. However, consistent application of these BMPs will prevent the spread of a wide range of NNIS beyond those on any relatively short priority list. As awareness grows, the understanding of NNIS will increase along with the capacity of forest practitioners to address these concerns.

When will it be implemented?

Effective implementation of BMPs will be a process of continuous learning. Over time, training for foresters, landowners, and loggers will ensure a successful BMP effort.

NNIS species covered by this guide vary by Forest. Forests may list their priority NNIS here:

| Common Name | Scientific Name | Habitat |
|---|---|---|
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Note: This list may be updated as new NNIS species appear. For factsheets on these species with information on identification and general control methods see Forestry Appendix C at http://council.wisconsinforestry.org/. For a more complete working list of terrestrial invasive plant species found in forested landscapes, see Appendix I at http://council.wisconsinforestry.org/.

A priority list of NNIS insects in forested landscapes:

| Common Name | Scientific Name |
|---|---|
| | |
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| | |
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| | |

Note: This list may be updated as new NNIS species appear. For factsheets on these species with information on identification and general control methods see Forestry Appendix C at http://council.wisconsinforestry.org/.

A priority list of NNIS diseases in forested landscapes:

| Common Name | Scientific Name |
| --- | --- |
| | |
| | |
| | |
| | |

Note: This list may be updated as new invasive species appear. For factsheets on these species with information on identification and general control methods see Forestry Appendix C at http://council.wisconsinforestry.org/.

## *Beyond the Scope Statement*

There are additional needs in invasive species management that are beyond the scope of this guide. These needs are addressed by complementary efforts that focus on additional vectors and broader scales which are not fully covered in this guide and include BMPs for NNIS that address recreation, transportation and utility rights-of-way and urban forestry; regulatory programs at regional or national scales including quarantine and port-of-entry regulations that address movement of NNIS and infested material into and within the United States; and federal agency actions to strengthen inspection and management.

# Forestry Best Management Practices

## Chapter 1. Introduction

### *What are non-native invasive species?*

Non-native plants, animals, and microorganisms found outside of their natural range can become invasive. While many of these are harmless because they do not reproduce or spread in their new surroundings, other non-native species (NNIS) are considered invasive if they can cause harm to the economy, ecology or human health of the new environment. These species thrive in new areas because they establish relatively quickly, tolerate a wide range of conditions, are easily dispersed, and are no longer limited by the diseases, predators, and parasites that kept their populations in check in their native range.

Some NNIS have been introduced intentionally for a variety of reasons, including for food (e.g., agriculture crops and livestock), erosion control (e.g., reed canary grass), gardening (e.g., Japanese barberry, purple loosestrife), shade trees (e.g., Norway maple), sport fishing (e.g., earthworms, carp, brown trout, rainbow trout, salmon), and game animals (e.g., ring-necked pheasant). Increases in international trade are resulting in an increasing rate of unintentional introductions of invasive species to forests in eastern North America. These include the hemlock woolly adelgid, an Asian scale insect, which has spread from Virginia to Maine and Georgia during the last 50 years, and beech bark disease, now spreading through the Upper and Lower Peninsulas of Michigan. This disease occurs when either of two species of fungi infests American beech following the invasion by an Asian scale insect.

NNIS are now widespread across an increasing number of acres in the United States, posing threats to habitats and economies in areas as diverse as agriculture, forestry, livestock, fisheries, and recreation. NNIS have spread to a wide range of ecosystems and now rank just behind habitat loss as the leading cause of rare species declines (Wilcove et al. 1998). Local, state, tribal, and national governments; public agencies; non-profit organizations; private corporations; and individual landowners have begun to recognize the NNIS threat and are taking steps to address the problem.

One of the most difficult aspects of managing NNIS is that they are usually widespread before they are recognized as harmful. Some species, like small insects or fungi, are so inconspicuous that populations go unnoticed for many years after introduction. Others species are non-invasive at first, but become invasive later due to adaptation, because wildlife begin to spread them (e.g., multiflora rose), or because population sizes reach the point where exponential growth allows them to increase rapidly.

Figure 1 illustrates this problem using a hypothetical population with a growth rate of 1.5x each generation. For the first 30 generations population growth is barely detectable; this is called the lag phase. After that, the species reaches a population threshold that allows for a rapid increase in the next ten generations – the exponential growth phase. Often a species is not recognized as invasive until it reaches the exponential phase, but by this point control is very difficult and eradication is usually impossible. Gaining an advantage in controlling such species may require taking action during the lag phase, rather than assuming that these species will not become invasive in the future. Recognizing invasive characteristics and taking action early in the invasion process will make control efforts more effective and less costly.

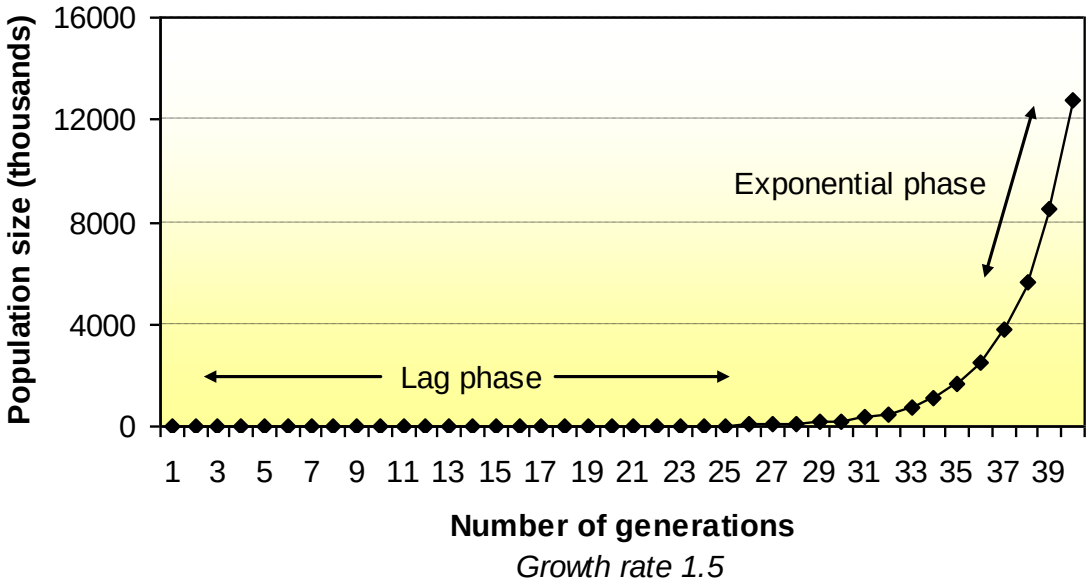



**Figure 1.** Population growth curve, illustrating the lag and exponential phases for a hypothetical population with a growth rate of 1.5x each generation. Population growth rates vary by species. A species with a growth rate higher than 1.5x (e.g., musk thistle, at 2.2x (Shea and Kelly 2004)) would have a shorter lag phase, and one with a lower growth rate (e.g., spotted knapweed, at 1.17x (Emery and Gross 2005)) would have a longer lag phase.

## *What impact have non-native invasive species had on forestry?*

Invasive insects and diseases have had a significant, negative impact on several commercially important tree species resulting in widespread mortality in some and a reduction in growth in others. Examples include the American chestnut (*Castanea dentata*), once one of the most abundant tree species in eastern U.S. hardwood forests and one of high economic importance. In the late 1800s, chestnut blight (a fungus) was accidentally introduced on nursery stock from Asia, and within 40 years, few chestnut trees remained. Although chestnut trees re-sprouted, the blight continues to attack the sprouts, preventing the tree from regaining its former status.

American elm (*Ulmus americana*) was once a major component of hardwood forests across the eastern half of the United States and a popular street tree in the eastern United States until the 1930s when an Asian fungus was introduced on European logs. The disease was spread by two beetle species, one European and one native, and by 1980 had killed the majority of elm trees.

**Typical tree-lined street before Dutch elm disease (Green Bay, WI).** Photo: Wisconsin Department of Natural Resources

Gypsy moth (*Lymantria dispar*), originally from Europe, Asia, and North Africa, was accidentally released in Massachusetts in 1867 in a failed attempt to raise a hardy silkworm. The larvae now defoliate approximately one million acres of oak and aspen forest annually from Maine to Virginia, and west to Wisconsin. While gypsy moth has not caused significant mortality, it is an additional stressor that slows growth and often contributes to mortality in trees that have been weakened by previous defoliation, or other stressors such as drought.


**Defoliation by gypsy moth.** Photo by Mark Robinson

Invasive shrubs are among the most common NNIS in the Midwest. European buckthorns (*Rhamnus spp.*) spread aggressively once they are introduced and have been shown to alter soil ecology, making control and restoration of infested sites difficult (Heneghan et al. 2006). They form dense thickets that negatively impact the establishment of tree seedlings and make accessing infested sites difficult (Frappier et al. 2003, 2004). Non-native honeysuckles (*Lonicera spp.*) also spread rapidly and grow in dense thickets. Honeysuckle infestation reduces species richness and density in forest herbaceous communities and negatively impacts tree seedling establishment (Woods 1993, Hutchinson and Vankat 1997, Collier et al. 2002).

Other NNIS that attack trees include fungal diseases of white pine and butternut. These pests are among many that are now present in Lake States forests, and more are arriving.

## *Impacts on tree regeneration, growth, and longevity*


**Note the lack of tree seedlings and saplings in this garlic mustard-infested forest.** Photo by J. Cardina

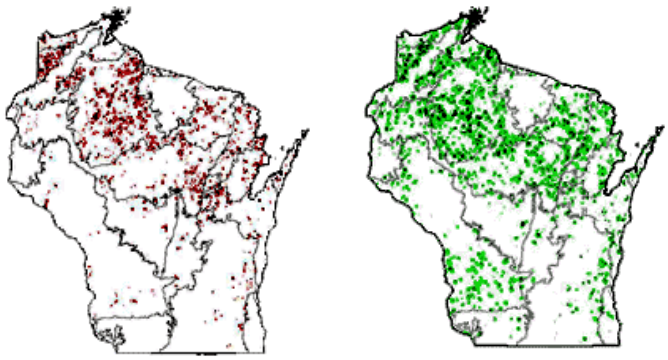
Some NNIS may impact forestry directly by reducing tree regeneration, growth, and longevity. For example, researchers have documented a reduction in the abundance, density, and richness of tree seedlings in areas infested with non-native honeysuckles (Gorchov and Trissell 2003, Collier et al. 2002, Hutchinson and Vankat 1997, Woods 1993). The invasive plant garlic mustard (*Alliaria petiolata*) appears to suppress tree regeneration by disrupting beneficial associations between tree seedling roots and fungi (mycorrhizal associations), which may help explain its ability to invade undisturbed sites (Stinson et al. 2006). There is also evidence that other NNIS such as common buckthorn (*Rhamnus cathartica*) and non-native earthworms alter the chemistry of forest

soils and consequently impact tree regeneration and growth (Bohlen et al. 2004, Heneghan et al. 2004, 2006).

Invasive vines such as Oriental bittersweet (*Celastrus orbiculatus*) can reduce the growth and longevity of desirable trees by shading the canopy, girdling branches and stems, and toppling them with their weight.

## *Non-native invasive species may alter forest stewardship*

Depending on the NNIS present, its abundance, site conditions, and other factors, a manager's forest stewardship objectives may be affected. For example, emerald ash borer (EAB), an Asian wood-boring beetle that attacks ash trees, was found in Michigan in 2002. By fall 2008, it was found in 10 additional states, including Wisconsin. (For an up-to-date map showing EAB distribution, go to www.emeraldashborer.info and click on 'Where is EAB'.) The borer has had a significant impact, causing mortality and the need for removal of non-infected ash to aid in slowing the spread. The borer is expected to spread throughout forested lands in Wisconsin, threatening all ash species. Consequently, forest composition objectives that include ash species are being revised. This is an extreme example of how the arrival of an NNIS can alter management plans.



**(Left) Black ash distribution and (Right) white and green ash distribution in WI based on 1996 Forest Inventory Analysis data. http://dnr.wi.gov/forestry/fh/ash/eab-impact.htm**

## *Forestry practices can influence the spread of non-native invasive species*

Forest activities can create site conditions suitable for many opportunistic NNIS. These conditions can occur through site disturbance that exposes soil and creates a seedbed for invasive plants, or by releasing NNIS that are already present. Forest management activities may also increase the likelihood of invasive propagules being accidentally introduced to a site.

**Propagule** (prŏp′ ə gyool) = Any reproductive structure or part of an organism that can grow independently of its parent source. In plants, this may be a fruit, seed, bud, tuber, root, stem with rooting structures, or shoot. In forest insects, this may be an egg, larva, pupa or adult. In forest diseases, this may be a spore, mycelial fragment (similar to roots), or a fruiting body.

## *What can be done regarding non-native invasive species?*

- **Prevention–**An awareness of NNIS and an understanding of their mode of invasion are important aspects of planning.
- **Early Detection and Rapid Response–**Detecting new populations early and responding rapidly increases the likelihood of successful control while keeping costs down.
- **Control**–In many cases an NNIS may be too widespread and abundant to eradicate. In those cases, it may be cost-effective to slow the spread of the species through integrated control and management planning.
- **Monitoring**–The periodic inspection of target areas–travel corridors, access points, post-activity areas, areas with previously treated infestations–can lead to earlier detection and more successful treatment in the long run.
- **Restoration**–NNIS are more likely to colonize sites that have been disturbed. The earlier a land manager can return the land to desirable vegetation, or find ways to minimize site disturbance, the less vulnerable a site will be to invasion.
- **Adaptation**–Once NNIS become well established in an area, completely controlling or eradicating populations is often impossible. People and businesses may be forced to adapt their activities to adjust to the impacts of these NNIS. These adaptations often include costly increases in operating expenses and decreases in recreational opportunities.

## *How to use this guide*

This guide provides best management practices (BMPs) to aid in the management and control of invasive plants, insects, and diseases in forests. In addition to the specific BMPs, the document contains information to help the user work through a process of assessing the threats posed by NNIS, in order to plan and implement a management strategy.

The guide is structured as in the following example:

→ **BMP Statement: Non-native invasive species BMPs are in bold font and are set off from the body of the document with an arrow. These statements are intended to describe voluntary practices that may reduce the impact of NNIS.**

a. BMP Considerations are listed below the BMP Statement.

b. BMP Considerations were written to give more information about why the BMP is important.

c. BMP Considerations introduce items that could be used to address the BMP; they do not apply to every species or situation, and the user does not necessarily have to follow them to address the BMP.

d. BMP Considerations may include details, suggestions, examples, and issues to consider about NNIS and applying the BMP.

A plant icon is used to identify BMP Statements or Considerations that apply to plants.

An insect icon is used to identify BMP Statements or Considerations that apply to invasive insects.

A microbe icon is used to identify BMP Statements or Considerations that apply to diseases (illustration from forestpathology.org).

If the BMP applies generally to all NNIS covered by this guide, no icon is used.

# Chapter 2. Elements of Non-native Invasive Species Management

NNIS management programs across the country have widely incorporated several common elements (see headings below). These elements serve as the guiding principles of the National Invasive Species Management Plan http://www.invasivespeciesinfo.gov/council/nmp.shtml and form the basis for the USDA-Forest Service Invasive Species Program http://www.fs.fed.us/invasivespecies/.

These elements can help guide or inform managers concerned about NNIS.

## *Prevention*

An effective, economical, and ecologically sound approach to managing NNIS is to prevent their introduction in the first place. This guide addresses practices that attempt to limit the introduction of NNIS to a site or stand. Other efforts beyond the scope of this guide are aimed at preventing species introduction into the U.S. or the state.

Land managers have limited resources to manage NNIS. Once a population becomes established, management can be expensive and, in many cases, eradication may be impossible. While it is still necessary to attempt to control the spread of established populations into non-infested areas, resources might be spent more efficiently on proactive management that focuses on prevention and early detection of new invasions.

**Elements of NNIS prevention planning can include:**

- Education and identification training
- Preventing the introduction of seeds/eggs/organisms into an area
- Early detection and eradication of small populations of NNIS
- Minimizing disturbance of desirable vegetation
- Building and maintaining healthy communities of native species to compete with NNIS
- Periodic inspection of high-risk areas such as access points, transportation corridors and disturbed or bare ground
- Managing stand density and growing conditions in forested stands
- Revegetating disturbed sites with desirable plants; where natives species are lacking
- Periodically evaluating the effectiveness of prevention planning

When planning projects that will disturb vegetation, it would be beneficial for landowners and land managers to consider NNIS management as a part of project decisions. Learn to recognize invasive plants, insects, and symptoms of disease, and consider how to rebuild or maintain healthy plant communities that will effectively compete with NNIS after the disturbance. Identify prevention practices and management needs at the onset of project planning.

## Early Detection and Rapid Response

> *Even the best prevention efforts cannot stop all introductions. Early detection of incipient invasions and quick, coordinated responses are needed to eradicate or contain NNIS before they become too widespread and control becomes technically and/or financially impossible. Populations that are not addressed early may require costly ongoing control efforts.*
> -National Invasive Species Management Plan, 2001

It is widely agreed that exclusion is the most effective approach to the problem of invasive species. However, there is a similar consensus that in the current climate of trade and travel, more introductions are inevitable. Because the chances for eradication or control are greatest immediately after introduction, early detection and rapid response will be an important part of managing invasive species (Worall 2002).

Early detection, as applied to invasive species, is a comprehensive, integrated system of active or passive surveillance to find new populations of invasive species as early as possible, when eradication and control are still feasible and less costly. It may be targeted at: a) areas where introductions are likely such as access points and travel corridors, b) areas with high ecological value where impacts are likely to be significant, and c) vulnerable habitats or recently disturbed areas (Worall 2002).

Rapid response is a systematic effort to eradicate, control, or contain invasive species while the infestation is still localized. It may be implemented in response to new introductions or to isolated infestations of a previously established species. Preliminary assessment and subsequent monitoring may be part of the response. It is most effective when based on a plan organized in advance so that the response is rapid and efficient (Worall 2002).

## Control

The site level eradication of some invasive populations is an attainable goal especially if new introductions are detected early. However, eradication may not be feasible when populations are large and pervasive. When limited resources or the degree of infestation preclude eradication, a more realistic management goal is to control the unwanted species by reducing their density and abundance to a level which, ideally, does not compromise the integrity of the ecosystem and allows native species to thrive. Control programs are usually ongoing and can include guide, mechanical, chemical, biological, and cultural components. Managers should evaluate their site, the life cycle characteristics of the NNIS, and the best available science to determine which control method or combination of methods will be most effective and economical.

Employing a combination of prevention and control measures, e.g., pulling, cutting, targeted pesticide use, biological controls, and native species reintroduction, is an effective way for managers to control NNIS. This approach is often referred to as integrated pest management (IPM). In the forest context, IPM can be defined as the maintenance of destructive agents (plants, insects, and diseases) at tolerable levels by the planned use of a variety of preventive, suppressive, or regulatory tactics and strategies that are ecologically and economically efficient and socially acceptable.

Where eradication of the NNIS is not realistic, control strategies must strike a balance between ecological impacts of allowing NNIS to spread and the economic realities of control measures. Not all control methods are practical, effective, economically feasible, or environmentally sound for application in forests. Control programs should be integrated in ways that maximize management objectives, while minimizing negative environmental impacts. Furthermore, control practices continue to develop based on

ongoing research. It's recommended that landowners and land managers consult most recent science or contact specialists to determine appropriate control measures.

### Slowing the Spread of Non-native Invasive Species

Slowing the spread of NNIS, also known as containment, refers to the process or goal of containing an infestation within a defined geographical area. Where eradication is not feasible, containment to a defined area can be very effective at slowing the regional spread of an NNIS. Preventative measures and the early detection of new infestations spreading from a defined containment area are significant components in slowing the spread of NNIS. Steps must be taken to prevent spread and new infestations must be located early so control measures can be implemented quickly. Steps in a containment program may include inventory and prioritization of populations for treatment, restricting activities in certain areas or to certain times of year, minimizing travel through infested areas, inspecting clothing and equipment to minimize species transport, and locating and controlling new infestations promptly.

### Reducing Impacts

If eradication, control, and containment methods fail to manage an infestation, the final option is to reduce the impact of NNIS on native species and the ecosystem. At this level the focus shifts from managing NNIS populations, to managing native species. Methods for reducing the impact of well-established and widespread NNIS on native systems can include: focusing control efforts to allow forest regeneration, translocating sensitive species to areas unaffected by the invasion, and manipulation of forest structure and composition, such as planting different species to fill gaps created by ash trees that could potentially be killed by emerald ash borer.

## *Monitoring*

Monitoring allows for the periodic inspection of post-activity sites to detect new invasions and evaluate the success of pest management plans and control measures. These inspections can be integrated with other forest activities. The early detection of new infestations will make control measures more effective and may reduce costs. Monitoring will also indicate if control programs are effective.

Monitoring can be an informal process, or it can be highly formal. Monitoring should be kept as simple as possible to meet NNIS management objectives. A monitoring program will ensure that target areas are monitored, that information is useful, and may keep long-term control costs down by ensuring that new infestations are detected early. Managers can simplify monitoring efforts by setting priorities, including identifying specific areas to visit and using a list of prioritized NNIS they are likely to encounter (CNAP 2000). Target areas can include locations that are susceptible to invasion, such as transportation corridors and recently disturbed areas, and/or previous infestations that have undergone control measures. Periodic visits to these areas will allow landowners and land managers to detect new invasions and assess the success of their control efforts.

## *Restoration*

Ecological restoration is the process of assisting the recovery of resilience and adaptive capacity of ecosystems that have been degraded, damaged, or destroyed (USDA-Forest Service CFLR 2012). Frequently, the ecosystem that requires restoration has been altered either by natural occurrences like wildfire, floods, or storms, or as the result of human activities, including the intentional or unintentional

introduction of NNIS. In the simplest circumstances, restoration can consist of removing or modifying a specific disturbance, thereby allowing ecological processes to recover. In other circumstances, restoration may also require the deliberate reintroduction of native species that have been lost and the elimination or control of harmful NNIS to the extent possible (Smith 2005). Restoring native plant communities to a site that has been cleared of NNIS may reduce the risk of future invasions and, in the long run, the need for active control.

## *Adaptation*

Ultimately, NNIS may cause significant and essentially irreversible changes to the environment. These changes may alter the ways in which people interact with the environment because once NNIS become well established in an area, completely controlling or eradicating populations is often impossible and because NNIS can change or reduce ecosystem services. Restoration of the ecosystem to a desirable condition may also not be possible or may be too costly. People and businesses may be forced to adapt their activities to adjust to the impacts of established populations of NNIS. These adaptations may include costly increases in operating expenses and decreases in recreational opportunities.

# Chapter 3. Management Planning

**BMP 3.1: Establish a strategy for managing NNIS.**

**BMP 3.2: Prior to implementing management activities, inventory for and locate NNIS infestations, consistent with the scale and intensity of operations.**

**BMP 3.3: Consider the need for action based on: (1) the degree of invasiveness; (2) severity of the current infestation; (3) amount of additional habitat or hosts at risk for invasion; (4) potential impacts; and, (5) feasibility of control with available methods and resources.**

**BMP 3.4: Plan management activities to limit the potential for the introduction and spread of NNIS.**

**BMP 3.5: Plan for post-activity management of highly damaging NNIS.**

## *Property Planning*

Property planning is a good way to identify long-term goals. It allows managers to consider the potential of the land to support different forest types and wildlife species, current and potential threats, and options for sustainably managing the property. Written property plans also provide a record of a manager's wishes. An evaluation of the NNIS threat and the ways to reduce the impact of NNIS are among the important considerations that go into any property planning.

The BMPs and guidance in this section are intended to help managers consider ways to reduce the likelihood of NNIS introductions, mitigate the effects of NNIS that may arrive despite their best efforts, and manage species that are already present.

→**BMP 3.1: Establish a strategy for managing NNIS.**

Considerations:

An NNIS strategy includes some or all of the following elements, as appropriate:

*a.* Preventative measures to limit introductions of NNIS to the property. For examples see the section on Prevention in *Chapter 2: Elements of Non-native Invasive Species Management*.

b. Early detection of NNIS.

c. An assessment of NNIS threats. The threat assessment considers the impact of NNIS on land management objectives and options for responding to these threats.

d. Goals for controlling NNIS present (e.g., slow spread, reduce abundance, eradicate).

e. Goals for reducing impacts of NNIS present (e.g., reduce abundance of host species [for insects and diseases] or habitat [for plants], increase vegetative diversity, and employ forest stewardship techniques that can be successful despite the presence of NNIS).

f. Methods for managing NNIS (e.g., guide, mechanical, chemical, biological, and cultural).

## *Activity Planning*

Once established, many NNIS can increase as a result of even well-intentioned activities. In many cases, however, skillful execution of routine management activities can help minimize or even reduce the threat of some NNIS. An *activity*, for purposes of this chapter, may include timber harvesting, site preparation, reforestation, prescribed burning, non-commercial practices, or in short – any practice that brings people and equipment into the forest or related habitats.

The goal of this chapter is to identify a set of steps and considerations that managers can utilize in their practice to prevent or minimize the threat of NNIS.

Inventorying to identify current NNIS infestations or invasions, evaluating the NNIS threat, and understanding and properly applying options for modifying the practice to reduce the impact of NNIS are important components of activity planning.

→**BMP 3.2: Prior to implementing management activities, inventory for and locate NNIS infestations, consistent with the scale and intensity of operations.**

Considerations:

Knowing which NNIS are present, and their location, is the first piece of information needed to evaluate threats. These are some steps to consider in scouting NNIS:

a. The extent and intensity of inventorying should be appropriate to the threat posed by NNIS in or likely to be in the area, and by the potential effect of the activities on the spread, release, or control of those species.

b. Inventorying can occur both within and around the activity area.

c. Inventorying for NNIS plants should occur at likely introduction sites such as access points, landings, skid trails, recreational trails and campsites, and other disturbed areas.

d. Inventorying for NNIS insects and diseases should also occur at high-priority introduction sites such as landings, campsites, new plantings, and stands of dead/dying/stressed trees.

e. Inventorying could also include conferring with forest health specialists or other resource managers to identify forest health threats or invasive plant, insect or disease infestations of concern in the area.

**→BMP 3.3: Consider the need for action based on: (1) the degree of invasiveness; (2) severity of the current infestation; (3) amount of additional habitat or hosts at risk for invasion; (4) potential impacts; and, (5) feasibility of control with available methods and resources.**

Considerations:

A threat assessment is the next planning step after inventorying for and locating NNIS, consistent with the scale and intensity of operations. Threats to forests and forestry operations are considered, and options for managing NNIS are identified.

a. Degree of invasiveness

   - Some NNIS are able to invade habitats and hosts rapidly. Species that reproduce frequently and in high numbers, mature quickly, and have multiple ways of dispersing tend to be more invasive. These species often pose a greater immediate threat than those with less invasive tendencies.

b. Severity of the current infestation

   - Areas with severe infestations will have a lower threat level than adjacent areas with little or no infestation. Project plans should minimize movement from infested to non-infested project areas.

c. Amount of additional habitat or hosts at risk

   - On properties where an NNIS is present in only part of the area, or its arrival is imminent, the threat level will be higher if there is additional suitable habitat (for plants), or host species (for insects and diseases) that can be invaded.

d. Impacts of NNIS on forest management objectives

   - Some NNIS have relatively low impacts on forests because they cannot tolerate forested conditions (e.g., shade), or the damage they cause is at a low level or temporary/cyclic. It may not be important to manage species such as these. Other species are extremely damaging to forests and can have severe economic and ecological consequences.

e. Feasibility of control

   - Controlling NNIS may be difficult and expensive. Consider control options and costs, as well as consequences and costs of not taking action. For species that do little damage, control may not be warranted. For large existing infestations, the level of effort required may be prohibitive. It is often more feasible to control small or intermediate infestations. For relatively small infestations of extremely damaging species, control is cost-effective in the long-term.

**→BMP 3.4: Plan management activities to limit the potential for the introduction and spread of NNIS.**

Considerations:

The planning phase is the time to consider whether special precautions for NNIS are needed and how they will affect the planned activity. The following BMP Considerations are examples of possible ways to address the BMP Statement.

a. Timing

- Consider the need for NNIS control efforts, and determine whether planned control efforts should occur prior to, after, or concurrent with the activity.
- If pre-treatment of NNIS is warranted, postpone activity until the infestation can be treated. Effective pre-treatments sometimes need to occur one to two years prior to the activity.
- Consider practical seasonal timing options that minimize the risk of introducing or moving an NNIS.
- An option is to choose not to carry out an activity where spread of NNIS is likely to jeopardize long-term productivity.

b. Cleaning

- Cleaning of clothing, footwear, and equipment may limit the introduction and spread of NNIS; make prior arrangements for any cleaning that may be included with the activity. Consider the risks different types of equipment pose to introducing/spreading NNIS.

c. Boundaries

- Set up activity boundaries to exclude areas infested with NNIS that could be moved by equipment and forest workers.

d. Scheduling

- Consider options for the sequence of operations within the activity area and, where feasible, plan to enter areas infested with NNIS last.

e. Ground disturbance

- Avoiding ground disturbance is one of the best prevention methods, but it is not always possible when carrying out forestry activities. However, one can plan to minimize soil disturbance.
- Consider the impacts of different types of equipment and, where feasible, plan to use equipment that minimizes soil and vegetation disturbance.
- Retain native vegetation in and around the activity area to the greatest extent possible.

f. Forest structure

- Increased sunlight may create favorable conditions for some invasive plants. Forestry activities typically lead to forest canopy manipulation. However, where consistent with project objectives, activities may be planned to allow for the maximum retention of canopy cover and understory structure, in order to suppress or limit the establishment and growth of shade intolerant invasives.
- Impacts of some forest insects and diseases can be mitigated through silvicultural prescriptions that increase tree vigor or change stand composition. Consider silvicultural treatments when they are known to be an effective strategy against these species.

- Consider the potential of the activity itself to achieve control of NNIS (e.g., prescribed burning or logging with modifications to remove and treat dense invasive shrub layers). If feasible, incorporate control treatments into the activity plan.

g. Transport

- Plan for a transportation system in the activity area that limits travel through areas infested with NNIS. Limit the transportation system to the minimum needed to meet project objectives.

- Consider transport of products away from the activity area and limit the ways that NNIS in the activity area could move off-site. See also *Chapter 9: Transport of Woody Materials.*

→**BMP 3.5: Plan for post-activity management of highly damaging NNIS.**

Considerations:

After the activity is completed, it may be necessary to monitor for NNIS and follow up with treatments.

a. Plan ahead to obtain resources for:

- Monitoring the site following a management activity, checking for new infestations of NNIS, or the spread of existing populations.

- Managing existing populations of NNIS.

- Reforestation, revegetation, and/or restoration may be necessary depending on site conditions.

# Chapter 4. Forestry Best Management Practices

***Prior to activities:***

**BMP 4.1: Provide training in identification of locally known NNIS plants and pests to forest workers.**

**BMP 4.2: If pre- or post-activity control treatments are planned, ensure that they are applied within the appropriate time window.**

**BMP 4.3: Consider the likely response of NNIS when prescribing activities that result in soil disturbance or increased sunlight.**

***During activities:***

**BMP 4.4: Prior to moving equipment onto and off of an activity area, scrape or brush soil and debris from exterior surfaces, to the extent practical, to minimize the risk of transporting propagules.**

**BMP 4.5: Take steps to minimize the movement of NNIS plants, insects, and diseases to non-infested areas, during forest stewardship activities.**

**BMP 4.6: Take reasonable steps to avoid traveling through or working in small, isolated, populations of NNIS during forest activities.**

Forestry activities are practices conducted in forests that represent long-term investments to produce a certain kind, or quality, of forest product. Forestry includes timber harvesting and cultural practices.

Timber harvesting refers to the felling, skidding, on-site processing, and loading of raw products onto trucks. Harvesting usually provides an economic return, but is also an important tool foresters use to meet forestry goals and objectives. Limiting the spread of NNIS can be an important consideration in timber harvest areas.

Cultural practices include site preparation, planting, pruning, and tending. These activities often lack an immediate economic return.

Site preparation is the creation of a favorable growing environment for tree seeds or seedlings. It is used to reduce competition from other vegetation. Site preparation can be accomplished by mechanical and/or chemical means and, occasionally, by prescribed burning. Often, an area disturbed for site preparation is conducive to the germination and establishment of NNIS plants.

Pruning is the removal of a tree's side branches or multiple leaders. This wounding can attract certain insects, and they may carry diseases to the site.

Tending activities occur during the time period between stand origin and final harvest and may include improvement cutting, thinning, or pre-commercial release. These treatments remove undesirable trees, trees that are too crowded, or trees that have overtopped other, more desirable young trees. Tending

activities generally occur as part of a timber harvest, but they can occur at other times as separate activities.

See *Chapter 3* for information on how to develop an NNIS Strategy for the site.

Whenever possible, and consistent with project scale and objectives, integrate the management of NNIS into standard silvicultural practices and regular work activities. When workers and equipment are already onsite, they may have the capability to selectively remove invasive tree and shrub species or infected or susceptible trees.

## *Prior to activities:*

→**BMP 4.1: Provide training in identification of locally known NNIS plants and pests to forest workers.**

→**BMP 4.2: If pre- or post-activity control treatments are planned, ensure that they are applied within the appropriate time window.**

Considerations:

**Consider life history of target NNIS in relation to timing of control methods and harvest (See**

a. Figure 2 and Forestry Appendix C at http://council.wisconsinforestry.org/.)

b. Allow enough time for control prior to activity; this may require a delayed harvest.

c. Allow time and resources for post-activity follow-up control measures, due to persistent seedbank and resprouting.

d. Consider scheduling harvest during time periods when trees are at a low risk of infection by disease and insects following wounding. Limit residual stem damage as much as possible.

e. Consider the importance of timely removal of harvested material.

→**BMP 4.3: Consider the likely response of NNIS when prescribing activities that result in soil disturbance or increased sunlight.**

Considerations for soil disturbance:

a. Ground disturbance can uproot existing vegetation and expose soil, creating a seedbed where NNIS plants may become established or expand their numbers. This may result in overwhelming competition for native vegetation and desirable trees.

b. Before conducting scarification, roller chopping, tilling, installing plow lines for prescribed burning, or other activities that expose soil, consider the NNIS plant species present on the site and the potential for other NNIS to arrive. If there is a seedbank of NNIS plants, or if seed-producing individuals are nearby, control measures may be warranted.

c. If soil disturbance is necessary to aid in germination and establishment of some tree seedlings, it should not extend beyond the area where regeneration is desired.

d. Soil disturbance may be used as an NNIS control strategy in infested areas by depleting the seedbank and employing aggressive follow-up control measures.

e. After a soil disturbance activity, encourage prompt regeneration of new trees or other desirable vegetation to rapidly close the time window during which conditions are favorable for NNIS establishment.

f. Retain native vegetation in and around the activity area to the extent possible.

g. Inspecting areas at highest risk of invasion following soil disturbance activities may help to detect new invasions.

Considerations for canopy manipulation:

a. Achieving forestry objectives often requires opening the canopy; however, many NNIS are stimulated when additional light becomes available. Maintaining shade may keep these species from expanding to a point where they out-compete native trees and other vegetation.

b. Consider conducting control treatments in advance of opening the canopy to reduce the impacts of NNIS that are present onsite or that hold potential for invasion.

c. To limit loss of site productivity due to NNIS, consider alternatives to complete and rapid canopy opening. Consider deferring canopy opening altogether in a heavily infested or vulnerable area until the infestation is treated.

d. Canopy opening, sometimes combined with soil disturbance, may be used as an NNIS control strategy in infested areas by depleting the seedbank and employing aggressive follow-up control measures.

e. After a canopy-opening activity, encourage prompt regeneration of new trees or other desirable vegetation to rapidly close the time window during which conditions are favorable for NNIS establishment.

f. Note that some tree foliage diseases are exacerbated by heavy canopy cover, such as anthracnose.

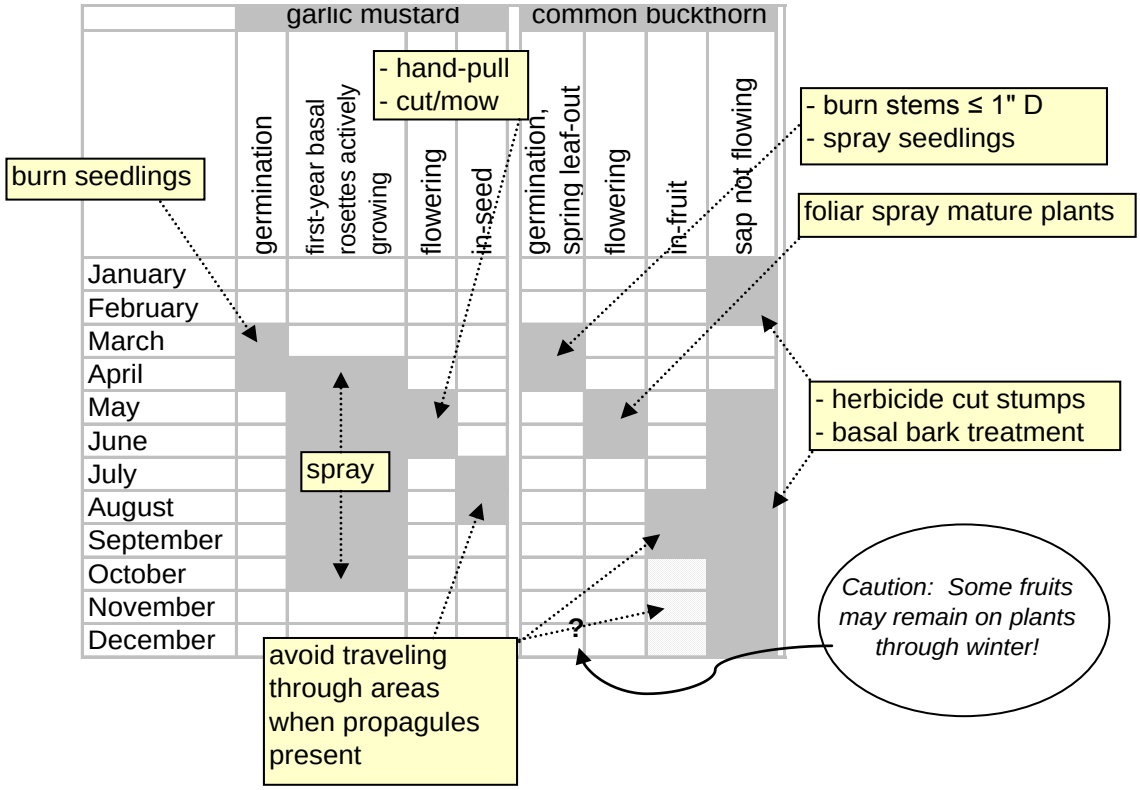



**Figure 2.** Identifying time windows for NNIS management. The goal of this chart is to present basic planning concepts. For more detailed information on species-specific control, see Forestry Appendix C at http://council.wisconsinforestry.org/**.**

## *During activities:*

Close coordination among managers will be especially important in effectively and reasonably applying BMPs 4.5 and 4.6. The considerations listed in these BMPs are a menu of possible choices. Practitioners may select one or more practices as based on these Considerations in planning an activity.

### Equipment cleaning

NNIS can spread by equipment used in forestry activities and by forest workers. Within the context of this chapter, equipment refers to off-road, rubber-tired and tracked equipment, including logging skidders, forwarders and processors, as well as dozers, graders, and other construction equipment. Plant propagules and fungal spores in soil or mud can be transported on equipment, as can insects in all life stages. NNIS can also be moved by boots, clothing, tools, and on the undercarriages of vehicles.

→**BMP 4.4: Prior to moving equipment onto and off of an activity area, scrape or brush soil and debris from exterior surfaces, to the extent practical, to minimize the risk of transporting propagules.**

Considerations:

a. Foresters and loggers may agree to additional cleaning methods.

b. Preferred locations for cleaning equipment areas are those where:

   - Monitoring can be conducted at a later date, perhaps in conjunction with post-harvest visits. See Chapter 2: Elements of Non-native Invasive Species Management for guidance on monitoring for invasives.
   - Equipment is unloaded and loaded.
   - NNIS are less likely to spread from cleaned equipment.
   - NNIS are already established

c. Equipment with the ability to run fans in reverse should use this feature to clean air intakes. Fans and air intakes can harbor plant materials and insects. Reversing the fan direction and blowing loose material out of equipment before leaving a site can reduce the likelihood of moving species to another site. Heat exhausted from the engine when fans are reversed may kill some insects and plant parts.

d. In areas where NNIS are present, it is a good practice to routinely remove soil, seeds, vegetative matter, or other debris from shoes, clothing, and tools.

**To reduce need for equipment cleaning, carry out work under conditions that minimize the risk of spread, e.g., frozen ground, snow cover, seed/propagule absence, etc. (See**

e. Figure 2 and Forestry Appendix C at http://council.wisconsinforestry.org/.)

→**BMP 4.5: Take steps to minimize the movement of NNIS plants, insects, and diseases to non-infested areas, during forestry activities.**

Considerations:

a. To minimize movement of NNIS propagules, consider excluding infested areas from equipment travel corridors.

**Carry out work under conditions that minimize the risk of spread, e.g., frozen ground, snow cover, seed/propagule absence, etc. (See**

b. Figure 2 and Forestry Appendix C at http://council.wisconsinforestry.org/.)

c. Clean equipment (see BMP 4.4) when moving from infested areas to non-infested areas to reduce the likelihood of spread.

d. Pre-designate landings to avoid yarding products from infested areas across non-infested areas.

e. Pre-designate skid and haul trails to minimize equipment travel from infested areas to non-infested areas. See also Chapter 5: Forest Access.

f. Harvest and skid in non-infested areas first.

g. Consider scheduling harvest during time periods when trees are at a low risk of infection by disease and insects following wounding.

→**BMP 4.6: Take reasonable steps to avoid traveling through or working in small, isolated, populations of NNIS during forestry activities.**

Considerations:

a. Avoidance is an effective way of slowing the spread of NNIS from isolated satellite populations.

b. Areas of avoidance should generally be designated prior to the activity.

c. To minimize movement of NNIS propagules, consider excluding infested areas from equipment travel corridors.

d. Clean equipment when moving from infested areas to non-infested areas to reduce the likelihood of spread. See also BMP 4.4 and Chapter 5: Forest Access.

e. Removal of affected trees is prescribed for some pest issues.

# Chapter 5. Forest Access

**BMP 5.1: To the extent practical, use existing roads, skid trails, and landings to reduce disturbance.**

**BMP 5.2: Avoid constructing new roads, skid trails, and landings in areas infested with NNIS where possible.**

**BMP 5.3: Avoid spreading seeds and other propagules from infested to non-infested areas during road maintenance, reconstruction, new construction, and closure.**

**BMP 5.4: Where site conditions permit, allow natural revegetation of the roads, skid trails, and landings to occur. If seeding or planting is necessary to minimize the threat of highly damaging NNIS from spreading, use native seed or annual, non-invasive cover crops for revegetation.**

**BMP 5.5: Ensure, to the extent practical, that fill and gravel are free of NNIS and their propagules.**

Forest access roads occupy a relatively narrow strip of land, often composing a network of passageways that provide access into remote reaches of forested landscapes. Many different types of forest access roads exist, though commonly the majority of roads fall within three categories. They include temporary roads, permanent seasonal roads, and permanent all-season forest roads. Skid trails and landings will also be considered in this chapter.

Temporary roads are designed and constructed for short-term use. Often a temporary road is needed for direct timber harvest access, wildland firefighting, or a specific project. Temporary roads are commonly closed, gated, or bermed after use and artificially or naturally revegetated.

Permanent seasonal roads, also known as permanent secondary roads, are maintained as part of a permanent road system, but are typically narrower and are built to lower engineering standards. Secondary roads may also be restricted to use only when the ground is frozen or firm to prevent rutting or damage to the road base.

Permanent all-season forest roads, also known as permanent primary roads, are the most improved and are constructed and maintained for year-round use. They are vital avenues of a forest transportation system and are often graveled and routinely repaired.

Skid trails are another type of forest access important to consider with NNIS planning. Skid trails provide forestry equipment quick access to felled timber for the immediate aim of transporting logs to a landing.

Landings are where products are sorted and loaded onto trucks; they may be permanent or temporary. Even the short-term use of skid trails and landings by forestry equipment removes vegetation and presents NNIS with the opportunity to colonize areas of bare soil.

Forestry activities rely on the construction and maintenance of roads, skid trails, and landings to provide access to management areas. These access points may facilitate the spread of NNIS by altering habitat conditions, stressing or removing native species, and allowing easier movement of animals and humans into the forest. The BMPs in this chapter refer to existing or new, private or public, forest access roads, skid trails, and landings constructed for the purpose of forest stewardship.

**→BMP 5.1: To the extent practical, use existing roads, skid trails, and landings to reduce disturbance.**

Considerations:

a. Treatment of existing infestations on roads, skid trails, and landings may help prevent further spread.

b. Consider future uses of the road system, particularly if NNIS are present.

c. Coordinate development of accesses with adjacent managers when possible.

**→BMP 5.2: Avoid constructing new roads, skid trails, and landings in areas infested with NNIS where possible.**

Considerations:

a. Survey potential routes for NNIS during the growing season.

b. Limit the number, width, and length of roads, skid trails, and landings to help minimize soil disturbance and to limit the risk of unintentionally transporting NNIS into non-infested areas.

c. Use existing infrastructure that is free of NNIS when possible.

**→BMP 5.3 Avoid spreading seeds and other propagules from infested to non-infested areas during road maintenance, reconstruction, new construction, and closure.**

> **Note:** BMP 4.4: Prior to moving equipment onto and off of an activity area, scrape or brush soil and debris from exterior surfaces, to the extent practical, to minimize the risk of transporting propagules.

Considerations:

a. For new road, trail or landing construction, survey potential routes for NNIS during the growing season.

b. Treat infestations on roads, skid trails, and landings before activities begin.

c. In areas where infestations are present, consider road closures, either permanent (bearing in mind that the use of existing infrastructure is encouraged) or temporary (to avoid activities when propagules are present or to allow for pre-activity control measures).

d. Limit the spread of existing populations by performing road maintenance from non-infested to infested areas.

**Carry out activities under conditions that minimize the risk of spread, e.g., frozen ground, snow cover, seed/propagule absence, etc. (See**

e. Figure 2 in Chapter 4 and Forestry Appendix C at http://council.wisconsinforestry.org/.)

f. Clean equipment after operations in infested areas.

g. Run equipment air intake fans in reverse when moving from infested to non-infested areas.

h. Check non-infested areas for new invasions where road work has taken place 1 to 2 years after the activity.

i. For road, trail or landing closures, erect a barrier such as a gate, berm, or boulders; and post "Closed" signs stating the length of time and/or reason for closure, and invite acceptable uses, to encourage compliance.

**→BMP 5.4: Where site conditions permit, allow natural revegetation of the roads, skid trails, and landings to occur. If seeding or planting is necessary to minimize the threat of highly damaging NNIS from spreading, use locally native seed or non-invasive, annual cover crops for revegetation.**

Considerations:

> **Note:** BMP 6.2: Revegetate or reforest as quickly as feasible after site disturbance.
>
> BMP 6.3: When consistent with site conditions and goals, allow natural revegetation of the ground layer to occur. If seeding or planting is necessary to minimize the threat of highly damaging NNIS from spreading, use locally native seed or non-invasive, annual cover crops for revegetation.

a. Revegetate roads that will not receive continued motorized use, i.e., temporary roads, skid trails, and landings.

b. In areas where NNIS are known to be in the seed bank, it may be necessary to treat NNIS before revegetating.

c. A non-persistent , annual cover crop, such as annual rye (*Lolium multiflorum*) or oats (*Avena sativa*), can be used to temporarily and rapidly stabilize the soil, discourage the establishment of NNIS, and allow native species to re-colonize.

d. Do not plant NNIS.

e. Use weed-free, locally native seed mixes.

f. Fertilizer should not be used when revegetating with native plant species. Native plants do not need additional nutrients; the fertilizer may encourage the growth of NNIS and other weed species.

g. Use weed-free mulch. Be aware "Marsh hay" may contain reed canary grass, for example.

h. Monitor newly revegetated areas for highly damaging NNIS and treat as necessary.

→**BMP 5.5: Ensure, to the extent practical, that fill and gravel are free of NNIS and their propagules.**

Considerations:

a. Keep stockpiled material free of NNIS.

b. Avoid infested source material, or treat it to remove NNIS prior to use.

# Chapter 6. Reforestation and Revegetation

**BMP 6.1: Limit the introduction and spread of NNIS during reforestation or revegetation site preparation activities.**

**BMP 6.2: Revegetate or reforest as quickly as feasible after site disturbance (see also BMP 5.4).**

**BMP 6.3: When consistent with site conditions and goals, allow natural revegetation of the ground layer to occur. If seeding or planting is necessary to minimize the threat of highly damaging NNIS from spreading, use locally native seed or non-invasive, annual cover crops for revegetation (see also BMP 5.4).**

**BMP 6.4: Select locally native plant materials that are site appropriate.**

**BMP 6.5: Plan for post-planting management of NNIS (see also BMP 3.5).**

Reforestation is the reestablishment of forest cover either naturally (e.g., natural seeding, coppice, root suckers) or artificially (e.g., direct seeding or planting).

NNIS can interfere with reforestation efforts by limiting regeneration success through direct competition for resources or by altering ecological interactions. For example, garlic mustard has been found to release a chemical that attacks a fungus on which tree roots depend for nutrient uptake (Stinson et al. 2006).

The use of accepted methods for successfully establishing the desired vegetation is important for quick forest establishment and not inadvertently encouraging NNIS. Wisconsin Management Guidelines (PUB-FR-226 2003), which can be found at http://www.dnr.state.wi.us/forestry/publications/Guidelines/toc.htm discusses methods for reforestation in Chapter 15 including: planting, seedling care and handling, root pruning and culling, machine and hand planting, transporting, seedling storage, direct seeding, and reforestation aids.

Revegetation is the reestablishment and development of vegetation. The purpose of revegetation is to provide ground cover with desirable species, as quickly as possible, in the hopes of discouraging establishment by NNIS.

Revegetation can be temporary or permanent depending on site conditions and goals. Temporary revegetation with an annual cover crop may be the goal when it's thought that native vegetation will recapture an area in a relatively short time. Permanent revegetation with locally native species may be the goal when little or no desirable vegetation is nearby to colonize the disturbed ground. Of course, temporary and permanent cover can be used in conjunction with each other. Often times an annual cover crop like annual rye is planted to quickly occupy disturbed ground and act as a nurse crop while a permanent cover is establishing.

### →BMP 6.1: Limit the introduction and spread of NNIS during reforestation or revegetation site preparation activities.

Site preparation methods should be determined by site conditions, silvicultural requirements of the target tree species, and site preparation objectives in the silvicultural prescription. Site preparation can be accomplished by mechanical methods, chemical methods and/or prescribed burning. Often these methods are used in conjunction to control competing vegetation. Mechanical site preparation can include scarification, roller chopping, disking, tilling, and raking.

Most site preparation methods involve disturbing the soil bed by removing existing vegetation and exposing soil to create a favorable growing environment for trees or other desirable vegetation. It is important to keep in mind that site preparation methods will create conditions favorable to NNIS plants as well. New NNIS may become established and existing populations may expand.

> **Note:** BMP 4.4: Prior to moving equipment onto and off of an activity area, scrape or brush soil and debris from exterior surfaces, to the extent practical, to minimize the risk of transporting propagules.

Considerations:

a. In areas where NNIS are known to be present, including in the seed bank, it may be necessary to treat NNIS as part of the site preparation process. Keep in mind it is almost always easier to treat NNIS before an area is planted to its desired vegetation.

**Time site preparation activities to avoid spreading NNIS seeds and other propagules. (See**

b. Figure 2 in Chapter 4 and Forestry Appendix C at http://council.wisconsinforestry.org/.)

c. While ground disturbance is necessary to aid in germination and establishment of desirable vegetation, it should not extend beyond the area where reforestation or revegetation is desired.

d. Consider targeted approaches (patch or row scarification) if broadcast mechanical site preparation is likely to spread infestations or initiate infestations (WDNR 2003).

e. Spot application of herbicides may reduce the impact to non-target plants.

f. Avoid damaging branches, stems, or roots of any standing trees during mechanical site preparation.

g. Retain native vegetation in and around the activity area to the extent possible (Clark 2003).

**→BMP 6.2: Revegetate or reforest as quickly as feasible after site disturbance (see also BMP 5.4).**

Considerations:

a. The time window from the end of logging to site preparation to reforestation or revegetation has the highest likelihood of NNIS colonizing disturbed soil (Clark 2003).

b. Getting planted materials into the ground before NNIS are established gives them the best chance for survival.

c. Keep in mind that thorough site preparation should not be sacrificed to plant quickly. Sites that are not properly prepped for planting will more likely have problems with competing vegetation and thus not be as successful.

**→BMP 6.3: When consistent with site conditions and goals, allow natural revegetation of the ground layer to occur. If seeding or planting is necessary to minimize the threat of highly damaging NNIS from spreading, use locally native seed or non-invasive, annual cover crops for revegetation (see also BMP 5.4).**

Natural revegetation is most likely to occur when a site is free of NNIS and is surrounded by native plants ready to occupy bare soil. Natural revegetation is not likely to occur in areas with continued disturbance, during drought conditions, or when desirable native vegetation is not present. Nor is it likely to be successful in a timely manner on dry sites due to lack of moisture and limited seed set.

Considerations:

a. A non-persistent, annual cover crop, such as annual rye or oats, can be used to temporarily and rapidly stabilize the soil, discourage the establishment of NNIS, and allow native species to re-colonize.

b. In areas where NNIS are known to be in the seed bank, it may be necessary to treat NNIS before revegetating.

c. Use NNIS-free, locally native seed mixes.

d. Fertilizer should not be used when revegetating with native plant species. Native plants do not need additional nutrients; the fertilizer may encourage the growth of NNIS.

e. Use NNIS-free mulch. Be aware that "Marsh hay" may contain reed canary grass, for example.

f. Monitor newly revegetated areas for highly damaging NNIS and treat as necessary.

**→BMP 6.4: Select plant materials that are site appropriate to favor establishment and vigor.**

Considerations for reforestation:

a. Healthy trees endure infestation and infection better than stressed trees.

b. Use plant materials from local sources of known, regional adaptation.

c. Use native or non-invasive annual species as cover crops.

d. Recognize that non-native earthworms and NNIS plant propagules may inhabit containerized stock.

Considerations for revegetation:

a. Use weed-free, locally appropriate native seed mixes.

b. Use locally sourced native seed. It will be best adapted to the local environmental conditions.

→**BMP 6.5: Plan for post-planting management of NNIS (see also BMP 3.5).**

Considerations:

a. After reforestation or revegetation activity, monitor for and treat new or expanded NNIS (WDNR 2003).

b. Where feasible or practical, manage existing populations of NNIS insects and diseases (See Forestry Appendix C at http://council.wisconsinforestry.org/.)

c. Consider the following actions if you have a heavy infestation of NNIS: plant tree species that can be sprayed with herbicides to kill NNIS without killing the tree; plant species (e.g., oaks) that can tolerate prescribed burning to control NNIS; plant trees that are already large enough to overtop and out-compete NNIS plants.

# Chapter 7. Fish and Wildlife Habitat Management

**BMP 7.1: Provide training in identification of locally known NNIS plants and pests to land managers whose objective is wildlife management.**

**BMP 7.2: Select locally native plants for seed mixes and plant materials used in wildlife habitat projects. (See also *Chapter 6: Reforestation and Revegetation*.)**

**BMP 7.3: If NNIS tree or brush removal is planned ensure that it is applied within the appropriate time window such that introduction and spread of NNIS is limited.**

**BMP 7.4: If desirable (i.e., native) tree or brush removal is planned as part of habitat enhancement, ensure that it is applied within the appropriate time window such that introduction and spread of NNIS is limited.**

**BMP 7.5: Prior to moving equipment onto and off of a management unit, scrape or brush soil and debris from exterior surfaces, to the extent practical, to minimize the risk of transporting propagules.**

**BMP 7.6: Take steps to minimize the movement of NNIS plants, insects, and diseases to non-infested areas during habitat maintenance activities.**

**BMP 7.7: Consider the likely response of NNIS when prescribing activities that result in soil disturbance or increased sunlight.**

**BMP 7.8: Take steps to minimize the movement of aquatic NNIS, including fish, crustaceans, mollusks, plants, insects, and diseases to non-infested waterways during habitat maintenance and assessment activities.**

Forests are also managed for wildlife habitat and also contain lakes, streams, and wetlands that provide habitat for aquatic and semi-aquatic species. In addition to providing important food and shelter for fish and wildlife, this habitat also provides valued opportunities for humans.

This chapter addresses forestry practices that are undertaken to enhance wildlife habitat or which may affect fish habitat within forests that are also being managed for timber production. Guidelines in this chapter are similar to those found elsewhere in the document, but are assembled here to provide a condensed set of BMPs that apply to the activities of land managers who are involved with fish and wildlife habitat management.

Forestry that incorporates wildlife objectives may employ the following practices, depending on the wildlife species desired:

- Planting tree species that enhance wildlife habitat for food, forage, nesting sites, cover.
- Planting tree species or other vegetation in riparian areas to provide shading, reduce erosion, and promote recruitment of woody debris to streams and lakes.

- Selective removal of trees that are less valuable for the desired wildlife species, while retaining tree species or growth forms that benefit them.
- Retaining snag and den trees and live trees that may become future snags or den trees.
- Creating patches of early-successional forest (e.g., aspen, paper birch) through even-aged management.
- Manipulating stand structure during timber harvest (e.g., creating forest gaps in northern hardwoods for gap-associated songbirds, reducing density in oak forests to favor savanna associates).

The many different kinds of wildlife found within our forests use a variety of habitats, including small isolated openings, large unbroken patches of forest, dense conifer thickets, savanna-like oak stands of low tree density, etc. Some of these habitats are inherently more susceptible to NNIS than others, particularly where forest edge habitat is extensive, and where intensive maintenance activities are required. Sunny forest edges favor germination of NNIS, providing a pathway for them to spread to the interior of a stand. Intensive maintenance activities, such as mowing wildlife openings, present another potential risk for NNIS to be introduced on machinery.

If forest stands are small and isolated, if management practices promote extensive habitat edge, or if intensive management is required to maintain habitat, a land manager must carefully consider the risks of NNIS along with the benefits to wildlife, and develop long-term management strategies accordingly.

See *Chapter 3* for information on how to develop an NNIS Strategy for the site. Whenever possible, and consistent with project scale and objectives, integrate the management of NNIS into standard wildlife habitat management practices.

Note: It is not within the purview of this guide to address the recreational aspects of forest wildlife habitat management *vis-à-vis* NNIS.

→**BMP 7.1: Provide training in identification of locally known NNIS plants and pests to land managers whose objective is wildlife management.**

→**BMP 7.2: Select locally native plant species for seed mixes and plant materials used in wildlife habitat projects. (See also *Chapter 6: Reforestation and Revegetation*.)**

Considerations specific to wildlife management:

a. Select native plant species for habitat plantings.

b. Do not plant NNIS. Be aware of NNIS that were promoted historically for wildlife habitat projects; examples include: autumn olive and non-native bush honeysuckles.

> **Good Practice:** When working in areas where NNIS are present, habitat managers should routinely remove soil, seeds, vegetative matter, or other debris from shoes, clothing, and tools.

→**BMP 7.3: If NNIS tree or brush removal is planned, ensure that it is applied within the appropriate time window such that introduction and spread of NNIS is limited.**

Considerations:

**For removal of NNIS trees, shrubs, and herbs, consider life history of target species in relation to timing of control methods and harvest. (See**

a. Figure 2 in Chapter 4 and Forestry Appendix C at http://council.wisconsinforestry.org/.)

b. Allow time and resources for post-activity follow-up control measures, due to persistent seedbank and resprouting.

→**BMP 7.4: If native tree or brush removal is planned as part of habitat enhancement, ensure that it is applied within the appropriate time window such that introduction and spread of NNIS is limited.**

Considerations:

a. Schedule harvest during time periods when trees are at a low risk of infection by disease and insects following wounding. (See Forestry Appendix C at http://council.wisconsinforestry.org/.)

**Forest Access:** Trails and roads may be created through forested habitats for the benefits of land managers or recreational users. These access points may facilitate the spread of NNIS by altering habitat conditions, stressing or removing native species, and allowing easier movement of animals and humans into the forest. See *Chapter 5: Forest Access* for pertinent BMPs and considerations.

**Equipment cleaning**

NNIS can spread by equipment used in wildlife habitat management activities. Within the context of this chapter, equipment refers to off-road, rubber-tired and tracked equipment, such as tractors used for wildlife opening maintenance**.** Plant propagules and fungal spores in soil or mud can be transported on equipment, as can insects in all life stages. NNIS can also be moved by boots, clothing, tools, and on the undercarriages of vehicles.

→**BMP 7.5: Prior to moving equipment onto and off of a management unit, scrape or brush soil and debris from exterior surfaces, to the extent practical, to minimize the risk of transporting propagules.**

Considerations:

a. Managers may agree to additional cleaning methods.

b. Preferred locations for cleaning equipment area are those where:

   - Monitoring can be conducted at a later date, perhaps in conjunction with post-harvest visits. See *Chapter 2: Elements of Invasive Species Management* for guidance on monitoring for NNIS.
   - Equipment is unloaded and loaded.
   - NNIS are less likely to spread from cleaned equipment.
   - NNIS are already established.

c. Equipment with the ability to run fans in reverse should use this feature to clean air intakes. Fans and air intakes can harbor plant materials and insects. Reversing the fan direction and blowing loose material out of equipment before leaving a site can reduce the likelihood of moving species to another site. Heat exhausted from the engine when fans are reversed may kill some insects and plant parts.

d. In areas where NNIS are present, it is a good practice to routinely remove soil, seeds, vegetative matter, or other debris from shoes, clothing, and tools.

**To reduce need for equipment cleaning, carry out work under conditions that minimize the risk of spread, e.g., frozen ground, snow cover, seed/propagule absence, etc. (See**

e. Figure 2 in Chapter 4 and Forestry Appendix C at http://council.wisconsinforestry.org/.)

→**BMP 7.6: Take steps to minimize the movement of NNIS plants, insects, and diseases to non-infested areas during habitat maintenance activities.**

Considerations:

a. To minimize movement of NNIS propagules, consider excluding infested areas from maintenance equipment travel corridors.

**Carry out work under conditions that minimize the risk of spread, e.g., frozen ground, snow cover, seed/propagule absence, etc. (See**

b. Figure 2 in Chapter 4 and Forestry Appendix C at http://council.wisconsinforestry.org/.)

c. Clean equipment (see BMP 7.5) when moving from infested areas to non-infested areas to reduce the likelihood of spread.

**Prescribed Fire:** Prescribed fire is utilized in wildlife habitat management for a number of reasons: for invasive species control, site preparation for planting or seeding, land conversion to a historical fire regime, site maintenance (e.g., prairie grass burns) and for site composition management (e.g., limiting succession of oak woodland to maple/basswood). See *Chapter 8: Fire Management* for pertinent BMPs and considerations.

**→BMP 7.7: Consider the likely response of NNIS or target species when prescribing activities that result in soil disturbance or increased sunlight.**

Considerations for soil disturbance:

a. Ground disturbance can uproot existing vegetation and expose soil, creating a seedbed where NNIS plants may become established or expand their numbers. This may result in overwhelming competition for native vegetation and desirable trees.

b. Before tilling, installing control lines created via mechanical or hand tools for prescribed burning, or other activities that expose soil, consider the NNIS plant species present on the site and the potential for other species to arrive. If there is a seedbank of NNIS plants, or if seed-producing individuals are nearby, control measures may be warranted.

c. Soil disturbance may be used as an NNIS control strategy in infested areas by depleting the seedbank and employing aggressive follow-up control measures.

d. After a soil disturbance activity, encourage prompt regeneration of new trees or other desirable vegetation to rapidly close the time window during which conditions are favorable for NNIS plant establishment.

e. Retain native vegetation in and around the activity area to the extent possible (Clark 2003).

f. After a soil-disturbing activity, monitor the area and treat new NNIS plant infestations.

Considerations for canopy manipulation:

Achieving forest wildlife habitat management objectives often requires opening the canopy. Some common timber harvest techniques that promote canopy opening include clearcuts, shelterwood cuts, patch cuts for wildlife openings, and increasing habitat edge. Many NNIS plants, however, are stimulated when additional light becomes available and may gain pathways to forest interiors via establishment in openings or along edges.

a. Consider conducting control treatments in advance of opening the canopy to reduce the impacts of NNIS plant species that are present on-site or that hold potential for invasion.

b. Consider deferring canopy openings altogether in a heavily infested or vulnerable area.

c. Opening the canopy, sometimes combined with soil disturbance, may be used as an NNIS control strategy in infested areas by depleting the seedbank and employing aggressive follow-up control measures.

d. After a canopy-opening activity, encourage prompt regeneration of new trees or other desirable vegetation

e. Note that some tree foliage diseases are exacerbated by heavy canopy cover, such as anthracnose.

**→BMP 7.8: Take steps to minimize the movement of aquatic NNIS, including fish, crustaceans, mollusks, plants, insects, and diseases among waterways during habitat management and assessment activities.**

Considerations for aquatic NNIS:

The introduction and spread of aquatic NNIS threaten the fisheries and aquatic biodiversity of the Eastern Region. A major pathway for the spread of aquatic NNIS is as 'hitchhikers' on waders, boats, trailers, nets, and other equipment moved between water bodies. This includes boats and equipment moved during field work associated with research and management activities. Many species are spread as eggs, resting stages, or fragments that are hardly visible to the human eye. Proper disinfection/decontamination protocols must be followed to prevent the spread of aquatic NNIS during fieldwork.

1. **Consider** the likelihood of inadvertently transporting aquatic NNIS when selecting field gear. For example, rubber-soled waders are less likely to transport propagules than felt-soled waders (see below for method to seal felt-soled waders against propagule transport).
2. **Check** all gear and equipment (e.g., boats, trailers, paddles, waders, nets, traps, sieves, buckets, floats, gloves, boots, clothing, etc.) and remove any visible plants, seeds, algae, mud, snails, and debris. Dispose of any debris by placing it in the trash, not by putting it down a drain or into bodies of water.
3. **Eliminate** water from all equipment before transporting anywhere. Much of the field equipment used in water contains many spots where water can collect and potentially harbor aquatic NNIS. Be sure to remove water from motors, jet drives, live wells, boat hulls, scuba tanks and regulators, boots, waders, bait buckets, seaplane floats, snorkel equipment, and any other gear.
4. Then **Clean** all gear and equipment, and tools used to clean the equipment, using an appropriate decontamination method (see below).
5. Then **Dry** all gear and equipment by exposing it to sunlight. If possible, carry multiple sets of field gear and use clean and dry gear for each waterway you visit.

Due to the nature of fieldwork, workers may have to visit multiple water bodies in a single day. When working on multiple streams, lakes, or watersheds, it is important to **disinfect gear before moving from one waterway to another**. If visiting multiple waterways in a single day, a portable disinfection kit should be carried. If possible, carry multiple sets of field gear and use clean and dry gear for each waterway you visit.

A simple **PORTABLE DISINFECTION KIT** might include:

- Large trash can and/or medium sized Rubbermaid-type bin for soaking wading boots
- Large stiff bristle brush for scrubbing
- Spray bottle(s) or herbicidal pump spray can(s)
- Measuring cup
- 5 percent detergent solution and/or 2 percent bleach solution
- Jug of clean water for rinsing and soaking

For sensitive equipment that can't be soaked, such as water chemistry probes, spray with 1:1 bleach:water solution and allow to air dry.

## Decontamination Methods

### *Non-absorbent Items (boats, canoes, rubber waders, 'hard-sided' objects)*

- **Dishwashing Detergent**: soak and scrub for at least one minute in 5% solution (add 6.5 oz of detergent with water to make 1 gallon). 'Green' products are less effective and not recommended for disinfecting.
- **Bleach:** soak or spray all surfaces for at least one minute in 2 percent household bleach (2.5 oz with water added to make 1 gallon). Bleach solutions must be replaced daily to remain effective.
- **Household Cleaner and hot water:** soak and agitate equipment for more than 10 minutes in a 1:1 solution of Formula 409 Antibacterial Formula and hot water
- **Hot Water:** soak for at least one minute in very hot water (above 140 °F – hotter than most tap water) OR for at least 20 minutes in hot water kept above 120 °F (hot tap water, uncomfortable to touch).
- **Drying:** Drying will kill Didymo and zebra mussel veligers, but slightly moist environments will support some organisms for months. This approach should only be used for gear that can be left in the sun for extended periods of time (i.e., a canoe that's left in the yard for several days between uses).

### *Absorbent Items*

Absorbent items require longer soaking times to allow thorough penetration into the materials. Felt-soled waders, for example, are difficult and take time to properly disinfect. Other absorbent items include clothing, sandals with fabric straps, or anything else that takes time to dry out. The thicker and denser a material, the longer it will require for adequate disinfection. Err on the side of caution. Bleach solutions are not recommended for absorbent materials. For decontaminating wetsuits, follow USGS protocol below.

- **Hot Water**: Soak items for at least 40 minutes in very hot water kept above 140 °F (hotter than most tap water or at least tap water that is uncomfortable to touch).
- **Dishwashing Detergent and hot water:** ('Green' products are less effective and not recommended for disinfecting): soak for 30 minutes in a hot 5percent detergent/water solution kept above 120 °F.
- **Drying:** This approach should only be used for gear that can be left in the sun for extended periods of time. Allow equipment to completely dry, preferably in direct sunlight at 84 °F or warmer for more than 24 hours.
- **Freeze:** Place item in freezer until solid.

## SCUBA and Snorkeling Gear (USGS protocol from http://www.glsc.usgs.gov/_files/ZMSOP.pdf)

- All dive gear and equipment should be inspected and cleaned. Any debris removed from equipment must be thrown into the trash and never into a body of water or flushed down a drain.
- All dive gear must be washed thoroughly by soaking in warm, soapy water and rinsing in warm, chlorinated tap water. Water temperatures greater than 110 °F have been found to be effective for killing larval zebra mussels; however, water temperatures exceeding 120 °F should not be used as it may damage certain temperature–sensitive dive gear and void some manufacturers' warranties. Also,

acidic or basic solutions (including vinegar or bleach) should not be used as they may compromise the integrity of thermoplastic materials.

- Buoyancy compensators must be flushed internally with warm tap water and dried completely using standard procedures as recommended by the manufacturer.
- Commercial dive gear cleaners, such a wetsuit shampoos, may also be used in the decontamination process.
- Drains in washing facilities must be attached to a source for wastewater treatment (municipal sewer) and must not discharge into external waters.
- All dive gear and equipment must be completely dry for a period of at least 24 hours before use in a new water body. Note: wetsuit seams should be closely inspected to insure that the material is completely dry.

### *Treating Felt-Soled Waders to Seal Them*

Missouri has banned the use of unsealed felt-soled waders. The following technique was developed by the Missouri Department of Conservation to seal felt-soled waders to make them legal for use in the state.

Materials Needed: Contact cement, solvent (compatible with the brand of contact cement you are using), and a paintbrush

In a well-ventilated area,

- 3:1 contact cement and solvent: Using a paintbrush, apply the contact cement solution to the felt sole and allow it to penetrate the felt. Allow it to dry.
- 50:50 contact cement and solvent: Paint over the layer you applied in step 1. Allow it to dry.
- 100 percent contact cement. Allow to Dry.
- Repeat Step 3. 100 percent contact cement. Allow to Dry

# Chapter 8. Fire Management

***Pre-fire, Pre-incident Training:***

**BMP 8.1: Incorporate NNIS awareness, identification, and prevention education into fire training (e.g., fire effects and prescribed fire training).**

***Prescribed Fire:***

**BMP 8.2: Avoid placing fire breaks in NNIS infestations.**

**BMP 8.3: Incorporate invasive species considerations into the planning of prescribed burns. (See also *Chapter 3: Management Planning*).**

**BMP 8.4: Avoid spreading NNIS seeds and other propagules from infested to non-infested areas during prescribed fire activities.**

**BMP 8.5: Following a prescribed burn, rehabilitate soil disturbance related to burn activities, especially bladed or plowed firelines, where NNIS establishment is likely.**

***Wildfire Suppression*:**

**BMP 8.6: When possible, avoid infestations when constructing fire breaks.**

**BMP 8.7: Avoid spreading NNIS seeds and other propagules from infested to non-infested areas during firefighting activities.**

**BMP 8.8: Following a wildfire, rehabilitate soil disturbance related to suppression activities, especially bladed or plowed firelines, where NNIS establishment is likely.**

Due to the nature of wildfire, it is recognized that restricting the spread of NNIS may not always be possible. Life safety, property, and resources shall remain the priorities (in that order) for wildfire suppression.

However, the management of NNIS should be integrated into standard prescribed fire practices whenever consistent with project scale and objectives.

Prescribed fire is utilized in forestry practices for a number of reasons: NNIS control, site preparation for tree planting or direct seeding, land conversion to a historical fire regime, site composition management (e.g., under burning in oak stands to set back red maple growth), and reducing fuel accumulations to reduce undesired effects from wildfires. Prescribed fire can be an effective and, sometimes, less costly management tool.

When utilizing prescribed fire for forestry practices, consider the use of the Fire Effects Information System website (http://www.fs.fed.us/database/feis/). This website offers information regarding how

various animal and plant species, including NNIS plants, react to fire. It also contains information regarding what intensity of fire is best for the management of these species.

Another website that may be useful in deciding whether prescribed fire is a viable management technique is The Nature Conservancy's Global NNIS Team website (http://tncweeds.ucdavis.edu/esadocs.html). The website features Invasive Plant Species Summaries which give information regarding the management of various NNIS.

## *Pre-fire, Pre-incident Training:*

→**BMP 8.1: Incorporate NNIS awareness, identification, and prevention education into fire training (e.g., fire effects and prescribed fire training).**

## *Prescribed Fire:*

→**BMP 8.2: Avoid placing fire breaks in NNIS infestations.**

Considerations:

a. Preplanning:

- Conduct an inventory for NNIS plant species in and outside of the burn unit near the planned fire break.
- Incorporate NNIS information into pre-prescribed burn briefings.
- Before moving equipment from the maintenance building/garage to the burn site remove NNIS and their propagules.

b. Location:

- Fire break construction (by mowing, plowing, or hand line) can spread NNIS.
- Locate fire breaks to limit the potential to spread NNIS.
- If NNIS are present that are damaged or killed by fire, incorporate the area of infestation into the burn unit when feasible.
- If NNIS are present that are promoted by fire, exclude the area of infestation from the burn unit when feasible.

c. Fire break type:

- Utilize existing natural and man-made breaks (lakes, streams, roads, trails, etc.) when possible.
- If NNIS are present consider utilizing a fire break type that restricts the spread of the infestation (i.e., mowed vs. mineral soil).

d. Construction

- Time the mowing of fire breaks to avoid the spread of NNIS. For example, mow before plants have seed heads.
- Construct firebreaks only deep enough and wide enough to control the spread of the fire (WDNR 2003).

**→BMP 8.3: Incorporate NNIS considerations into the planning of prescribed burns (see also *Chapter 3: Management Planning*).**

Considerations:

a. If an NNIS is present that is sensitive to fire, consider timing and conditions of the fire to maximize control. For example, burning buckthorn in early spring when plant carbohydrate stores are at their lowest may kill buckthorn seedlings and saplings or reduce resprouting vigor in older plants.

b. If an NNIS is present that is promoted by fire, consider a different management technique or plan follow up NNIS control measures. For example, burns may stimulate the germination of buckthorn seeds. Follow-up treatments (e.g., herbicide) should then be used to kill the established seedlings. Planning for this response and follow up can be used as a technique for depleting the seedbank of invasive plant seeds.

c. See Appendix A for an overview of control methods and Forestry Appendix C at http://council.wisconsinforestry.org/ for a list of highly invasive plant species.

**→BMP 8.4: Avoid spreading NNIS seeds and other propagules from infested to non-infested areas during prescribed fire activities.**

> **Note:** BMP 4.4: Prior to moving equipment onto and off of an activity area, scrape or brush soil and debris from exterior surfaces, to the extent practical, to minimize the risk of transporting propagules.

Considerations:

a. Do not move equipment from a burn unit that has NNIS to an area that is free of NNIS unless the equipment has been cleaned.

b. A thorough cleaning of equipment at the end of the burn day will minimize spread.

c. Maintain an NNIS-free equipment staging area and cleaning area, for example, by cleaning equipment on a non-porous surface like blacktop or on a filter pad to collect debris removed from vehicles.

d. To prevent the spread of aquatic NNIS, avoid moving water from one waterbody to another. For example, any equipment that draws water from one waterbody should not be drained into another waterbody. As part of general maintenance, equipment, such as portable pumps and hoses, should be flushed and run with clean water between uses. Also, waterbodies with particularly virulent diseases (e.g., Viral Hemorrhagic Septicemia) and known aquatic invasive species (e.g., dreissenid mussels,

Eurasian watermilfoil) should be excluded from use during fire operations. See operational guidelines from USFS Intermountain Region (R4) for more information.

e. Post-burn monitor activity areas, staging areas, access routes, and equipment cleaning areas for new infestations (WDNR 2003).

**→BMP 8.5: Following a prescribed burn, rehabilitate soil disturbance related to burn activities, especially bladed or plowed firelines, where NNIS establishment is likely.**

> **Note:** BMP 6.2: Revegetate or reforest as quickly as feasible after site disturbance.
>
> BMP 6.3: When consistent with site conditions and goals, allow natural revegetation of the ground layer to occur. If seeding or planting is necessary to minimize the threat of highly damaging NNIS from spreading, use locally native seed or non-invasive, annual cover crops for revegetation.

Considerations:

a. Revegetate firelines in areas that are most likely to be colonized by NNIS (e.g., areas that are near existing populations of NNIS).

b. Limit soil disturbance during break rehabilitation.

c. Rehabilitation of firelines can prevent the use of fireline corridors as illegal motorized vehicle travelways. Place sufficient downed trees, root wads, and boulders to block access by motorized vehicles and to slow the flow of water, both of which may carry seeds of NNIS plants.

## *Wildfire Suppression:*

**→BMP 8.6: When possible, avoid infestations when constructing fire breaks.**

There are two methods for attacking a wildfire: direct attack and indirect attack. In the **direct attack** method firefighters build a fire break directly along the edge of the wildfire. It is understood that direct attack prevents the decision of where to place the fire line in conjunction with areas that have, or do not have, NNIS present. In the **indirect attack** method firefighters build a fire break at a safe distance away from the fire and burn the area between the fire break and the fire to remove fuel.

Considerations for Indirect attack:

a. Location:

- Fire break construction (by mowing, plowing, or hand line) can spread NNIS.
- Locate fire breaks to limit the potential to spread NNIS.
- If NNIS are present that are damaged or killed by fire, incorporate the area of infestation into the burn unit when feasible.

- If NNIS are present that are promoted by fire, exclude the area of infestation from the burn unit when feasible.

b. Fire break type:

- Utilize existing natural and manmade fire breaks (lakes, streams, roads, trails, etc.) when possible.

c. Construction:

- Construct fire breaks only deep enough and wide enough to control the spread of the fire (WDNR 2003).

**→BMP 8.7: Avoid spreading NNIS seeds and other propagules from infested to non-infested areas during firefighting activities.**

> **Note:** BMP 4.4: Prior to moving equipment onto and off of an activity area, scrape or brush soil and debris from exterior surfaces, to the extent practical, to minimize the risk of transporting propagules.

Considerations:

a. When feasible, do not move equipment from a burn unit that has NNIS to an area that is free of NNIS unless the equipment has been cleaned.

b. A thorough cleaning of equipment at the end of the burn day will minimize spread.

c. Maintain an NNIS-free equipment staging area and cleaning area, for example, by cleaning equipment on a non-porous surface like blacktop or on a filter pad to collect debris removed from vehicles.

d. To prevent the spread of aquatic NNIS, avoid moving water from one waterbody to another. For example, any equipment that draws water from one waterbody should not be drained into another waterbody. As part of general maintenance, equipment, such as portable pumps and hoses, should be flushed and run with clean water between uses. Also consider excluding waterbodies with particularly virulent diseases (e.g., Viral Hemorrhagic Septicemia) and known aquatic invasive species (e.g., dreissenid mussels, Eurasian watermilfoil) from use during fire operations. See operational guidelines from USFS Intermountain Region (R4) for more information.

e. Post-burn, monitor activity areas, staging areas, access routes, and equipment cleaning areas for new infestations (WDNR 2003).

**→BMP 8.8: Following a wildfire, rehabilitate soil disturbance related to suppression activities, especially bladed or plowed fire lines, where NNIS establishment is likely.**

> **Note:** BMP 6.2: Revegetate or reforest as quickly as feasible after site disturbance.
>
> BMP 6.3: When consistent with site conditions and goals, allow natural revegetation of the ground layer to occur. If seeding or planting is necessary to minimize the threat of highly damaging NNIS from spreading, use locally native seed or non-invasive, annual cover crops for revegetation.

Considerations:

a. NNIS that establish a seed source in firelines can spread into adjacent areas (Merriam et al. 2006).

b. Revegetate firelines in areas that are most likely to be colonized by NNIS (i.e., areas that are near existing populations of NNIS).

c. Rehabilitation of firelines can prevent the use of fireline corridors as illegal motorized vehicle travelways. Place sufficient downed trees, root wads, and boulders to block access by motorized vehicles and to slow the flow of water, both of which may carry seeds of NNIS plants.

d. Limit soil disturbance during break rehabilitation.

# Chapter 9. Transport of Woody Material

**BMP 9.1: Prior to trucking, implement mitigation strategies to reduce the risk of transporting highly damaging NNIS insect and disease species when present, to the extent practical.**

## *Long-range Transport*

Movement of NNIS occurs naturally in a wide variety of ways. Some species of plants, insects, and fungi have very small reproductive propagules that can be moved long distances by wind without the influence of human activity. There are however, some NNIS that do not move long distances on their own including Emerald ash borer, Sirex wood wasp, and Asian longhorned beetle.

## *Regulatory Considerations*

**Be aware of all state and federal quarantine rules related to transportation of regulated articles out of a quarantined area.**

It is a violation of state and federal laws to transport designated regulated articles outside of a quarantined area. USDA Animal Plant Health Inspection Service (APHIS) and the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) are responsible for designating the quarantined area and determining what materials will be regulated. Movement of regulated articles may be allowed under certain circumstances; details of exceptions are provided in a compliance agreement, which is issued by USDA APHIS.

**BMP 9.1: Prior to trucking, implement mitigation strategies to reduce the risk of transporting highly damaging NNIS insect and disease species when present, to the extent practical.**

Considerations:

a. This BMP does not include NNIS plant species.

b. Practical mitigation strategies to minimize the risk of transporting highly damaging NNIS should be discussed during the planning process and considered for inclusion in the management plans, prescriptions, timber sale prospectus, and contract language.

c. Mitigation activities should focus on site- and threat-specific activities that reduce the risk of transporting NNIS.

d. Examples of mitigation strategies are listed in Table 2. Strategies for a particular NNIS may be appropriate for application on a broad-scale, for a specific site only or not at all.

e. Effectively reducing the risk of transporting NNIS requires the cooperation of foresters, landowners, loggers, and purchasers of raw products.

f. Mitigation strategies begin in the planning phases and include numerous steps: inventorying (BMP 3.2), planning of NNIS management strategies (BMP 3.4), training in identification of NNIS (BMP 4.1), and timing of control treatments (BMP 4.2).

**Table 1.** Examples of NNIS forest insects and diseases and possible mitigation strategies to minimize the risk of long-range transportation

| **NNIS** | **Possible Mitigation Strategies** |
|---|---|
| Conifer bark beetles (*Ips* spp.) | If harvesting conifers during April-September, transport conifer logs away from the residual conifer stand within four weeks of harvest to avoid the build-up of bark beetle populations in the freshly cut log and reinfestation of the residual stand. |
| Annosum root rot (*Heterobasidion annosum)* | If working in a stand of conifers known to be infected with Annosum root rot, leave infested material on the site to limit the movement of disease. This material is typically dying or in a state of decline. |
| Oak wilt (*Ceratocystis fagacearum)* | Oak trees that have been killed from oak wilt will produce an infectious spore stage the spring or summer of the year following death. This "infectious material" can be the source of a new introduction of oak wilt.<br><br>*Oak that is killed by oak wilt and may still produce the infectious spore stage should not be transported into counties where oak wilt has not been confirmed.*<br><br>*If transporting oak that could produce a spore stage (infectious material), consider either utilizing (removing bark and jacket wood) from infected trees before spores can be formed (spring of year following death) or leaving recently-killed trees on site.*<br><br>Oak trees killed from oak wilt that have loose or sloughing bark are not infectious and do not require any special treatment. |

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# Appendices for Forestry Best Management Practices

## *Forestry Appendix A. Regulations*

Each Eastern Region Forest may add their state regulations, as appropriate here.

**Invasive Plant Statutes and Codes -- Wisconsin**

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Wisconsin Statutes http://www.legis.state.wi.us/rsb/stats.html
See left navigation area to search for a specific statute in the website's *Infobase* or go to a Statute Chapter.

**15.34 Department of natural resources; creation.**
**15.347 Same; councils.**
**(18)** INVASIVE SPECIES COUNCIL
**History:** 1973 c.74; 1991 a.316; 2001 a.16.

**23.22 Invasive species.**
**Cross Reference:** See also ch. NR 198, Wis. adm. code.
**History:** 2001 a. 109 ss. 72t, 72xd; 2003 a. 33.

**23.235 Nuisance weeds.**
**History:** 1987 a. 41; 1999 a. 150 s. 616; Stats. 1999 s. 23.235; 2001 a. 16; 2001 109 ss. 72td to 72wj.

**26.02 Council on forestry.**
**History:** 2001 a. 109.

**28.04 Management of state forests.**
**History:** 1995 a. 257.
**Cross Reference:** See also ch. NR 44 and s. NR 1.24, Wis. adm. code.

**66.0407 Noxious weeds.**
**History:** 1975 c. 394 s. 12; 1975 c. 421; Stats. 1975 s. 66.96; 1983 a. 112, 189; 1989 a. 56 s. 258; 1991 a. 39, 316; 1997 a. 287; 1999 a. 150 ss. 617 to 619; Stats. 1999 s. 66.0407.

**94.38 Agricultural and vegetable seeds; definitions.**
**History:** 1975 c. 39, 308; 1983 a. 189; 1985 a. 138; 1993 a. 112.

**94.39 Seed labeling requirements.**
**History:** 1975 c. 39, 308; 1985 a. 138.

**94.41 Prohibitions.**
**History:** 1973 c. 194, 195; 1985 a. 138; 1993 a. 492.

**94.45 Powers and authority of the department** [Department of Agriculture].
**History:** 1975 c. 39, 308; 1983 a. 189 s. 329 (20).
**Cross Reference:** See also ch. ATCP 20, Wis. adm. code.

Administrative Code http://www.legis.state.wi.us/rsb/code.htm
See left navigation area to search for a specific Statute in the website's *Infobase* or go to a Code Chapter (look under "NR Natural Resources".) http://www.legis.state.wi.us/rsb/code/codtoc.html

**NR 150.025 Policy.**
**History:** Register, February, 1981, No. 302, eff. 3-1-81; renum. (2) (g) and (h) to be (2) (h) and (i), cr. (2) (g), Register, February, 1984, No. 338, eff. 3-1-84; am. (2) (e), Register, January, 1987, No. 373, eff. 2-1-87.

**NR 1.211 Cooperative forestry policy.**
**History:** Cr. Register, July, 1989, No. 403, eff. 8-1-89.

**NR 44.04 Master plan development, adoption and public involvement.**
**History:** Cr. Register, August, 1996, No. 488, eff. 9–1–96.

**Insects and Diseases Statutes**

Wisconsin Statutes http://www.legis.state.wi.us/rsb/stats.html
See left navigation area to search for a specific Statute in the website's *Infobase* or go to a Statute Chapter: http://www.legis.state.wi.us/rsb/Statutes.html

*Wisconsin Statutes that apply to the Department of Natural Resources (WDNR):*

**26.30 Forest insects and diseases; department jurisdiction; procedure.**
**History:** 1977 c. 29 s. 1650m (1); 1979 c. 32 s. 92 (9); 1979 c. 110 s. 60 (11); 1983 a. 189; 1985 a. 13; 1991 a. 316; 2003 a. 33, 57.
**Cross Reference:** See also s. NR 47.910, Wis. adm. code.

*Wisconsin Statutes that apply to the Department of Agriculture, Trade and Consumer Protection (WDATCP):*

**94.01 Plant inspection and pest control authority.**
**History:** 1975 c. 394 s. 18; Stats. 1975 s. 94.01.
**Cross Reference:** See also ch. ATCP 21, Wis. adm. code.

**94.02 Abatement of pests.**
**History:** 1975 c. 394ss. 5, 19; 1975 c. 421; Stats. 1975 s. 94.02; 1977 c. 418; 1981 c.20.

**94.03 Shipment of pests and biological control agents; permits.**
**History:** 1975 c. 394 ss. 6, 17; 1983 a. 189 s. 329 (20).

**94.10 Nursery stock; inspection and licensing.**
**History:** 1975 c. 394 ss. 20, 22; 1975 c. 421; Stats. 1975 s. 94.10; 1983 a. 189; 1989 a. 31; 1993 a. 16; 1995 a. 27; 1999 a.9.

**94.685 Pesticides; licensing of dealers and distributors of restricted-use pesticides.**
**History:** 1987 a. 27; 1991 a. 269; 1993 a. 16, 490; 1997 a. 27.
**Cross Reference:** See also chs. ATCP29, 30, and 31 and ss. ATCP 160.19 and 160.21, Wis. adm. code.

**94.69 Pesticides; rules.**
**History:** 1975 c. 94s. 91 (10); 1977 c. 106; 1983 a. 410; 1997 a. 27, 237.
**Cross-reference:** See s. 94.709 for prohibition of use of DDT and exceptions to the prohibition.
**Cross Reference:** See also chs. ATCP 29, 30, and 31 and ss. ATCP 160.19 and 160.21, Wis. adm. code.

*Wisconsin Statutes that apply to both the Department of Agriculture, Trade and Consumer Protection (WDATCP) and the Department of Natural Resources (WDNR):*

**146.60 Notice of release of genetically engineered organisms into the environment.**
**History:** 1989 a. 15; 1993 a. 213; 1995 a. 27 s. 9126 (19); 1997 a. 283; 2001 a. 109.

## *Forestry Appendix B: Resources*

Each R9 forest may add NNIS resources as appropriate.

**NNIS –** *All NNIS, Wisconsin*

*Center for Invasive Plant Management (CIPM).* http://www.weedcenter.org
This web site provides information on invasive plant identification, biology, and impacts of NNIS. It also includes links to a resource guide, weed control methods, and invasive plant management online textbook.

*Great Lakes Indian Fish and Wildlife Commission (GLIFWC)—Exotic Plant Information Center.* http://www.glifwc.org/invasives/ This site features a searchable database of NNIS accounts. It also provides distribution maps, educational materials, and a slide library.

*Invasive Plants Association of Wisconsin (IPAW).* http://www.ipaw.org
The mission of IPAW is to promote better stewardship of the natural resources of Wisconsin by advancing the understanding of invasive plants and encouraging the control of their spread. Their web site offers a photo gallery, NNIS list, educational resources, news and events, and more.

*Midwest Invasive Plant Network (MIPN).* http://www.mipn.org/
This organization's mission is to reduce the impact of invasive plant species in the Midwest. The web site provides information on prevention, early detection and rapid response, control and management, education, research, and more.

*Plant Conservation Alliance (PCA), Weeds Gone Wild, Alien Plant Invaders of Natural Areas.* http://www.nps.gov/plants/alien/ This web site provides a list of invasive plants in the US, background information on the threats and impacts of NNIS, fact sheets, and relevant links.

*University of Wisconsin Herbarium.* http://www.botany.wisc.edu/wisflora
The Herbarium's web site is fully searchable for Wisconsin's vascular plant species. It includes photos, habitat information, distribution maps, and herbarium specimen data.

**NNIS Insects and Diseases**

*Department of Agriculture Trade and Consumer Protection (DATCP).*
http://www.datcp.state.wi.us/core/insectspesticides/insectspesticides.jsp
DATCP is responsible for the prevention, introduction and spread of plant pests. This webpage provides information on specific pests, rules, firewood restrictions, and firewood dealer certification.

*Department of Agriculture Trade and Consumer Protection (DACTP)—Wisconsin Pest Bulletin.* http://pestbulletin.wi.gov/index.jsp The most relevant links are: *Nursery and Forest*, *Exotic Pest of the Week*, and *DATCP Contacts*.

*Emerald Ash Borer: What you need to know.* http://www.emeraldashborer.info/ This web site is part of a multi-state effort to provide the latest information about EAB to the public.

*National Agricultural Pest Information System (NAPIS)—Pest Tracker.* http://ceris.purdue.edu/napis/
This web site has links to state information, pest information, survey maps and publications. Information

presented here is derived, in part, from the National Agricultural Pest Information System (NAPIS), an agricultural pest tracking and database sponsored by the U.S. Department of Agriculture Animal and Plant Health Inspection Service (APHIS) and Plant Protection and Quarantine (PPQ) Cooperative Agricultural Pest Survey, (CAPS).

*The Exotic Forest Pest Information System for North America.* http://spfnic.fs.fed.us/exfor/index.cfm This web site contains a database of invasive insects, mites, and diseases with background information for each pest.

*U.S. Department of Agriculture (USDA) Animal Plant Health Inspection Service (APHIS).* http://www.aphis.usda.gov/plant_health/ APHIS safeguards agriculture and natural resources from the risks associated with the entry, establishment, or spread of animal and plant pests. The site has links to information on specific plant pests, pest detection and identification information, and plant protection and quarantine manuals.

*U.S. Department of Agriculture (USDA) Forest Service—North Central Research Station: Emerging Forest Insect Pests.*
http://www.ncrs.fs.fed.us/4501/focus/emerging_pests/ The North Central Research Station web site provides information on exotic forest insects, describes current research, and features publications and maps for a 20-state region spanning the Midwest and Northeast.

*Wisconsin Gypsy Moth.* http://www.gypsymoth.wi.gov/ The Wisconsin Gypsy Moth site has information on predicting defoliation, management options, identification, and life cycle and includes the phone number for the Gypsy Moth Information Line.

*Wisconsin's Emerald Ash Borer Resource.* http://emeraldashborer.wi.gov/ This site includes information on surveys, detection, and management, and includes an email address and phone number to report suspected infestations.

**All Non-native Invasive Species:**

*National Invasive Species Council's Definition of Invasive Species.*
http://www.invasivespeciesinfo.gov/docs/council/isacdef.pdf
*National Invasive Species Management Plan.* http://www.invasivespeciesinfo.gov/council/nmp.shtml

*The Nature Conservancy (TNC)—Global Invasive Species Initiative.* http://tncweeds.ucdavis.edu This web site provides many resources designed to help conservationists deal most effectively with NNIS. It provides links to an introduction on NNIS management, planning and strategy, control methods, and photo archive and more.

*USDA Forest Service Invasive Species Program.* http://www.fs.fed.us/invasivespecies This web site serves as a portal to Forest Service NNIS information and related management and research activities across the agency and with partners. The program's goal is to *reduce, minimize, or eliminate the potential for introduction, establishment, spread, and impact of NNIS across all landscapes and ownerships.*

**General Sites of Interest:**

Great Lakes Restoration Initiative Projects. GLRI Projects Funded by the USDA Forest Service.
https://restore.glnpo.net/glas_pub/qadetailreport.htm?reportType=Organization&reportYear=All Years&subID=18

Non-Native Invasive Species Framework for Plants and Animals in the U.S. Forest Service, Eastern Region. *http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm91_054493.pdf*

U.S. Forest Service Eastern Region Native Plant Framework.
http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm91_054410.pdf

U.S. Forest Service Eastern Region (R9) Non-native Invasive Species Program.
http://www.fs.usda.gov/main/r9/forest-grasslandhealth/invasivespecies

U.S. Forest Service Manual 2900, Invasive Species Management.
http://www.fs.fed.us/im/directives/fsm/2900/wo_2900_zero_code.doc

U.S. Forest Service Non-native Invasive Species – Laws, Regulations and Policies.
http://www.fs.usda.gov/detail/r9/forest-grasslandhealth/invasivespecies/?cid=fsm91_054666

**General Invasive Plant Management:**

*Center for Invasive Plant Management (CIPM)—Weed Control Methods.*
http://www.weedcenter.org/management/control.htm
The Weed Control Methods web page offers information and links on the following control techniques: biocontrol, grazing, herbicides, mechanical and prescribed burning.

*Department of Conservation and Natural Resources Invasive Exotic Plant Tutorial for Natural Land Managers. Invasive Exotic Plants in Pennsylvania List.*
http://www.dcnr.state.pa.us/forestry/invasivetutorial/List.htm
Although this site is for Pennsylvania most of the species featured are also invasive in Wisconsin. The site provides links to fact sheets and management and control recommendations.

*Garlic mustard (*Alliaria petiolata*)—Guide for identifying and controlling.*
http://www.for-wild.org/download/garlicmustard.pdf

*Illinois Nature Preserve Management Guidelines.* http://dnr.state.il.us/INPC/Management_guidelines.htm
The information presented gives guidance to landowners, managers, custodians and stewards of sites in the Illinois Nature Preserve Programs on control methods for common NNIS.

*Invasive Plants of the Upper Midwest* by Elizabeth J. Czarapata. This book is a comprehensive, fully-illustrated guide to the identification and control of invasive plant species. Available for purchase at www.ipaw.org.

*Plant Conservation Alliance—Alien Plant Invaders of Natural Areas.*
http://www.nps.gov/plants/alien/factmain.htm This web site features illustrated, easy-to-read fact sheets on select invasive plants with native ranges; plant descriptions; ecological threats; US distributions and habitats; background of introductions; plant reproduction and dispersal; management approaches; alternative native plants; and other useful information.

*The Nature Conservancy (TNC)—Weed Control Methods Handbook: Tools and Techniques for Use in Natural Areas.* http://tncweeds.usdavis.edu/handbook.html
The handbook provides detailed information on the use of manual and mechanical techniques, grazing, prescribed fire, biocontrol, and herbicides for use in controlling NNIS in natural areas.

*USDA Forest Service Invasive Species Program—Control and Management.* http://www.fs.fed.us/invasivespecies/controlmgmt/index.shtml This page provides links for more information on research, management planning, forest service activities, and pest-specific control and management.

*USDA Forest Service—Dangerous Travelers: Controlling Invasive Plants along America's Roadsides (Video).* http://www.fs.fed.us/invasivespecies/ The video outlines the best management practices that road crews should be following in their day-to-day operations. This is the first in a series on "Best Management Practices for Invasive Species Prevention." The video can also be ordered on DVD by contacting: USDA Forest Service; San Dimas Technology and Development Center; 444 East Bonita Avenue; San Dimas, CA 91773; (909) 599-1267

*Wisconsin Department of Natural Resources (WDNR). Wisconsin Manual of Control Recommendations: Ecologically Invasive Plants.* http://dnr.wi.gov/invasives/publications/manual/manual_toc.htm

**Biocontrol:**

Invasive Plants of the Eastern U S—Biological Control of Invasive Plants in the Eastern United States. (USDA Forest Service Publication FHTET-2002-04, 413 p.) http://wiki.bugwood.org/Archive:BCIPEUS This web site serves as a reference guide for field workers and land managers concerning the historical and current status of the biological control of select invasive plants in the eastern United States.

*Cornell University. Biological Control: A Guide to Natural Enemies in North America.* http://www.nysaes.cornell.edu/ent/biocontrol/ This web site provides photographs and descriptions of biocontrol agents of insect, disease and weed pests in North America.

**Grazing:**

*University of Idaho Rangeland Ecology and Management. Targeted Grazing: A Natural Approach to Vegetation Management and Landscape Enhancement.* http://www.cnr.uidaho.edu/rx-grazing/Handbook.htm The handbook outlines the basics of applying targeted grazing for vegetation management. This handbook includes 18 chapters and represents a compilation of the latest research on harnessing livestock to graze targeted vegetation in ways that improve the function and appearance of a wide variety of landscapes.

**Prescribed fire:**

*California Invasive Plant Council—The Use of Fire as a Tool for Controlling Invasive Plants.* http://www.cal-ipc.org/ip/management/UseofFire.pdf
This document contains information on the following: planning and implementing prescribed burns, control of invasive plants with prescribed fire, using prescribed burning in integrated strategies, effects of fire on plant communities, effects of fire on chemical, physical, and biotic properties of soil.

*Center for Invasive Plant Management (CIPM)—Fire As a Tool For Controlling Nonnative Invasive Plants.* http://www.weedcenter.org/management/burning_weeds.pdf
This review focuses on the intentional use of fire, alone or integrated with other methods, to control exotic plants in North America.

*The Nature Conservancy (TNC)—Fire Management Manual.* http://www.tncfiremanual.org/index.htm The manual serves as the Conservancy's guiding document on all aspects of wildland fire management.

*USDA Forest Service—Fire Effects Information System (FEIS).* (http://www.fs.fed.us/databas/feis/). FEIS features a searchable database that summarizes and synthesizes research about living organisms in the United States —their biology, ecology, and relationship to fire.

*Wisconsin Prescribed Fire Council.* http://www.prescribedfire.org/index.html The Wisconsin Prescribed Fire Council strives to make the use of prescribed fire in Wisconsin safer and more accepted for all practitioners. The site provides information and links on government relations, liability, training, weather, and fire implementation.

**Herbicide:**

*Department of Agriculture Trade and Consumer Protection (DATCP)—Pesticide Database Searches.* http://www.kellysolutions.com/wi/ Use this site to search for registered pesticide products, the companies that sell and use pesticides, and the people that apply them.

*Herbicide safety information—Material Data Safety (MDS) sheets and product labels.* http://www.cdms.net/LabelsMsds/LMDefault.aspx?t=.

*The Nature Conservancy (TNC)—Safe Herbicide Handling in Natural Areas: A Guide for Land Stewards and Volunteer Stewards.* http://tncweeds.ucdavis.edu/products/library/herbsafe.pdf

*The Nature Conservancy (TNC)—Upkeep and Maintenance of Herbicide Equipment: A guide for natural area stewards.* http://tncweeds.ucdavis.edu/products/library/herbupkeep.pdf

**Early Detection and Rapid Response:**

*iMapInvasives: Geotracking invasive exotic species.* http://imapinvasives.org/index.html
A consortium developed an on-line GIS-based NNIS mapping tool designed to aid in Early Detection and Rapid Response efforts. The site allows one to display maps and query by NNIS or contributing organization. Currently the site has only sample plant data for the state of New York. Long-term goals for the site include seeking participation of additional states and/or provinces.

*National Biological Information Infrastructure (NBII). National Framework for Early Detection, Rapid Assessment, and Rapid Response to Invasive Species.*
http://159.189.176.5/portal/community/Communities/Ecological_Topics/Invasive_Species/Early_Detection,_Rapid_Response_(EDRR)/ This framework includes seven main components: 1) identification and validation, 2) reporting, 3) expert verification, 4) occurrence databases, 5) rapid assessment, 6) planning, 7) rapid response.

*The Nature Conservancy (TNC)—Weed Information Management System (WIMS).*
http://tncweeds.ucdavis.edu/wims.html WIMS is a Microsoft Access-based relational database application that is designed to assist natural resource managers in managing their weed data.

*The North American Weed Management Association.* http://www.nawma.org/ The North American Weed Association has developed a data collection standard for invasive plant monitoring in the western United States and it has been adopted by several federal agencies, including US Forest Service and the National Park Service. At the home page, scroll down to “Mapping Standards” link.

*USDA Forest Service. The Early Warning System for Forest Health Threats in the United States.*
http://www.fs.fed.us/foresthealth/publications/EWS_final_draft.pdf

This is a monitoring framework for early detection and response to environmental threats (e.g., insects, diseases, NNIS, and fire) to forest lands. The framework is based on the following steps: 1) identify potential threats, 2) detect actual threats, 3) assess impacts, and 4) respond.

*Wisconsin Department of Natural Resources/ University of Wisconsin-Madison Herbarium—Invasive Plants of the Future.* http://dnr.wi.gov/invasives/futureplants/
This monitoring and early reporting project has three main goals: 1) identify and report populations of high-risk early-stage target weed species in Wisconsin; 2) eliminate or contain those populations before they spread; and 3) coordinate long-term monitoring of occurrence sites. All land managers are encouraged to participate in this program.

**Prioritizing Management:**

*NatureServe—An Invasive Species Assessment Protocol: Evaluating Non-Native Plants for Their Impacts on Biodiversity.*
http://www.natureserve.org/library/invasiveSpeciesAssessmentProtocol.pdf
The Invasive Species Assessment Protocol was developed as a tool for assessing, categorizing, and listing non-native invasive vascular plants according to their impact on biodiversity in a large area such as a nation, state or province, or ecological region. This protocol is designed to make the process of assessing and listing invasive plants objective and systematic.

*Animal and Plant Health Inspection Service (APHIS)—Weed-Initiated Pest Risk Guidelines for Qualitative Assessments.*
http://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/wra.pdf
This document provides a template for conducting pest risk analysis: initiating the process by identifying a pest that may qualify as a quarantined pest, and/or pathways that may allow introduction or spread of a quarantine pest; and assessing pest risk (determining which pests are quarantine pests, characterized in terms of likelihood of entry, establishment, spread, and economic importance.)

**Non-native Invasive Species Plant Lists:**

*Chequamegon-Nicolet National Forest, Invasive Plants of Immediate Concern.*
http://www.fs.fed.us/r9/cnnf/natres/nnis/species_list.html)

*Invasive Plant Association of Wisconsin, Working List of Invasive Plants in Natural Plant Communities and Wild Areas of the State.*
http://www.ipaw.org/list/list1.htm?n0

*USDA Forest Service, Invasive Plants Field and Reference Guide: An Ecological Perspective of Plant Invaders of Forests and Woodlands.*
http://www.na.fs.fed.us/pubs/misc/ip/ip_field_guide.pdf

*USDA PLANTS Database. Invasive and Noxious Weeds.* http://plants.usda.gov/java/noxiousDriver This database provides information about the vascular plants, mosses, liverworts, hornworts, and lichens of the US, including invasive plants. It includes species distribution, characteristics, species abstracts, images, references and links to more information.

*Wisconsin DNR, Program Feasibility Study: Invasive Plants in Forests*
*Plants Currently a Problem in Wisconsin's Forests (p.6-12).*
http://dnr.wi.gov/org/land/forestry/Publications/pdf/InvasivePlantStudy.pdf

*WDNR Target Invasive Plants of the Future.*
http://dnr.wi.gov/invasives/futureplants/target.htm

**Insects and Diseases Lists:**

*The Nature Conservancy's Invasive Species Initiative Regional List of Pests, 2004 (scroll down to Midwest region, but note that this covers from MI to ND, south to TX).*
http://tncweeds.ucdavis.edu/products/gallery/regionlist.html

*USDA Forest Service Invasive Species Program Web pages.*
http://www.fs.fed.us/invasivespecies/speciesprofiles/index.shtml

*USDA Forest Service North Central Research Station.*
http://www.ncrs.fs.fed.us/4501/focus/emerging_pests/

*Wisconsin DNR Forest Health Protection Unit's Annual Report: Forest Health Conditions in Wisconsin, 2005.*
http://dnr.wi.gov/org/land/forestry/fh/pdf/AnnualReport2005.pdf

## *Forestry Appendix C: Species Lists/Factsheets for Highly Damaging Invasive Species*

Go to http://council.wisconsinforestry.org/

## *Forestry Appendix D: Species Recommended for Revegetation*

Go to http://council.wisconsinforestry.org/.

## *Forestry Appendix E: Working List of Terrestrial Invasive Plant Species*

Go to http://council.wisconsinforestry.org/.

## *Forestry Appendix F: List of BMPs*

Go to http://council.wisconsinforestry.org/.

# Outdoor Recreation Activities Best Management Practices

## Introduction

The best management practices (BMPs) presented in this document are intended to help prevent the introduction and further spread of non-native invasive species (NNIS) - plants, insects, and diseases - on private and public lands. In addition to the specific BMPs, the document contains information to help recreational users assess the threats posed by NNIS.

The document is structured as in the following example:

→**BMP Statement: NNIS BMPs appear in bold and are underlined. These statements describe voluntary practices that reduce the impact of NNIS.**

Suggestions:

a. BMP Suggestions are listed below the BMP Statement.

b. BMP Suggestions give more information about why the BMP is important.

c. BMP Suggestions introduce items that could be used to address the BMP; they will not apply to every species or situation, and the user does not necessarily have to follow them to address the BMP.

d. BMP Suggestions may include details, examples, proposals, and issues to consider about NNIS and applying the BMP.

As you read the BMPs, keep in mind that they are intended as concepts that can be tailored by individual Eastern Region Forests, for dissemination to user groups, partners , and the public. Although the specific language may change, the message should remain the same.

## Best Management Practices

### *Universal or Common BMPs*

*(BMP Prefix = "U")*

→**BMP U-1: Learn to recognize NNIS common to the areas where you enjoy outdoor recreational activities.**

Suggestions:

a. Read guides, brochures, and pamphlets produced by government agencies or other weed management groups on NNIS plants and invertebrates.

b. Check out the Wisconsin DNR website for photos and instructions. http://dnr.wi.gov/invasives

**→BMP U-2: Wear outer layers of clothing and footwear that are not "seed-friendly."**

Suggestions:

a. In appropriate areas, wear low-tread footwear that doesn't hold soils, seeds, plant parts, or invertebrates.

b. Wear disposable shoe covers over footwear in infested areas; properly dispose of them when leaving the area.

c. Consider dedicating a pair of shoes or boots for use only on infested properties.

d. Wear ankle gaiters over socks and shoelaces.

e. Avoid exposing Velcro, bulky knits (e.g., wool, fleece), pants with cuffs, and other fabrics or clothing styles that can carry seeds.

**→BMP U-3: Inspect and clean hair, clothing, footwear, and gear for soils, seeds, plant parts, or invertebrates before and after recreating.**

Suggestions:

a. Use items like a stiff brush, stick or small screwdriver to help remove soils, seeds, plant parts, or invertebrates; use boot brushes and other removal devices when provided.

b. Wear a hat to cover hair.

c. Preferred locations for cleaning are those where:
   - NNIS are already established.
   - Gear is unloaded and loaded
   - Areas are easily monitored for new infestations due to the cleaning activity, i.e., along a road, at a trailhead, or in a parking lot.

d. Do not clean clothing, footwear, or gear in or near waterways. This may promote the spread of NNIS downstream.

**→BMP U-4: Prior to moving equipment, vehicles, and trailers onto and off of an activity area, spray, scrape, or brush soils, seeds, plant parts, or invertebrates from exterior surfaces, to the extent practical, to minimize the risk of transporting NNIS.**

Suggestions:

a. Visit a carwash or designated cleaning station; be sure to spray the undercarriage of all vehicles.

b. Preferred locations for equipment cleaning areas are those where:
   - Equipment is unloaded and loaded.
   - NNIS are already established.
   - Areas are easily monitored for new infestations due to the cleaning activity, i.e., along a road, at a trailhead, or in a parking lot.

c. Do not clean equipment, vehicles, or trailers in or near waterways. This may promote the spread of NNIS downstream.

**→BMP U-5: Inspect and remove soils, seeds, plant parts, or invertebrates from the coat and feet of animals and their clothing/gear before and after recreating.**

Suggestions:

a. Carry a grooming brush, shedding blade, small scissors, hoof knife, etc. to help remove soil and NNIS propagules from animals.

b. Preferred locations for cleaning are those where:
   - NNIS are already established.
   - Animals are unloaded and loaded.
   - Areas are easily monitored for new infestations due to the cleaning activity, i.e., along a road, at a trailhead, or in a parking lot.
   - Do not clean animals in or near waterways – it may promote the spread of invasives downstream.

**→BMP U-6: Properly dispose of soils, seeds, plant parts, or invertebrates, found during inspection and cleaning.**

Suggestions:

a. Place materials in a bag and send to a landfill, where possible.

b. Materials may be composted but only if compost pile reaches very high temperatures and the finished compost can be monitored for seed emergence.

c. Materials may be disposed of in piles; locate the pile in an area that facilitates easy monitoring and control if infestations spread from it.

d. Materials may be burned; locate the burn pile in an area that facilitates easy monitoring and control if infestations spread from it.

**→BMP U-7: Stay on designated trails, roads, and other developed areas.**

Suggestions:

a. Minimize soil disturbance; it may promote NNIS plant seed germination and establishment.

b. Destruction of native plants favors NNIS.

c. By venturing into uninfested areas, you may introduce NNIS by carrying propagules.

d. Avoid trails that are wet or muddy. If wet areas are encountered, go through them rather than around, if possible.

**→BMP U-8: When off trail, avoid areas that appear to be infested with NNIS; "When in doubt, stay out!"**

Suggestions:

a. The chances of transporting soils, seeds, plant parts, or invertebrates increase in areas of heavy infestation or when seeds are present.

b. Direct contact with some NNIS can affect human and animal health, including skin and eye irritation.

**→BMP U-9: Report infestations of NNIS to the appropriate land manager or property owner.**

Suggestions:

a. Provide as exact a location as possible; take a photo, GPS coordinates, or map the infestation.

b. Use diplomacy if contacting a private landowner.

**→BMP U-10: Volunteer to help control NNIS.**

Suggestions:

a. Contact public and private landowners, agencies, and nonprofit organizations to find out about volunteer opportunities.

(See Recreation Appendix A: Resources for information on control)

**→BMP U-11: Spread the word – help educate others about NNIS and their effects on our environment, economy, and recreational opportunities.**

**→BMP U-12: Incorporate NNIS prevention into planning for special events.**

Suggestions:

a. Place cleaning stations at entrance and exit points.

b. Plan travel routes to avoid areas of heavy infestation.

c. Provide participants with informational brochures and other educational materials related to NNIS prevention.

d. Identify species in the field to educate participants.

e. Consider adding a component of removal and proper disposal of NNIS as part of the event.

f. Plan events for proper times of the year to help avoid the spread of NNIS.

# Best Management Practices for Animal–based Activities

*(BMP Prefix = "A")*

## *Introduction:*

This section covers outdoor recreation involving animals. This includes a range of activities, including any animal used as a pack or transport animal, including but not limited to: horse, llama, alpaca, and pack goat. It includes dogs used for companions, walking, hunting (land and water), mushing, skijoring, field trials, and competition. It also includes animals taken outdoors.

## *NNIS and recreational animal use:*

NNIS are having a negative effect on the quality and accessibility of recreational lands available for many recreational activities. By definition, nonnative NNIS eliminate native plant species. As a result, they change the wildlife habitat and modify both the appearance and the utility of the landscape and may pose a threat to the health of animals. Wild parsnip (*Pastinaca sativa*) may cause burns on thin haired dogs and hoary alyssum (*Berteroa incana*) can be deadly to horses. As responsible recreational users, it is important to be aware of potential ways that NNIS could be transported inadvertently when traveling to or from public lands. Left unmanaged, these threats could contribute to diminished quality and quantity of outdoor recreation within the state.

## *General guidance:*

To minimize the introduction and spread of NNIS, recreationists with animals should focus on: 1) grooming of self and animal and cleaning of transport vehicles and trailers before and after visiting recreational lands; 2) staying on designated trails, 3) properly disposing of any debris or waste, and 4) reporting any infestations of NNIS.

## *Best Management Practices:*

**→BMP A-1: Learn to recognize NNIS common to the areas where you enjoy outdoor recreational activities.**

Suggestions:

a. Read guides, brochures, and pamphlets produced by government agencies or other weed management groups on NNIS plants and invertebrates.

b. Pay attention to signage at infested areas and trailheads, (e.g., "this is a picture of garlic mustard; you will see it along the west side of the trail").

c. Check the Wisconsin DNR website for photos and instructions: http://dnr.wi.gov/invasives

**→BMP A-2: Wear outer layers of clothing and footwear that are not "seed-friendly."**

Suggestions:

a. In appropriate areas, wear low-tread footwear that doesn't hold soils, seeds, plant parts, or invertebrates.

b. Wear disposable shoe covers over footwear in infested areas; properly dispose of them when leaving the area.

c. Consider dedicating a pair of shoes or boots for use only on infested properties.

d. Wear ankle gaiters over socks and shoe laces.

e. Avoid wearing Velcro, bulky knits (*e.g.*, wool, fleece), pants with cuffs, and other fabrics or clothing styles that can carry seeds.

**→BMP A-3: Inspect and clean hair, clothing, footwear, and gear for soils, seeds, plant parts, or invertebrates before and after recreating.**

Suggestions:

a. Use items like a stiff brush, stick or small screwdriver to help remove soils, seeds, plant parts, or invertebrates; use boot brushes and other removal devices when provided.

b. Wear a hat to cover hair.

c. Do not clean clothing, footwear, or gear in or near waterways – it may promote the spread of NNIS downstream.

d. Preferred locations for cleaning are those where:

- NNIS are already established.
- Gear is unloaded and loaded.
- Areas can be easily monitored for new infestations due to the cleaning activity, i.e., along a road, at a trailhead, or in a parking lot.

**→BMP A-4: Prior to moving equipment, vehicles, and trailers onto and off of an activity area, spray, scrape, or brush soils, seeds, plant parts, or invertebrates from exterior surfaces, to the extent practical, to minimize the risk of transporting NNIS.**

Suggestions:

a. Visit a car wash or designated cleaning station; be sure to spray the undercarriage of all vehicles.

b. Especially check bumpers, grills, and undercarriage of vehicles and trailers as these are sites for nesting insects.

**c.** Preferred locations for cleaning areas are those where:

- NNIS are already established.
- Equipment is unloaded and loaded.
- Areas can be easily monitored for new infestations due to the cleaning activity, i.e., along a road, at a trailhead, or in a parking lot.

d. Do not clean equipment, vehicles, or trailers in or near waterways – it may promote the spread of NNIS downstream.

**→BMP A-5: Inspect and remove soils, seeds, plant parts, or invertebrates from the coat and feet of animals and their clothing/gear before and after recreating.**

Suggestions:

a. Fully groom your animal before and after an outing in order to protect both the public land and your home.

b. Carry a grooming brush, shedding blade, small scissors, hoof knife, etc. to help remove soil and NNIS propagules from animals.

c. Do not clean clothing, footwear, gear, vehicles, or animals in or near waterways – it may promote the spread of NNIS downstream.

d. Preferred locations for cleaning are those where:

- NNIS are already established.
- Animals are unloaded and loaded.
- Areas can be easily monitored for new infestations due to the cleaning activity, i.e., along a road, at a trailhead, or in a parking lot.

**→BMP A-6: Properly dispose of soils, seeds, plant parts, or invertebrates.**

Suggestions:

a. Place materials in a bag and send it to a landfill, where possible.

b. Materials may be composted but only if the compost pile reaches very high temperatures and the finished compost can be monitored for NNIS plant seed emergence.

c. Materials may be disposed of in piles; locate the pile in an area that facilitates easy monitoring and control if infestations spread from it.

d. Materials may be burned; locate the burn pile in an area that facilitates easy monitoring and control if infestations spread from it.

**→BMP A-7: Stay on designated trails, roads, and other developed areas and observe animal restraint rules.**

Suggestions:

a. Staying on designated trails, roads, and developed areas keeps you and your animal safe.

b. Minimize soil disturbance; it may promote NNIS plant seed germination and establishment.

c. Destruction of native plants favors NNIS.

d. By venturing into uninfested areas, you may introduce NNIS by carrying propagules.

e. Avoid trails that are wet or muddy. If wet areas are encountered, go through them rather than around, if possible.

**→BMP A-8: When off-trail, avoid areas that appear to be infested with NNIS; "when in doubt, stay out!"**

Suggestions:

a. The chances of transporting soils, seeds, plant parts, or invertebrates increase in areas of heavy infestation or when seeds are present.

b. Direct contact with some N246NIS can affect human and animal health, including skin and eye irritation.

**→BMP A-9: Report infestations of NNIS to the appropriate land manager or property owner.**

Suggestions:

a. Provide as exact a location as possible; take photos, GPS coordinates, or map the infestation.

b. Use diplomacy if contacting a private landowner.

**→BMP A-10: Volunteer to help control NNIS.**

Suggestions:

a. Contact public and private landowners, agencies, and nonprofit organizations to find out about volunteer opportunities.
(See Recreation Appendix A: Resources for information on control.)

**→BMP A-11: Follow the property guidelines for all animal waste disposals.**

Suggestions:

a. If the property does not have a proper receptacle, haul waste out and dispose of it properly.

**→BMP A-12: Incorporate NNIS prevention into planning for special events.**

Suggestions:

a. Place cleaning stations at entrance and exit points.

b. Plan travel routes to avoid areas of heavy infestation.

c. Provide participants with informational brochures and other educational materials related to NNIS prevention.

d. Identify NNIS in the area to educate participants.

e. Consider adding a component of removal and proper disposal of NNIS as part of the event.

f. Plan events for proper times of the year to help avoid the spread of NNIS.

**→BMP A-13: Spread the word – help educate others about NNIS and their effects on our environment, economy, and recreational opportunities.**

# Best Management Practices for Bicycle Activities

(BMP Prefix = "B")

## *Introduction:*

A bicycle is a human-powered, pedal driven vehicle. There are a wide variety of bicycling-based activities. Many, but not all, are types of recreation. These recommendations apply to both recreation (for example: mountain biking or off-road biking, bicycle touring, road biking, cyclocross (cross-country bicycle racing in open, rough terrain with riders often forced to dismount and carry their bicycle), and BMX (bicycle motorcross)) and non-recreation (for example: bicycle commuting, law enforcement patrolling, and deliveries) uses of bicycles, as well as unicycles, tricycles, and quadracycles (one, three, and four wheels, respectively), which are not strictly bicycles.

## *NNIS and bicycle recreation:*

NNIS are having a negative effect on the quality and accessibility of recreational lands available for many recreation activities including bicycle recreation. NNIS are eliminating native plant species, changing wildlife habitat, and modifying the appearance and utility of the landscape. Left unmanaged, these threats will contribute to a diminished quality and quantity of outdoor recreation within the state.

- NNIS plants out-compete the native vegetation in the landscape by replacing diverse plant communities with aggressive single (monoculture) species.

a. NNIS plants directly affect human health and activities in many ways. Some produce painful skin burns; others have sharp spines, and thorns that can cause physical discomfort. Toxic berries can cause poisoning. Some allergies are caused by NNIS.

b. Economic damage associated with NNIS' impacts and their management is estimated to cost the U.S. $137 billion annually. This cost includes losses in agriculture, fisheries, timber, utilities, overall land productivity, tourism, and recreation.

- Bicyclists face the possibility of losing land access due to the concern of the spreading of NNIS plants.

- NNIS take over habitat that supports native wildlife and, potentially, endangered species.

- Bicycles and their operators have the potential of unintentionally carrying NNIS from one area to another. Soils, seeds, plant parts, or invertebrates may cling to gear, bicycles, and clothing.

- Disturbed soils may create favorable conditions for the establishment and spread of NNIS plants.

## *General guidance:*

To minimize the introduction and spread of NNIS, bicyclists should focus on:

1) Inspecting and cleaning bicycles, equipment, and clothing,

2) Staying on established trails and routes, and

3) "Leave No Trace": leaving as little impact on the land as possible.

## *Best Management Practices:*

**→BMP B-1: Learn to recognize NNIS common to the areas where you enjoy outdoor recreational activities.**

Suggestions:

a. Read guides, brochures, and pamphlets produced by government agencies or other weed management groups on NNIS plants and invertebrates.

b. Pay attention to signage at infested areas and trailheads, (e.g., "this is a picture of garlic mustard; you will see it along the west side of the trail").

c. Check the Wisconsin DNR website for photos and instructions: http://dnr.wi.gov/invasives

**→BMP B-2: Wear outer layers of clothing and footwear that are not "seed-friendly."**

Suggestions:

a. In appropriate areas, wear low-tread footwear that doesn't hold soils, seeds, plant parts, or invertebrates.

b. Wear disposable shoe covers over footwear in infested areas; properly dispose of them when leaving the area.

c. Dedicate a pair of shoes or boots for use only on infested properties.

d. Wear ankle gaiters over socks and shoe laces.

e. Avoid wearing Velcro, bulky knits (e.g., wool, fleece), pants with cuffs, and other fabrics or clothing styles that can carry seeds.

**→BMP B-3: Inspect and clean hair, clothing, footwear, and gear for soils, seeds, plant parts, or invertebrates before entering and upon leaving riding areas.**

Suggestions:

a. Do not clean your clothing, footwear, and gear in or near waterways to prevent spreading NNIS downstream.

b. Use items like a stiff brush, stick or small screwdriver to help remove soils, seeds, plant parts, or invertebrates; use boot brushes and other removal devices when provided.

c. Periodically check for NNIS at stops (visual inspections).

d. Preferred locations for cleaning are those where:

- NNIS are already established.
- Gear is unloaded and loaded
- Areas are easily monitored for new infestations due to the cleaning activity, i.e., along a road, at a trailhead, or in a parking lot.

**→BMP B-4: Prior to moving bicycles, equipment, vehicles, and trailers onto and off of an activity area, spray, scrape, or brush soils, seeds, plant parts, or invertebrates from exterior surfaces, to the extent practical, to minimize the risk of transporting NNIS.**

Suggestions:

a. Visit a carwash or cleaning station; be sure to check the tires and drive chain and spray the undercarriage of all vehicles. Make this all part of a regular maintenance check.

b. Preferred locations for equipment cleaning areas are those where:
   - Equipment is unloaded and loaded.
   - NNIS are already established.
   - Areas are easily monitored for new infestations due to the cleaning activity, i.e., along a road, at a trailhead, or in a parking lot.

c. Do not clean equipment, vehicles, or trailers in or near waterways – it may promote the spread of NNIS downstream.

d. Periodically check bike and gear for NNIS at stops (visual inspections).

e. Insects like the gypsy moth can be transported on bicycles, equipment, vehicles, and trailers. Check for insect egg masses, pupae, and caterpillars.

**→BMP B-5: Inspect and remove soils, seeds, plant parts, or invertebrates from the coat and feet of animals and their clothing/gear before and after recreating.**

Suggestions:

a. Carry a grooming brush, shedding blade, small scissors, hoof knife, etc. to help remove soil and NNIS propagules from animals.

b. Do not clean clothing, footwear, gear, vehicles, or animals in or near waterways – it may promote the spread of NNIS downstream.

c. Preferred locations for cleaning are those where:
   1. NNIS are already established.
   2. Animals are unloaded and loaded
   3. Areas are easily monitored for new infestations due to the cleaning activity, i.e., along a road, at a trailhead, or in a parking lot.

**→BMP B-6: Properly dispose of soils, seeds, plant parts, or invertebrates, found during inspection and cleaning.**

Suggestions:

a. Place materials in a bag and send to a landfill, where possible.

b. Materials may be composted but only if the compost pile reaches very high temperatures and the finished compost can be monitored for NNIS plant seed emergence.

c. Materials may be disposed of in piles; locate the pile in an area that facilitates easy monitoring and control if infestations spread from it.

d. Materials may be burned; locate the burn pile in an area that facilitates easy monitoring and control if infestations spread from it.

**→BMP B-7: Stay on established and designated trails, roads, and other developed areas.**

Suggestions:

a. Minimize soil disturbance; it may promote NNIS plant seed germination and establishment.

b. Destruction of native plants favors NNIS.

c. By venturing into uninfested areas, you may introduce NNIS by carrying propagules.

d. Do not create your own trails without landowner permission.

e. Avoid trails that are wet or muddy. If wet areas are encountered, go through them rather than around, if possible.

**→BMP B-8: When off-trail, avoid areas that appear to be infested with NNIS; "when in doubt, stay out!"**

Suggestions:

a. The chances of transporting soils, seeds, plant parts, or invertebrates in areas of heavy infestation or when seeds are present.

b. Direct contact with some NNIS can affect human and animal health, including skin and eye irritation.

**→BMP B-9: Report infestations of NNIS to the appropriate land manager or property owner.**

Suggestions:

a. Provide as exact a location as possible; take photos, GPS coordinates, or map the infestation.

b. Use diplomacy if contacting a private landowner.

**→BMP B-10: Volunteer to help control NNIS.**

Suggestions:

a. Contact public and private landowners, agencies, and nonprofit organizations to find out about volunteer opportunities.
(See Recreation Appendix A: Resources for information on control.)

**→BMP B-11: Incorporate NNIS prevention into planning for special events.**

Suggestions:

a. Place cleaning stations at entrance and exit points.

b. Plan travel routes to avoid areas of heavy infestation.

c. Provide participants with informational brochures and other educational materials related to NNIS prevention.

d. Identify NNIS in the area to educate participants.

e. Consider adding a component of removal and proper disposal of NNIS as part of the event.

f. Plan events for proper times of the year to help avoid the spread of NNIS.

**→BMP B-12: Spread the word - help educate others, about NNIS and their effects on our environment, economy, and recreational opportunities.**

# Best Management Practices for Camping

*(BMP Prefix = "C")*

## *Introduction*

Camping is an outdoor recreational activity in which participants can get away from civilization and enjoy nature while spending one or more nights at a campsite. Camping describes a wide range of activities. Backpack campers carry their gear on their backs, while recreational vehicle campers arrive equipped with their own electricity, heat, furniture, and bathroom facilities. Camping may be a recreational activity by itself, or it can be done in conjunction with other activities, such as hiking, boating, and fishing.

Campers span a broad range of interests and preferences, and campsites are designed accordingly. Many campgrounds have facilities like fire rings, grills, bathrooms, and utilities, though not all campsites have similar levels of development. Campsites can range from a patch of dirt with a sign marking it, to a level paved pad with water and electricity. Some RV campgrounds, for instance, offer hookups where motor homes are supplied with electricity, water, and sewer services. While in the case of "dispersed camping," backpack campers simply select a site on which to camp within a designated public land area – sites are not designated in any way.

Those who seek a more rugged experience in the outdoors prefer to camp with only tents. Tent campers often use an automobile to carry equipment to a campground ("car camping"). Other vehicles used for camping include motorcycles, touring bicycles, boats, and canoes; using pack animals is also a popular alternative.

## *NNIS and camping*

Historically the introduction and spread of NNIS can often be linked to people who unintentionally move the pests in infested plants, wood, and other materials. Often the infestations are located within campgrounds where factors like heavy public use and the presence of firewood combine to create optimal conditions for NNIS. These NNIS are a threat to the natural communities within parks, forests, campgrounds, and public and private lands. In addition, NNIS impact the recreational opportunities available to campers.

- NNIS plants may overgrow trails, making hiking and biking difficult.
- NNIS plants often out-compete native wildflowers.
- NNIS often lower biodiversity in natural areas, disturbing ecosystems and eliminating wildlife habitat.
- Some noxious weeds adversely affect animal and human health.

Camping activities can raise the potential threat of spreading NNIS. A camper venturing into natural areas and transporting gear may unintentionally introduce NNIS.

- Soils, seeds, plant parts, or invertebrates may cling to gear, vehicles, or animals.
- Campers may trample native plants and disturb the soil, creating a favorable condition for the introduction of NNIS.

- Firewood is especially troublesome, as it is frequently moved long distances and harbors many NNIS insects, fungi, and diseases.

## *General guidance*

To minimize the introduction and spread of NNIS, campers should (1) inspect and clean vehicles and gear, (2) minimize disturbance of natural environments, and (3) purchase or use local firewood, rather than transporting it. By reducing opportunities for NNIS "hitchhikers" and staying on established campsites and trails, campers can do their part to keep recreational lands healthy.

## *Best Management Practices:*

**→BMP C-1: Learn to recognize NNIS common to the areas where you enjoy outdoor recreational activities.**

Suggestions:

a. Read guides, brochures, and pamphlets produced by government agencies or other weed management groups on NNIS plants and invertebrates.

b. Pay attention to signage at infested areas and trailheads, (e.g., "this is a picture of garlic mustard; you will see it along the west side of the trail").

c. Check the Wisconsin DNR website for photos and instructions. http://dnr.wi.gov/invasives

**→BMP C-2: Wear outer layers of clothing and footwear that are not "seed-friendly."**

Suggestions:

a. In appropriate areas, wear low-tread footwear that doesn't hold soils, seeds, plant parts, or invertebrates.

b. Wear disposable shoe covers over footwear in infested areas; properly dispose of them when leaving the area.

c. Consider dedicating a pair of shoes or boots for use only on infested properties.

d. Wear ankle gaiters over socks and shoe laces.

e. Avoid wearing Velcro, bulky knits (e.g., wool, fleece), pants with cuffs, and other fabrics or clothing styles that can carry seeds.

**→BMP C-3: Inspect and clean hair, clothing, footwear, and gear for soils, seeds, plant parts, or invertebrates before and after recreating.**

Suggestions:

a. Use a broom or stiff brush to clean tents, tarps, shoes, and vehicles; shake out sleeping bags and clothes.

b. Use items like a stiff brush, stick or small screwdriver to help remove soils, seeds, plant parts, or invertebrates; use boot brushes and other removal devices when provided.

c. Wear a hat to cover hair.

d. Do not clean clothing, footwear, or gear in or near waterways – it may promote the spread of NNIS downstream.

e. Refrain from washing any garments within the campsite.

f. Preferred locations for cleaning are those where:

- NNIS are already established.
- Gear is unloaded and loaded.
- Areas can be easily monitored for new infestations due to the cleaning activity, i.e., along a road, at a trailhead, or in a parking lot.

**→BMP C-4: Prior to moving equipment, vehicles, and trailers onto and off of an activity area, spray, scrape or brush soils, seeds, plant parts, or invertebrates from exterior surfaces, to the extent practical, to minimize the risk of transporting NNIS.**

Suggestions:

a. Visit a carwash or cleaning station; be sure to spray the undercarriage of all vehicles.

b. Preferred locations for equipment cleaning areas are those where:

- Equipment is unloaded and loaded.
- NNIS are already established.
- Areas can be easily monitored for new infestations due to the cleaning activity, i.e., along a road, at a trailhead, or in a parking lot.

c. Do not clean vehicles or trailers in or near waterways – it may promote the spread of invasives downstream.

**→BMP C-5: Inspect and remove soils, seeds, plant parts, or invertebrates from the coat and feet of animals and their clothing/gear before and after recreating.**

Suggestions:

a. Carry a grooming brush, shedding blade, small scissors, hoof knife, etc. to help remove soil and NNIS propagules from animals.

b. Do not clean clothing, footwear, gear, vehicles, or animals in or near waterways – it may promote the spread of invasives downstream.

c. Preferred locations for cleaning are those where:

- NNIS are already established.
- Animals are unloaded and loaded.
- Areas can be easily monitored for new infestations due to the cleaning activity, i.e., along a road, at a trailhead, or in a parking lot.

**→BMP C-6: Properly dispose of soils, seeds, plant parts, or invertebrates, found during inspection and cleaning.**

Suggestions:

a. Place materials in a bag and send it to a landfill, where possible.

b. Materials may be composted but only if the compost pile reaches very high temperatures and the finished compost can be monitored for NNIS plant seed emergence.

c. Materials may be disposed of in piles; locate the pile in an area that facilitates easy monitoring and control if infestations spread from it.

d. Materials may be burned; locate the burn pile in an area that facilitates easy monitoring and control if infestations spread from it.

**→BMP C-7: Stay on designated camping areas, tent pads, roads, and trails**.

Suggestions:

a. Minimize soil disturbance; it may promote NNIS plant seed germination and establishment.

b. Destruction of native plants favors NNIS.

c. By venturing into uninfested areas, you may introduce NNIS by carrying propagules.

d. Avoid trails that are wet or muddy. If wet areas are encountered, go through them.

e. Avoid poorly located campsites that encourage erosion and degrade the soil and surrounding vegetation.

f. Travel and set up camp on durable surfaces.

**→BMP C-8: When off-trail, avoid areas that appear to be infested with NNIS; "when in doubt, stay out!"**

Suggestions:

a. The chances of transporting soils, seeds, plant parts, or invertebrates increase in areas of heavy infestation or when seeds are present.

b. Direct contact with some NNIS can affect human and animal health, including skin and eye irritation.

**→BMP C-9: Report infestations of NNIS to the appropriate land manager or property owner.**

Suggestions:

a. Provide as exact a location as possible; take photos, GPS coordinates, or map the infestation.

b. Use diplomacy if contacting a private landowner.

**→BMP C-10: Volunteer to help control NNIS.**

Suggestions:

a. Contact public and private landowners, agencies, and nonprofit organizations to find out about volunteer opportunities.
**(See Recreation Appendix A: Resources for information on control.)**

**→BMP C-11: Incorporate NNIS prevention into planning for special events.**

Suggestions:

a. Place cleaning stations at entrance and exit points.

b. Plan travel routes to avoid areas of heavy infestation.

c. Provide participants with informational brochures and other educational materials related to NNIS prevention.

d. Identify NNIS in the area to educate participants.

e. Consider adding a component of removal and proper disposal of NNIS as part of the event.

f. Plan events for proper times of the year to help avoid the spread of NNIS.

**→BMP C-12: Spread the word – help educate others about NNIS and their effects on our environment, economy, and recreational opportunities.**

**→BMP C-13: Do not transport firewood.**

Suggestions:

a. Follow appropriate quarantine rules.
DATCPEmeraldAshBorer@wisconsin.gov or call 1-800-462-2803**.**

b. Ideally, purchase firewood from within the campground where you are staying, as that wood is often cut on-site and sold by non-profit groups who reinvest earnings in the property.

c. Private vendors often have firewood available for sale just outside of the property as well; for firewood availability at your destination, contact the property directly.

d. When buying firewood, make sure you receive pieces that are dry and have either no bark or bark that is loose (a sign that the wood is very dry), reducing the threat of spreading NNIS.

e. Leave fallen branches and bark where they have fallen - do not transport them to your campsite.

f. Burn all firewood. Do not leave any unused wood behind, and do not take it with you to another destination.

Firewood has the potential to spread many destructive NNIS, both known and as yet, unknown. Confirmed threats include: emerald ash borer, butternut canker, white pine blister rust, and oak wilt.

Firewood is often stored unused for long periods of time and is handled by people generally not trained to notice signs of NNIS pests. Once established in new areas, NNIS forest pests can quickly kill trees in forests, parks, communities, and campgrounds.

**→BMP C-14: Unless gathering natural foods or other permitted material, don't pick plants.**

Suggestions:

a. Picking plants is prohibited on many public lands.

b. While many NNIS plants have attractive blooms, discarded flower or seed heads can spread NNIS plant seeds.

c. When processing gathered materials, remove NNIS plants and dispose of them properly.

d. Some NNIS plants may cause skin and eye irritation.

e. If you are interested in controlling NNIS plants, contact the property manager.

**Despite their appeal for ornamental purposes, avoid picking plants such as teasel and bittersweet since this provides opportunities to spread these NNIS through discarded plant parts and seeds.**

**→BMP C-15: Follow guidelines for bringing animals into recreational areas.**

Suggestions:

a. Be careful when choosing the location to tie your animal within the campsite; consider their access to vegetation and ability to cause soil disturbance, (for example, digging holes).

b. Animal owners are responsible for proper removal and disposal of their animals' waste products; dispose of animal waste in trash receptacles.

# Best Management Practices for Hunters, Trappers, and Anglers

*(BMP Prefix = "HTA")*

## *Introduction*

Hunting is an outdoor recreational activity that can be described as pursuing and harvesting wild game with firearm or archery equipment. Hunting opportunities are generally divided into big game (deer or bear) and small game (squirrel, rabbit, ruffed grouse, turkey, waterfowl, and some furbearers). Hunters use a variety of techniques in their pursuit of game. These techniques include but are not limited to: stand hunting, still hunting, driving of game, waiting near a bait site, calling, and the use of dogs to locate, track, or retrieve game. Hunters often travel many miles across the state or even from other states to get to their favorite hunting locations. They may also walk long distances, often through a variety of habitats, in pursuit of their intended quarry. Hunters, if they are not careful, can unintentionally spread NNIS.

Trapping is an outdoor recreational activity that can be described as placing traps with the intent of capturing a species of animal for harvest or relocation. Trappers primarily target what are considered fur-bearing animals. Trappers use a wide variety of traps in their pursuit of fur-bearing animals. Sites where trappers place traps to capture animals are commonly known as "sets." These sets can be divided into wet and dry sets depending on what type of habitat the target species primarily uses. Wet sets are placed in water with the intention of catching a specific species that is found in or near aquatic habitats. Dry sets are placed with the intention of catching species utilizing upland habitats. Trappers often move traps from one location to another throughout the season to target different populations. By moving traps to different locations, trappers (if they are not careful) may potentially spread NNIS.

Fishing is an outdoor recreational activity that can be described as attempting to catch fish typically through the use of rod and reel (hook and line). Fishing is often done either through the use of some sort of boat, wading in shallow water, or from the shoreline or bank. Wading and shoreline or bank anglers often walk some distance on the upland areas adjacent to the water body they intend to fish in. This movement along the shoreline may unintentionally spread NNIS.

## *NNIS and hunters, trappers and anglers*

NNIS are rapidly spreading to many new areas. These species can become established in parks, forests, lakes, rivers, and fields and damage the quality of the natural habitat.

- NNIS can reduce the quality of or eliminate valuable game habitat through aggressive competition.
- NNIS can choke lakes and waterways and make them impassable.
- NNIS can overgrow trails making passage difficult.
- Some NNIS can adversely affect human health.
- Soils, seeds, plant parts, or invertebrates may cling to gear, vehicles, and clothing.

Since hunters, trappers, and anglers often take their gear with them to a variety of locations, they can unintentionally transport NNIS.

## *General guidance*

To reduce the possibility of spreading NNIS, hunters, trappers, and anglers should focus on:

a. Inspecting and cleaning vehicles, equipment, tools, and clothing

b. Minimizing disturbance of soil and natural environments

c. Staying on designated trails with motorized vehicles

By reducing opportunities for NNIS to find their way into new areas, hunters, trappers, and anglers can do their part in keeping recreational lands healthy and productive.

## *Best Management Practices*

**→BMP HTA-1: Learn to recognize NNIS common to the areas where you enjoy outdoor recreational activities.**

Suggestions:

a. Study guides, brochures, and pamphlets produced by government agencies or other weed management groups on NNIS plants and invertebrates.

b. Pay attention to signage at infested areas and trailheads (e.g., "this is a picture of garlic mustard; you will see it along the west side of the trail").

c. Check out the Wisconsin DNR website for photos and instructions. http://dnr.wi.gov/invasives

**→BMP HTA-2: Wear outer layers of clothing and footwear that are not "seed friendly."**

Suggestions:

a. In appropriate areas, wear low-tread footwear that doesn't hold soils, seeds, plant parts, or invertebrates.

b. Wear disposable shoe covers over footwear in infested areas; properly dispose of them when leaving the area.

c. Consider dedicating a pair of shoes or boots for use only on infested properties.

d. Wear ankle gaiters over socks and shoe laces.

e. Avoid wearing bulky knits (e.g., wool, fleece), pants with cuffs, and other fabrics or clothing styles that may carry seeds.

**→BMP HTA-3: Inspect and clean hair, clothing, footwear, and gear for soils, seeds, plant parts, or invertebrates, before and after recreating.**

Suggestions:

a. Use items like a stiff brush, stick or small screwdriver to help remove soils, seeds, plant parts, or invertebrates; use boot brushes and other removal devices when provided.

b. Wear a hat to cover hair.

c. Do not clean clothing, footwear, or gear in or near waterways – it may promote the spread of NNIS downstream.

d. Preferred locations for cleaning are those where:

- NNIS are already established.

- Gear is unloaded and loaded.
- Areas can be easily monitored for new infestations due to the cleaning activity, i.e., along a road, at a trailhead, or in a parking lot.

**→BMP HTA-4: Prior to moving equipment, vehicles or trailers onto or off of an activity area, spray, scrape, or brush soils, seeds, plant parts, or invertebrates from exterior surfaces, to the extent practical, to minimize the risk of transporting NNIS.**

Suggestions:

a. Visit a carwash or cleaning station; be sure to spray the undercarriage of all vehicles.

b. Do not clean equipment, vehicles, or trailers in or near waterways – it may promote the spread of NNIS downstream. Traps should be rinsed free of mud, dirt, and debris when removing them from the location of a set.

c. Preferred locations for cleaning are those where:
   - NNIS are already established.
   - Equipment is unloaded and loaded.
   - Areas can be easily monitored for new infestations due to the cleaning activity, i.e., along a road, at a trailhead, or in a parking lot.

**→BMP HTA-5: Inspect and remove soils, seeds, plant parts, or invertebrates, from the coat and feet of animals (i.e., hunting dogs) before and after recreating.**

Suggestions:

a. Carry a grooming brush, shedding blade, small scissors, etc. to help remove soil and NNIS propagules from animals.

b. Do not clean animals in or near waterways – it may promote the spread of NNIS downstream.

c. Preferred locations for cleaning are those where:
   - NNIS are already established.
   - Animals are unloaded and loaded.
   - Areas can be easily monitored for new infestations due to the cleaning activity, i.e., along a road, at a trailhead, or in a parking lot.

**→BMP HTA-6: Properly dispose of soils, seeds, plant parts, or invertebrates, found during inspection and cleaning.**

Suggestions:

a. Place materials in a bag and send to landfill, where possible.

b. Materials may be composted but only if the compost pile reaches very high temperatures and the finished compost can be monitored for NNIS plant seed emergence.

c. Materials may be disposed of in piles; locate the pile in an area that facilitates easy monitoring and control if infestations spread from it.

d. Materials may be burned; locate the burn pile in an area that facilitates easy monitoring and control if infestations spread from it.

**→BMP HTA-7: Stay on designated trails, roads, and other developed areas with motorized vehicles.**

Suggestions:

a. Minimize soil disturbance; it may promote NNIS plant seed germination and establishment.

b. Destruction of native plants favors NNIS.

c. By venturing into uninfested areas, you may introduce NNIS by carrying propagules.

d. Avoid trails that are wet or muddy. If wet areas are encountered, go through them rather than around, if possible.

**→BMP HTA-8: When off trail, avoid areas that appear to be infested with NNIS; "When in doubt, stay out!"**

Suggestions:

a. The chances of transporting soils, seeds, plant parts, or invertebrates increase in areas of heavy infestation or when seeds are present.

b. Direct contact with some NNIS can affect human and animal health, including skin and eye irritation.

c. Minimize soil disturbance if traveling off-trail and on stream banks; disturbed soils can create favorable conditions for the establishment and spread of NNIS plants.

**→BMP HTA-9: Report infestations of NNIS to the appropriate land manager or property owner.**

Suggestions:

a. Provide as exact a location as possible; take photos, GPS coordinates; or map the infestation.

b. Use diplomacy if contacting a private landowner.

**→BMP HTA-10: Volunteer to help control NNIS.**

Suggestions:

a. Contact public and private landowners, agencies, and nonprofit organizations to find out about volunteer opportunities.
(See Recreation Appendix A: Resources for information on control.)

**→BMP HTA-11: Dispose of unused live bait (worms) in garbage container.**

Suggestions:

a. If you use earthworms as fishing bait, throw any unused earthworms in the trash, not in the water or on the land.

b. Do not transport leaves, mulch, compost, or soil from one place to another unless you are confident that there are no earthworms or their cocoons present.

**All bait worms are not native and can cause serious damage to forest ecosystems.**

**→BMP HTA-12: Incorporate NNIS prevention into planning for special events.**

Suggestions:

a. Place cleaning stations at entrance and exit points.
b. Plan travel routes to avoid areas of heavy infestation.
c. Provide participants with informational brochures and other educational materials related to NNIS prevention.
d. Identify NNIS in the area to educate participants.
e. Consider adding a component of removal and proper disposal of NNIS as part of the event.
f. Plan events for proper times of the year to help avoid the spread of NNIS.

**→BMP HTA-13: Spread the word – help educate others about NNIS and their effects on our environment, economy, and recreational opportunities.**

**→BMP HTA-14: Never intentionally transport live aquatic organisms from one waterway to another.**

**→BMP HTA-15: Eliminate water from all equipment before transporting anywhere.**

Suggestions:

a. Eliminate all water from every conceivable item before you leave the area you are visiting.
b. Remove water from motors, jet drives, live wells, boat hulls, scuba tanks and regulators, boots, waders, bait buckets, seaplane floats, swimming floats.
c. Once water is eliminated, follow the cleaning instructions listed below.

**→BMP HTA-16: Avoid the use of felt-soled waders. Felt soles can harbor microscopic aquatic NNIS, facilitating their spread.**

Suggestions:

a. Use waders with rubber soles instead of felt soles
b. Clean and dry all waders before moving from one waterway to another.

# Best Management Practices for Motorized Activities

*(BMP Prefix = "M")*

## *Introduction*

Motorized terrestrial recreation refers to the use of snowmobiles, all-terrain vehicles, 4x4 trucks, jeeps, side-by-side utility terrain vehicles, off-highway motorcycles, amphibious machines, golf carts, dune buggies, and all other off-road motorized vehicles used in a nature-based setting. This form of recreation is broadly participated in by individuals, groups, and families. The motorized vehicle recreation sector includes a variety of users including those who are principally interested in the pleasure of operating the machines, those who use the machines as an integral part of an outdoor recreation experience such as sightseeing and wildlife viewing, and those who use the machines as transportation for their recreation activities such as hunting, camping, trapping, photography, etc. Motorized recreation can be especially beneficial for those who have physical limitations.

## *NNIS and motorized recreation*

NNIS are having a negative effect on the quality and accessibility of recreational lands available for many recreation activities including all forms of motorized terrestrial recreation. NNIS are eliminating native plant species, changing wildlife habitat, and modifying the appearance and utility of the landscape. Left unmanaged, these threats will contribute to a diminished quality and quantity of outdoor recreation within the state.

a. NNIS plants out-compete the native vegetation in the landscape by replacing diverse plant communities with aggressive single (monoculture) species.

b. NNIS plants can directly affect human health and activities in many ways. Some produce painful skin burns, while others have sharp spines and thorns that can cause physical discomfort. Toxic berries can cause poisoning. Some allergies are caused by NNIS.

c. Economic damage associated with NNIS impacts and their management is estimated to cost the U.S. $137 billion annually. This cost includes losses in agriculture, fisheries, timber, utilities, overall land productivity, tourism, and recreation.

- Motorized recreationists face the possibility of losing land access due to the concern of the spreading of NNIS plants.
- NNIS take over habitat that supports native wildlife and, potentially, endangered species.
- Vehicles, operators, and passengers have the potential of unintentionally carrying NNIS from one area to another. Soils, seeds, plant parts, or invertebrates may cling to gear, vehicles, and clothing.
- Disturbed soils may create favorable conditions for the establishment and spread of NNIS plants.

## *General guidance*

To minimize the introduction and spread of NNIS, motorized recreational users should focus on:

1) Inspecting and cleaning vehicles, equipment, and clothing,

2) Staying on established trails and routes, and

3) Treading lightly and leaving as little impact on the land as possible.

## *Best Management Practices*

**→BMP M-1: Learn to recognize NNIS common to the areas where you enjoy outdoor recreational activities.**

Suggestions:

a. Read guides, brochures, and pamphlets produced by government agencies or other weed management groups on NNIS plants and invertebrates.

b. Pay attention to signage at infested areas and trailheads, (e.g., "this is a picture of garlic mustard; you will see it along the west side of the trail").

c. Check out the Wisconsin DNR website for photos and instructions. http://dnr.wi.gov/invasives

**→BMP M-2: Wear outer layers of clothing and footwear that are not "seed-friendly."**

Suggestions:

a. In appropriate areas, wear low-tread footwear that doesn't hold soils, seeds, plant parts, or invertebrates.

b. Wear disposable shoe covers over footwear in infested areas; properly dispose of them when leaving the area.

c. Consider dedicating a pair of shoes or boots for use only on infested properties.

d. Wear ankle gaiters over socks and shoe laces.

e. Avoid wearing Velcro, bulky knits (e.g., wool, fleece), pants with cuffs, and other fabrics or clothing styles that can carry seeds.

**→BMP M-3: Inspect and clean hair, clothing, footwear, and gear for soils, seeds, plant parts, or invertebrates; before and after recreating.**

Suggestions:

a. Use items like a stiff brush, stick or small screwdriver to help remove soils, seeds, plant parts, or invertebrates; use boot brushes and other removal devices when provided.

b. Insects like the gypsy moth can move around on motorized vehicles; check for insect egg masses, pupae, and caterpillars of NNIS.

c. Do not clean clothing, footwear, or gear in or near waterways – it may promote the spread of NNIS downstream.

d. Preferred locations for cleaning are those where:

- NNIS are already established.
- Gear is unloaded and loaded.

- Areas can be easily monitored for new infestations due to the cleaning activity, i.e., along a road, at a trailhead, or in a parking lot.

**→BMP M-4: Prior to moving equipment, vehicles, and trailers onto and off of an activity area, spray, scrape, or brush soils, seeds, plant parts, or invertebrates from exterior surfaces, to the extent practical, to minimize the risk of transporting NNIS**

Suggestions:

a. Visit a carwash or cleaning station; be sure to spray the undercarriage of all vehicles.

b. Preferred locations for equipment cleaning areas are those where:
   - NNIS are already established.
   - Equipment is unloaded and loaded.
   - Areas can be easily monitored for new infestations due to the cleaning activity, i.e., along a road, at a trailhead, or in a parking lot.

c. Do not clean equipment, vehicles, or trailers in or near waterways – it may promote the spread of NNIS downstream.

**→BMP M-5: Inspect and remove soils, seeds, plant parts, or invertebrates, from the coat and feet of animals and their clothing/gear before and after recreating.**

Suggestions:

a. Carry a grooming brush, shedding blade, small scissors, hoof knife, etc. to help remove soil and NNIS propagules from animals.

b. Do not clean animals in or near waterways – it may promote the spread of NNIS downstream.

c. Preferred locations for cleaning are those where:
   - NNIS are already established.
   - Animals are unloaded and loaded.
   - Areas can be easily monitored for new infestations due to the cleaning activity, i.e., along a road, at a trailhead, or in a parking lot.

**→BMP M-6: Properly dispose of soils, seeds, plant parts, or invertebrates, found during inspection and cleaning.**

Suggestions:

a. Place materials in a bag and send to landfill, where possible.

b. Materials may be composted but only if the compost pile reaches very high temperatures and the finished compost can be monitored for NNIS plant seed emergence.

c. Materials may be disposed of in piles; locate the pile in an area that facilitates easy monitoring and control if infestations spread from it.

d. Materials may be burned; locate the burn pile in an area that facilitates easy monitoring and control if infestations spread from it.

**→BMP M-7: Stay on designated trails, roads, and other developed areas.**

Suggestions:

a. Minimize soil disturbance; it may promote NNIS plant seed germination and establishment.

b. Destruction of native plants favors NNIS.

c. By venturing into uninfested areas, you may introduce NNIS by carrying propagules.

d. Do not create your own trails on public lands.

e. If wet areas are encountered on established trails, go through them rather than around, if possible.

**→BMP M-8: When off-trail, avoid areas that appear to be infested with NNIS; "when in doubt, stay out!"**

Suggestions:

a. The chances of transporting soils, seeds, plant parts, or invertebrates increase in areas of heavy infestation or when seeds are present.

b. Direct contact with some NNIS can affect human and animal health, including skin and eye irritation.

**→BMP M-9: Report infestations of NNIS to the appropriate land manager or property owner.**

Suggestions:

a. Provide as exact a location as possible; take photos, GPS coordinates, or map the infestation.

b. Use diplomacy if contacting a private landowner.

**→BMP M-10: Volunteer to help control NNIS.**

Suggestions:

a. Contact public and private landowners, agencies, and nonprofit organizations to find out about volunteer opportunities.
**(**See Recreation Appendix A: Resources for information on control.)

**→BMP M-11: Minimize soil displacement from the trail/roadway and soil degradation outside the traveled portion; disturbed soils may create favorable conditions for the establishment and spread of NNIS plants.**

Suggestions:

a. Avoid sudden stops and quick directional changes with acceleration or braking.

b. Stay on the trail/roadway to not widen it so there is little or no compaction or impact outside the trail/roadway.

c. In the winter, ride only when there is adequate snow cover and when the trail is firm or frozen.

**→BMP M-12: Incorporate NNIS prevention into planning for special events.**

Suggestions:

a. Place cleaning stations at entrance and exit points.

b. Plan travel routes to avoid areas of heavy infestation.

c. Provide participants with informational brochures and other educational materials related to NNIS prevention.

d. Identify species in the field to educate participants.

e. Consider adding a component of removal and proper disposal of NNIS as part of the event.

f. Plan events for proper times of the year to help avoid the spread of NNIS.

**→BMP M-13: Spread the word – help educate others about NNIS and their effects on the environment, economy, and recreational opportunities.**

# Best Management Practices for Pedestrian-based Activities

*(BMP Prefix = "P")*

## *Introduction*

The category of "pedestrian recreation" encompasses a range of outdoor recreational activities in which participants travel on foot (or using a device to assist with foot travel) from one place to another. Travel may take place on or off trail and occurs mostly as a single-day event (i.e., would not involve camping).

Examples of pedestrian recreation include walking, sightseeing, hiking, backpacking, and running, sometimes using assistive devices like wheelchairs, walkers, and strollers. Other activities include wildlife watching, photography, and picnicking. Pursuits like rock climbing, caving, and gathering of natural foods and other materials, as well as winter sports like cross-country skiing and snowshoeing are also pedestrian forms of recreation.

Participants in these recreational activities are as varied and diverse as their interests. Some hikers, for instance, prefer hard-surfaced trails, while others seek out more rustic and "wild" experiences. Nature photographers and wildlife watchers may travel miles from developed areas, or may find that "perfect shot" along a boardwalk or nature trail. Each recreational user has a unique comfort level and base of experience that will determine the type of opportunities sought by that individual. So, best management practices targeting these user groups must allow for flexibility and diversity of experiences.

## *NNIS and pedestrian recreation*

NNIS are making recreational on and off trail travel increasingly difficult:

- NNIS plants may overgrow trails and forested areas, making walking, hiking, and other travel difficult.
- Many NNIS plants adversely affect human health. Some plants have prickly stems and thorns that cut exposed skin, while others produce chemicals that can cause severe skin burns and eye irritations.
- NNIS plants often out-compete native wildflowers and other plants, eliminating photographic and wildlife viewing opportunities.
- NNIS often lower biodiversity of natural areas, resulting in less healthy ecosystems, loss of wildlife habitat, and reduced quality of recreational experiences.

By definition, people engaged in pedestrian forms of recreation are moving from one place to another, so the potential for spreading NNIS always exists. When people leave established trails and enter natural habitats, this potential increases as the resulting disturbance may favor NNIS:

- Pedestrians may damage native plants and disturb soils, creating favorable conditions for growth of NNIS plants.
- Soils, seeds, plant parts, or invertebrates may cling to gear or clothing, especially if pedestrians travel from an infested area to a non-infested area.

## *General guidance*

To minimize the introduction and spread of NNIS, pedestrians should focus on: (1) inspecting and cleaning clothing, footwear, and gear, (2) minimizing disturbance of natural environments by staying on trails and in developed areas when possible, and (3) staying out of heavily infested areas. Becoming familiar with the most common NNIS is critical so that all recreational users can learn to stay out of these "hot spots."

## *Best Management Practices*

**→BMP P-1: Learn to recognize NNIS common to the areas where you enjoy outdoor recreational activities.**

Suggestions:

a. Read guides, brochures, and pamphlets produced by government agencies or other weed management groups on NNIS plants and invertebrates.

b. Pay attention to signage at infested areas and trailheads (e.g., "this is a picture of garlic mustard; you will see it along the west side of the trail").

c. Check out the Wisconsin DNR website for photos and instructions. http://dnr.wi.gov/invasives.

**→BMP P-2: Wear outer layers of clothing and footwear that are not "seed-friendly."**

Suggestions:

a. In appropriate areas, wear low-tread footwear that doesn't hold soils, seeds, plant parts, or invertebrates.

b. Wear disposable shoe covers over footwear in infested areas; properly dispose of them when leaving the area.

c. Dedicate a pair of shoes or boots for use only on infested properties.

d. Wear ankle gaiters over socks and shoe laces.

e. Avoid wearing Velcro, bulky knits (e.g., wool, fleece), pants with cuffs, and other fabrics or clothing styles that can carry seeds.

**→BMP P-3: Inspect and clean hair, clothing, footwear, and gear for soils, seeds, plant parts, or invertebrates before and after recreating.**

Suggestions:

a. Use items like a stiff brush, stick or small screwdriver to help remove soils, seeds, plant parts, or invertebrates; use boot brushes and other removal devices when provided.

b. Wear a hat to cover hair.

c. Do not clean clothing, footwear, or gear in or near waterways; it may promote the spread of NNIS downstream.

d. Preferred locations for cleaning are those where:

   - NNIS are already established.

- Gear is unloaded and loaded.
- Areas can be easily monitored for new infestations due to the cleaning activity, i.e., along a road, at a trailhead, or in a parking lot.

**→BMP P-4: Prior to moving equipment such as strollers, wheelchairs, etc. onto and off of an activity areas, spray, scrape, or brush soils, seeds, plant parts, or invertebrates from exterior surfaces, to the extent practical, to minimize the risk of transporting NNIS.**

Suggestions:

a. If traveling to the site via vehicle, visit a carwash or cleaning station; be sure to spray the undercarriage.

b. Preferred locations for equipment cleaning areas are those where:
   - Equipment is unloaded and loaded.
   - NNIS are already established.
   - Areas can be easily monitored for new infestations due to the cleaning activity, i.e., along a road, at a trailhead, or in a parking lot.

c. Do not clean equipment in or near waterways; it may promote the spread of NNIS downstream.

**→BMP P-5: Inspect and remove soils, seeds, plant parts, or invertebrates from the coat and feet of animals and their clothing/gear before and after recreating.**

Suggestions:

a. Carry a grooming brush, shedding blade, small scissors, hoof knife, etc. to help remove soil and NNIS propagules from animals.

b. Do not clean clothing, footwear, gear, vehicles, or animals in or near waterways – it may promote the spread of NNIS downstream.

c. Preferred locations for cleaning are those where:
   - NNIS are already established.
   - Animals are unloaded and loaded.
   - Areas can be easily monitored for new infestations due to the cleaning activity, i.e., along a road, at a trailhead, or in a parking lot.

**→BMP P-6: Properly dispose of soils, seeds, plant parts, or invertebrates found during inspection and cleaning.**

Suggestions:

a. Place materials in a bag and send it to a landfill, where possible.

b. Materials may be composted but only if the compost pile reaches very high temperatures and the finished compost can be monitored for NNIS plant seed emergence.

c. Materials may be disposed of in piles; locate the pile in an area that facilitates easy monitoring and control if infestations spread from it.

d. Materials may be burned; locate the burn pile in an area that facilitates easy monitoring and control if infestations spread from it.

**→BMP P-7: Stay on designated trails, roads, and other developed areas.**

Suggestions:

a. Minimize soil disturbance; it may promote NNIS plant seed germination and establishment.

b. Destruction of native plants favors NNIS.

c. By venturing into uninfested areas, you may introduce NNIS by carrying propagules.

d. Avoid trails that are wet or muddy. If wet areas are encountered, go through them rather than around, if possible.

**→BMP P-8: When off-trail, avoid areas that appear to be infested with NNIS; "when in doubt, stay out!"**

Suggestions:

a. The chances of transporting soils, seeds, plant parts, or invertebrates increase in areas of heavy infestation or when seeds are present.

b. Direct contact with some NNIS can affect human and animal health, including skin and eye irritation.

**→BMP P-9: Report infestations of NNIS to the appropriate land manager or property owner.**

Suggestions:

a. Provide as exact a location as possible; take photos, GPS coordinates, map the infestation.

b. Use diplomacy if contacting a private landowner.

**→BMP P-10: Volunteer to help control NNIS.**

Suggestions:

a. Contact public and private landowners, agencies, and nonprofit organizations to find out about volunteer opportunities.
(See Recreation Appendix A: Resources for information on control.)

**→BMP P-11: Unless gathering natural foods or other permitted material, don't pick plants.**

Suggestions:

a. Picking plants is prohibited on many public lands.

b. While many NNIS plants have attractive blooms, discarded flower or seed heads can spread NNIS plant seeds.

c. When processing gathered materials, remove NNIS plants and dispose of them properly.

d. Some NNIS plants may cause skin and eye irritation.

e. If you are interested in controlling NNIS plants, contact the property manager.

**Despite their appeal for ornamental purposes, avoid picking plants such as teasel and bittersweet since this provides opportunities to spread these species through discarded plant parts and seeds.**

→**BMP P-12: Incorporate NNIS prevention into planning for special events.**

Suggestions:

a. Place cleaning stations at entrance and exit points.

b. Plan travel routes to avoid areas of heavy infestation.

c. Provide participants with informational brochures and other educational materials related to NNIS prevention.

d. Identify species in the field to educate participants.

e. Consider adding a component of removal and proper disposal of NNIS as part of the event.

f. Plan events for proper times of the year to help avoid the spread of NNIS.

→**BMP P-13: Spread the word – help educate others about NNIS and their effects on our environment, economy, and recreational opportunities.**

# Best Management Practices for Land Management

*(BMP Prefix = "LM")*

## *Introduction*

Recreational lands fall under a broad spectrum of ownerships: federal, tribal, state, county, municipal, private, business/industry, and non-profits. On some sites, recreational use is subordinate to a different overall, e.g., silviculture. Land managers may include landowners, employees of the landowner, contractors, agency employees, and volunteers.

Working cooperatively and supporting private landowner efforts to manage and restore habitats for at-risk species is essential to protecting biodiversity. For instance, with over 85 percent of Wisconsin's land in private ownership, landowners and their designated land managers are the key to protecting the state's valuable natural habitats from threats like NNIS. The Wisconsin DNR estimates that approximately 90 percent of rare species have populations on private land.

To manage the threat of NNIS, land managers may voluntarily consider a three-tiered approach: (1) planning; (2) operations and maintenance; and (3) information and education. Planning may include developing a management plan, conducting inventories, and monitoring. Operations and maintenance relates to management activities on developed and undeveloped lands. Education and information targets recreational users, staff, volunteers and local communities with messages related to NNIS identification, impacts, and spread prevention.

## *What are NNIS?*

NNIS are plants, animals and pathogens that are "out of place." A species is regarded as NNIS if it has been introduced by human action to a location, area, or region where it did not previously occur naturally (i.e., is not native), becomes capable of establishing a breeding population in the new location without further intervention by humans, and spreads widely throughout the new location.

One of the reasons that NNIS are able to succeed is that they often leave their predators and competitors behind in their native ecosystems. Without these natural checks and balances, they are able to reproduce rapidly and out-compete native species.

NNIS can alter ecological relationships among native species and can affect ecosystem function, economic value of ecosystems, and human health.

Two of the most important concepts to consider include limiting the spread and reducing impacts. Limiting the spread of NNIS means working to contain an infestation within a defined area. Preventive measures may include restricting activities and minimizing travel through infested areas, especially during certain times of year. Other voluntary practices like inspecting clothing and equipment may also limit the spread of invasives.

## *NNIS and land management*

Land managers often find that their ability to meet site management goals and users needs is inhibited, if not prevented, by the presence of NNIS. For example, thorny shrubs may limit access by hikers, bikers, and hunters. NNIS shrubs in the understory may inhibit forest regeneration. Furthermore, NNIS control efforts may divert resources from other property management and development activities.

Land management and NNIS control efforts can be complicated when recreational users, equipment, and property staff inadvertently spread seeds, soil, and propagules from infested sites to uninfested sites. Failure to promptly address new infestations of NNIS as soon as detected can potentially lead to a greater resource drain in the future.

A **propagule** (prŏp′ ə gyool) is any reproductive structure or part of an organism that can grow independently of its parent source. In plants, this may be a fruit, seed, bud, tuber, root, stem with rooting structures, or shoot. In invertebrates this may be an egg, larva, pupa, or adult. In forest diseases, this may be a spore, mycelial fragment (similar to roots), or fruiting body.

### *General guidance:*

Land managers should attempt to voluntarily limit the introduction and spread of NNIS. They may incorporate voluntary NNIS monitoring and management into their standard operations, set specific goals and objectives for their control, and provide guidance and infrastructure necessary to limit the impact of recreational users.

The goal of the BMPs is to minimize the risk of transporting soils, seeds, plant parts, or invertebrates. To EMPHASIZE and minimize the introduction and spread of NNIS, land managers may focus on:

1. Planning for NNIS management.
2. Incorporating NNIS management into all operations and maintenance property activities.
3. Informing and educating users, staff, and volunteers.
4. Monitoring may detect new invasions of NNIS.

## Best Management Practices for Recreational Land Managers

The following best management practices are intended to help land owners and land managers reduce the likelihood of NNIS introductions and control the effects of NNIS that may arrive despite their best efforts.

***1. Information and Education***

**BMP - LM1. Provide training in identification and control of known NNIS to employees, contractors, users, and volunteers.**

**BMP - LM2. Inform and educate the general users in the area about common NNIS, their impacts, and ways to prevent their introduction and spread.**

**BMP - LM3. Post NNIS messages, posters, and prevention strategies at prominent locations on the property; provide informational materials directly to recreational users.**

***2. Planning***

**BMP - LM4. Assess the extent of NNIS on and near the property by inventorying, locating, and documenting infestations.**

**BMP - LM5. Develop a prioritized action plan for managing NNIS on the property based on threats to the property and feasibility of control.**

**BMP - LM6. In planning for all activities on the property, work to limit the potential introduction and spread of NNIS.**

**BMP - LM7. Assess current available resources and seek new resources to control NNIS spread.**

***3. Operations and Maintenance Activities***

**BMP - LM8. Do not use NNIS plants.**

**BMP - LM9. Ensure that NNIS control treatments are applied safely and within the appropriate time window.**

**BMP - LM10. Take steps to minimize the movement of NNIS to non-infested areas during operation and management activities.**

**BMP - LM11. Prior to relocating equipment, vehicles and trailers be sure to spray, scrape or brush soil and debris from exterior surfaces to the extent possible.**

**BMP - LM12. Properly dispose of soil, seeds, plant parts or invertebrates found during inspection and cleaning.**

**BMP - LM13. Consider the likely response of NNIS when prescribing land management activities that result in disturbance such as soil, increased sunlight, fire, etc.**

**BMP - LM14. Ensure to the extent practical, that construction and maintenance materials (mulch, gravel, topsoil, etc.) are free of NNIS.**

**BMP - LM15. Minimize soil disturbance and quickly revegetate disturbed soils; whenever possible, promote and retain native vegetation.**

***4. Monitoring***

**BMP - LM16. Monitor each site following management activities; determine necessary treatments based on presence of NNIS.**

## *What is a Suggestion?*

Following each BMP are voluntary suggestions that will assist land managers in implementing the best management practices for NNIS. Suggestions are intended to provide additional information and guidance on the voluntary practices of the BMPs.

## 1. Information and Education

**→BMP LM-1: Provide training in identification and control of known NNIS to employees, contractors, users, and volunteers.**

Suggestions:

a. Include training on identification, control methods, and prevention techniques.

b. Provide information about where to report sightings of NNIS and locations of new infestations.

c. Encourage prevention and control as part of land stewardship activities.

d. Present targeted messages during peak recreational use seasons.

e. Provide incentives for users, volunteers, and employees to support NNIS control and management goals; recognize those who contribute to these efforts.

**→BMP LM-2: Inform and educate the general users in the area about common NNIS, their impacts, and ways to prevent their introduction and spread.**

Suggestions:

a. Provide information on identification of NNIS common to the property; include the potential ecological, economic, and social impacts of these species, along with concerns related to user health and safety.

b. Include links to partners like Cooperative Weed Management Areas, resource agencies, and conservation organizations.

c. See Recreation Appendix A for list of resources.

d. Consider the potential of materials that are removed from the property (i.e., sand and gravel, hay, firewood, timber sales) as a source of spread and take appropriate action

**→BMP LM-3: Post NNIS messages, posters, and prevention strategies at prominent locations on the property; provide informational materials directly to recreational users.**

Suggestions:

a. Include guidelines on the prevention of NNIS spread and information on the potential impacts within recreation permits, property maps, entrance stickers, licenses, and other materials provided directly to users.

b. Post informational signs at public areas (trailheads, campgrounds, picnic areas, boat launches, etc.) and locations where NNIS management efforts are being implemented; explain impacts, control methods, and spread prevention strategies.

c. Install prevention equipment like boot brushes and washing stations, along with informational signs, at trailheads, boat launches, and other key use areas.

d. Use plantings around public areas to demonstrate appropriate use of native plants; see Recreation Appendix A for additional resources and information.

Firewood has the potential to spread many destructive NNIS, both known and as yet, unknown. Confirmed threats include: emerald ash borer, butternut canker, white pine blister rust, and oak wilt.

Firewood is often stored unused for long periods of time and is handled by people generally not trained to notice signs of NNIS pests. Once established in new areas, NNIS forest pests can quickly kill trees in forests, parks, communities, and campgrounds.

## 2. Planning

Since dealing with NNIS is a long-term effort and can be very time-consuming and expensive, it is important that objectives are pursued to the extent practical through planned actions. Evaluating the threats posed by NNIS and determining ways to reduce their impacts are important considerations in any planning efforts. Planning includes property-based planning as well as activity based planning.

***Property Planning***

Property planning can be completed for any land and will provide the foundation and long-term goals for its management. Planning considers the rationale for various aspects of land management, including sustaining plant and animal communities and providing recreational opportunities. By evaluating the potential risk of NNIS, landowners and managers can more effectively protect the viability of their property.

→**BMP LM-4: Assess the extent of NNIS on and near the property by inventorying, locating, and documenting infestations.**

Suggestions:

Knowing which NNIS are present, and where, is the first piece of information needed to evaluate the risks. There are several steps to consider when scouting for NNIS:

a. Inventory for NNIS at probable introduction sites such as access points, trails, campsites, and other disturbed areas.

b. Document occurrences in a manner consistent with property practices.

c. When planning for a specific management activity on the property, inventory both within and around the activity area.

d. Be aware of the species that are not common and require early detection and rapid response.

***Early Detection and Rapid Response***

Since the chances of controlling an NNIS are greatest immediately after introduction, early detection and rapid response are an important part of managing NNIS.

***Early Detection*** uses a comprehensive surveillance system to locate new populations of NNIS early when control is still feasible and less costly. Detection targets (a) areas where introductions are likely, such as access points and travel corridors, (b) areas with high ecological value, and (c) vulnerable habitats or recently disturbed areas.

***Rapid response*** is a systematic effort to contain and control NNIS while the infestation is localized. Having a prioritized management plan will provide the most effective, organized, and efficient response to a new introduction or infestation.

→**BMP LM-5: Develop a prioritized action plan for managing NNIS on the property based on threats to the property and feasibility of control.**

Suggestions:

When developing an NNIS management plan, consider the following:

a. Which NNIS are currently present on the property? How are they impacting land management objectives? Use the Decision Guide to assess the threat and determine the steps to take.

b. What resources do you have available to control NNIS?

c. Identify key staff and volunteers, budget, and equipment.

d. How will you prioritize your efforts? Consider the following order:

   (1) early detection of NNIS;

   (2) control of small, isolated populations;

   (3) protection of high-quality areas with few NNIS; and

   (4) management of high-use areas that may be a source of further infestations.

e. What specific goals do you have for controlling NNIS present on the property? Sample goals might include:

   - Reduce abundance of host species or habitat by increasing vegetative diversity and maintaining a healthy forest understory.
   - Revegetate disturbed areas with desirable native plants
   - Use regular monitoring and early detection to identify and control small populations of NNIS.
   - Use appropriate methods to prevent the introduction of soil, seeds, pests, and propagules into uninfested areas.

f. How will you educate and inform recreational users, staff, contractors, and volunteers on NNIS including identification, impacts, and prevention?

g. Reference the Decision Guide at the end of the Land Management BMPs.

***Activity Planning***

Once established, NNIS may proliferate, even with targeted management activities. In many cases, skillful execution of routine management activities may help to minimize and reduce the threat of some NNIS. An "activity," for purposes of this document, may include any practice that influences vegetation, soils, or other habitat conditions.

Activity planning can occur on properties of all sizes and within all types of ownership. Planning should include inventorying to identify current NNIS infestations, evaluation of risk, and modification of management activities to reduce the potential for their spread.

→**BMP LM- 6: In planning for all activities on the property, work to limit the potential introduction and spread of NNIS.**

Suggestions:

For each specific management activity undertaken, first inventory and map any NNIS present. Then conduct a risk assessment; consider threats to the property and identify options for managing NNIS.

a. What impacts do NNIS have on management objectives?
    - Some NNIS have relatively low impacts due to their low level or temporary/cyclic nature. It may be a lower priority to manage these species. Other species can be extremely damaging, causing severe ecological, economic, and social impacts.

b. Select locally native species for seed mixes and plant materials used in land management projects.
    - Do not purchase or garden with plants that are known to be invasive.
    - Plant locally native plants. This will support native plant populations and provide habitat for birds, beneficial insects, and other wildlife. Native plants are also easier to garden with because they require less watering, fertilization, and pest control.
    - The majority of NNIS plants were introduced as garden ornamentals. As a land manager or landowner, you can help prevent the introduction of new NNIS plant species and help control the spread of existing infestations.
    - Is control of NNIS feasible?
    - Controlling NNIS may be difficult, time consuming and expensive: consider control options and costs, as well as the impacts of not taking action.

c. How can you time the activity to maximize effectiveness of control efforts and minimize potential for spread?
    - Consider the need for NNIS control efforts and determine whether planned control efforts should occur before, during, or after the primary activity.
    - If pre-treatment of NNIS is necessary, postpone activity until the infestation can be treated. Effective pre-treatments sometimes need to occur one to two years prior to the activity.
    - Consider seasonal timing options to minimize the spread of NNIS, while still achieving management objectives.

d. Minimize soil disturbance.

- Avoid disturbing natural vegetation by maintaining wide buffers around sensitive areas.
- If possible avoid soil removal or disturbance; plan the project or activity to keep such disturbances to the absolute minimum.
- Consider alternatives that may have fewer impacts.

**Control**

Early detection and rapid response may allow for the elimination of some NNIS populations at the site level. However, when populations are large and resources are limited, a more realistic management goal is to control the NNIS by reducing their populations to levels that will allow native species to thrive. Control programs are usually ongoing and can include manual, mechanical, chemical, biological, and cultural components. Land managers should evaluate their site and life cycle characteristics of the NNIS to determine which control methods will be the most effective and economical while minimizing negative environmental impacts.

**→BMP – LM- 7: Assess current available resources and seek new resources to control NNIS spread.**

Suggestions:

a. Available resources include facilities, equipment, finances, and human resources.

b. Identify local and regional partners, such as Cooperative Weed Management Areas, with whom you may collaborate and share resources.

c. Identify individuals or groups with a primary focus on NNIS; if these are volunteers, provide staff support and ways to sustain their commitment.

**d.** Access information on grants, funding, and organizations online.
**See Recreation Appendix A and Appendices B and C for additional information**

**Cooperative Weed Management Areas**

A Cooperative Weed Management Area (CWMA) is a partnership of government organizations, agencies, tribes, individuals, and various interest groups that manage NNIS plants within a defined area.

## 3. Operations and Maintenance Activities

As managers work to provide a spectrum of recreational opportunities, NNIS management can be integrated with daily operations.

Managers can implement the prioritized NNIS management plan, initiating control efforts and considering spread prevention and control in normal management activities.

**→BMP LM - 8: Do not use NNIS plants.**

Suggestions:

a. See lists of NNIS plants in Recreation Appendix A Resources.

b. Whenever possible, promote and retain native vegetation.

c. Select plant materials that are site appropriate, healthy, and not prone to pests and diseases.

d. Site appropriate species are those that are suited to the climate, microclimate and soil type, texture and moisture where they are to be planted.

e. Recognize that non-native earthworms, NNIS pests and NNIS plant propagules may inhabit the soil associated with the planting stock.

**→BMP LM - 9: Ensure that NNIS control treatments are applied safely and within the appropriate time window.**

Suggestions:

a. Consider life history of target NNIS in relation to timing of control methods **(**see Recreation Appendix C for a sample "Identifying Time Window for NNIS Management").

b. Mow infested areas prior to seed formation to reduce further spread. (See Recreation Appendix B, Mowing Guidance).

c. Allow time and resources for post-treatment follow-up control measures, due to persistent seed bank and resprouting for several years.

d. Consider the need for NNIS control efforts and determine whether planned control efforts should occur before, during, or after the primary activity.

e. If pre-treatment of NNIS is necessary, postpone activity until the infestation can be treated. Effective pre-treatments sometimes need to occur one to two years prior to the activity.

f. Consider seasonal timing options to minimize the spread of NNIS, while still achieving management objectives.

**→BMP LM- 10: Take steps to minimize the movement of NNIS to non-infested areas during operation and management activities.**

Suggestions:

a. Mow infested areas prior to seed formation to reduce further spread. (See Recreation Appendix B, Mowing Guidance)

b. Consider excluding infested areas from travel corridors.

c. Carry out work under conditions that minimize the risk of spread, e.g., frozen ground, snow cover, absence of seeds/propagules, etc. (see Recreation Appendix C for a sample "Identifying Time Windows for NNIS Management" chart).

d. Clean equipment when moving from infested to non-infested areas.

e. Avoid placing fire breaks within infestations of NNIS. If NNIS that are present are promoted by fire, exclude the area of infestation from the burn unit when feasible.

f. If the NNIS that are present are controlled by fire, incorporate the area of infestation into the burn unit when feasible.

g. Use existing natural and man-made fire breaks (lakes, streams, roads, and trails, etc.) when possible.

h. If existing roads are infested with NNIS, treat before using them.

i. In areas with infestations, consider temporarily closing or rerouting roads or trails. Where appropriate, ask user groups to become actively involved and help control an infestation so the trail can be reopened.

j. For road, trail, or landing closures, erect barriers such as gates, berms, or boulders and post signs stating the length of time and reason for closure.

k. If necessary, close facilities to carry out NNIS management.

l. Consider the potential of materials that are removed from the location (i.e., sand and gravel, hay, firewood, timber sales) as a source of spread and take appropriate action

**→BMP LM- 11: Prior to relocating equipment, vehicles and trailers be sure to spray, scrape or brush soil and debris from exterior surfaces to the extent possible.**

Suggestions:

a. Visit a carwash or cleaning station; be sure to spray the undercarriage of all vehicles.

b. Preferred locations for cleaning are those where:
   - NNIS are already established.
   - Equipment is unloaded and loaded.
   - Areas can be easily monitored for new infestations due to the cleaning activity, i.e., along a road, at a trailhead.

c. To limit the spread of NNIS downstream, do not clean equipment, vehicles, or trailers in or near waterways.

**→BMP LM -12: Properly dispose of soil, seeds, plant parts or invertebrates found during inspection and cleaning.**

Suggestions:

a. Contain whatever is being disposed; cover trailers, use heavy bags, etc.

b. Place materials in a bag and send to landfill, where possible. Contact your local solid waste authority for details.

c. Materials may be composted but only if compost pile temperature reaches very high temperatures and the finished compost can be monitored for weed emergence.

d. Materials may be disposed of in piles. Locate the pile in an area that facilitates easy monitoring and control if infestations spread from the pile.

e. Materials may be burned. Locate the burn pile in an area that facilitates easy monitoring and control if infestations spread from the pile.

f. When chipping ash logs or brush, be sure the chip size is less than ½- inch.

   See current state guidance:
   http://www.emeraldashborer.wi.gov/articleassets/MulchAndChipsEAB-CA-WI.pdf.

**→BMP LM-13: Consider the likely response of NNIS when prescribing land management activities that result in disturbance such as soil, increased sunlight, fire etc.**

Suggestions:

a. Ground disturbance may uproot existing vegetation and expose soil, creating a seedbed for NNIS plants that can overwhelm native vegetation.

b. Soil disturbance, when combined with aggressive follow-up control measures, may be used to control NNIS within infested areas by depleting the seed bank.

c. After a soil disturbance, encourage prompt regeneration of desirable vegetation to limit introduction of NNIS plants.

d. After a soil disturbance, monitor the area and treat new NNIS plant infestations.

e. Following a prescribed burn, restore or rehabilitate disturbed areas.

**→BMP LM-14: Ensure, to the extent practical, that construction and maintenance materials (mulch, gravel, topsoil, etc.) are free of NNIS.**

Suggestions:

a. Use on-site materials when possible.

b. Keep stockpiled material free of NNIS.

c. Cover exposed piles of soil or construction materials with plastic sheeting.

d. Mechanically disturb piles to prevent growth of invasives.

e. Use soil and aggregate sources from areas that are free of NNIS.

f. Avoid infested source material or treat it to remove NNIS prior to use.

g. If using half- or full-logs from on-site, remove bark when possible.

h. Use weed-free oat or wheat straw for mulch where available; "marsh hay" may contain reed canary grass. For more information on certified weed-free materials visit: http://hayandforage.com/links/hay/weed-seed-free-programs/.

**→BMP LM-15: Minimize soil disturbance and quickly revegetate disturbed soils; whenever possible, promote and retain native vegetation.**

Suggestions:

a. Avoid planting NNIS.

b. In areas where NNIS are known to be in the seed bank, treat NNIS before revegetating.

c. Non-persistent, annual cover crops like annual rye or oats can be used to temporarily stabilize the soil, discouraging the establishment of NNIS and allowing native species to re-colonize.

d. Revegetate or restore depending on site conditions.

e. Use weed-free, locally appropriate seed mixes where available.

f. Stockpile displaced topsoil and native plants for future use on the same site.

g. If conditions permit, allow native plants to recolonize disturbed sites.

**Monitoring**

Monitoring sites after activities may detect new invasions early and evaluate the success of NNIS control efforts. Monitoring inspections can be integrated with other activities and should be kept as simple as possible to meet NNIS management objectives. While monitoring sites for known NNIS, landowners and managers should be alert for emerging NNIS threats like the emerald ash borer, gypsy moth, and other species that may move into the area.

→**BMP LM-16: Monitor each site following management activities; determine necessary treatments based on presence of NNIS.**

Suggestions:

a. Conduct periodic inspections of each site following a management activity. Anticipate response of NNIS to activities and check for new infestations or the spread of existing populations.

b. Determine appropriate control measures to respond to new infestations or spreading populations; continue monitoring.

c. The area where the activity occurred should be monitored on a regular basis several times a year.

d. Encourage land managers to increase monitoring by involving volunteer groups.

e. See Recreation Appendix A, Resources.

**Beyond NNIS Control: Ecological Restoration**

NNIS removal and control is only a small part of overall NNIS management. Restoring a healthy ecosystem is the ultimate goal of NNIS programs. Returning native communities to a site that has been cleared of invasives reduces the risk of future invasions and, in the long run, the need for active control.

There are several steps in planning and carrying out a successful restoration:

- determine what type of native community is appropriate
- determine goals for the project and measures of success
- determine whether site conditions will need to be changed and how the site will be prepared and planted
- set a timeline, project budget, and a list of materials and contractors
- develop a plan for monitoring the site and conducting follow-up management activities.

**NNIS Earthworms**

Earthworms are not native to the Great Lakes Region. There were no native earthworms in the area after the last glaciation. The current population, brought by early Europeans and being spread in bait, soil, gravel, and mulch, is slowly changing the face of our native forests and recreational lands. To be sure, it's a slow-motion invasion: Many worms spread just half a mile every century. But they are now so numerous and widespread that they are dramatically changing the forest ecosystem, devouring a layer of the forest floor that native wildflowers, beetles, and other species need to survive.

***Consider posting signs**:* DO NOT DUMP BAITWORMS IN THE WATER OR ON THE GROUND. PUT THEM IN THE TRASH.

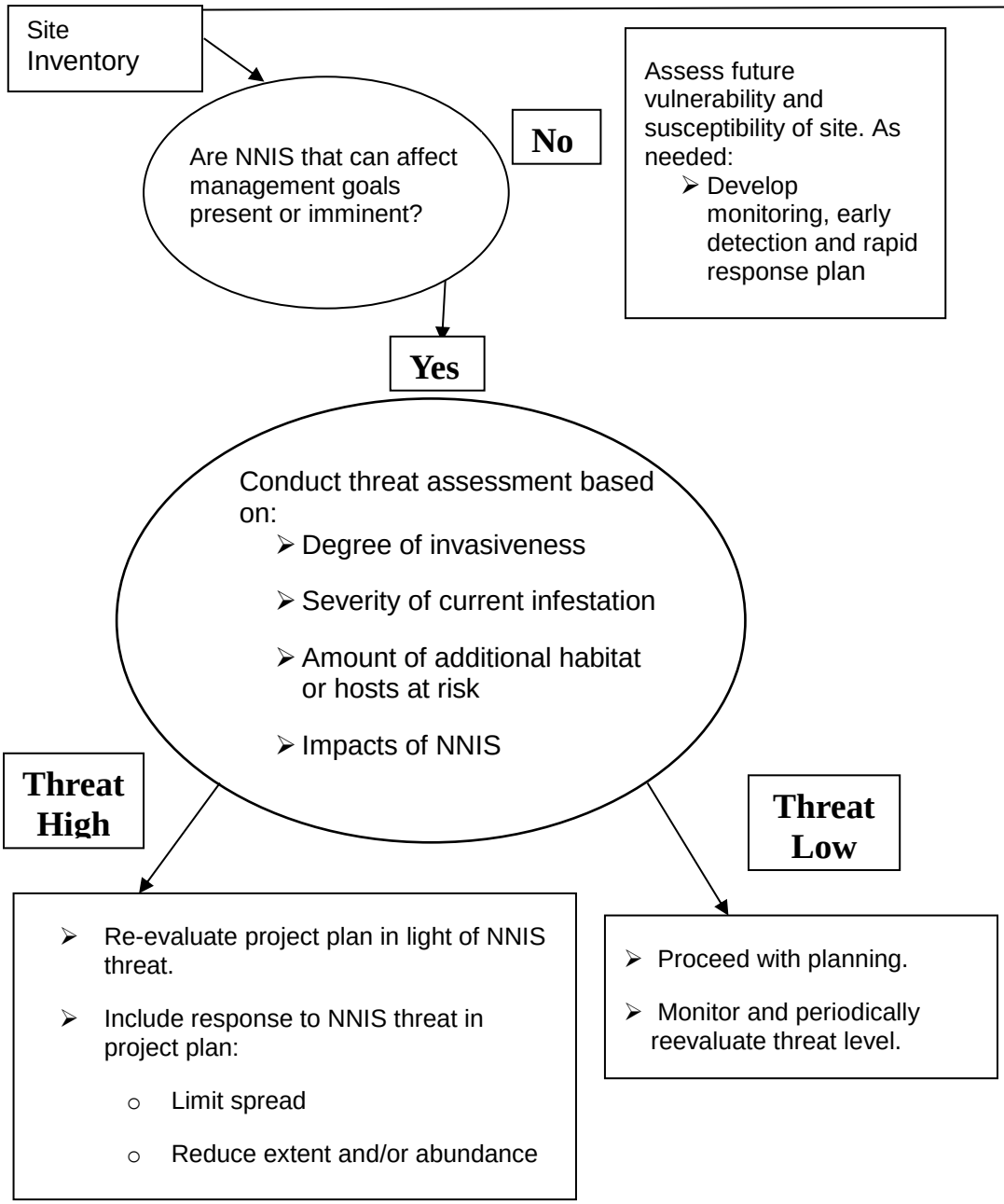
Learn more by exploring these links:

http://www.wormpost.com/worms/biology.html

http://cfhe.cfans.umn.edu/projects/leadingedge.html

(See Recreation Appendix C for a sample "Identifying Time Windows for NNIS Management" chart.)

## *Decision Guide for Long-term Site and Activity Planning*



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http://tncweeds.ucdavis.edu/esadocs.html (last updated 10/07)

USDA-Forest Service. Guide to Noxious Weed Prevention Practices. Version 1.0, Dated July 5, 2001. http://www.fs.fed.us/invasivespecies/.

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# Appendices for Outdoor Recreation Best Management Practices

## *Recreation Appendix A: Resources*

Each U.S. Forest Service Eastern Region Forest should add information specific to their state or Forest here.

**NNIS Plants (**See also All Invasives)

*Center for Invasive Plant Management (CIPM).* http://www.weedcenter.org

This web site provides information on invasive plant identification, biology, and impacts of NNIS. It also includes links to a resource guide, weed control methods, and NNIS plant management online textbook.

*Great Lakes Indian Fish and Wildlife Commission (GLIFWC)—Exotic Plant Information Center.* http://www.glifwc.org/invasives/ This site features a searchable database of NNIS accounts. It also provides distribution maps, educational materials, and a slide library.

*Invasive Plant Association of Wisconsin (IPAW).* http://www.ipaw.org

The mission of IPAW is to promote better stewardship of the natural resources of Wisconsin by advancing the understanding of NNIS plants and encouraging the control of their spread. Their web site offers a photo gallery, NNIS list, educational resources, news and events, and more.

*Midwest Invasive Plant Network (MIPN).* http://www.mipn.org/
This organization's mission is to reduce the impact of NNIS plant species in the Midwest. The web site provides information on prevention, early detection and rapid response, control and management, education, research, and more.

*Plant Conservation Alliance (PCA), Weeds Gone Wild, Alien Plant Invaders of Natural Areas.*

http://www.nps.gov/plants/alien/ This web site provides a list of NNIS plants in the US, background information on the threats and impacts of NNIS, fact sheets, and relevant links.

*University of Wisconsin Herbarium.* http://www.botany.wisc.edu/wisflora

The Herbarium's web site is fully searchable for Wisconsin's vascular plant species. It includes photos, habitat information, distribution maps, and herbarium specimen data.

**NNIS Insects and Diseases**

*Department of Agriculture Trade and Consumer Protection (DATCP).*
http://www.datcp.state.wi.us/core/insectspesticides/insectspesticides.jsp

DATCP is responsible for the prevention, introduction and spread of plant pests. This webpage provides information on specific pests, rules, firewood restrictions, and firewood dealer certification.

*Department of Agriculture Trade and Consumer Protection (DACTP)—Wisconsin Pest Bulletin.* http://pestbulletin.wi.gov/index.jsp The most relevant links are: Nursery and Forest, Exotic Pest of the Week, and DATCP Contacts.

*Emerald Ash Borer: What you need to know.* http://www.emeraldashborer.info/ This web site is part of a multi-state effort to provide the latest information about EAB to the public.

*National Agricultural Pest Information System (NAPIS)—Pest Tracker.* http://ceris.purdue.edu/napis/ This web site has links to state information, pest information, survey maps and publications. Information presented here is derived, in part, from the National Agricultural Pest Information System (NAPIS), an agricultural pest tracking and database sponsored by the US Department of Agriculture Animal and Plant Health Inspection Service (APHIS) and Plant Protection and Quarantine (PPQ) Cooperative Agricultural Pest Survey, (CAPS).

*The Exotic Forest Pest Information System for North America.* http://spfnic.fs.fed.us/exfor/index.cfm This web site contains a database of NNIS insects, mites, and diseases with background information for each pest.

*U.S. Department of Agriculture (USDA) Animal Plant Health Inspection Service (APHIS).* http://www.aphis.usda.gov/plant_health/ APHIS safeguards agriculture and natural resources from the risks associated with the entry, establishment, or spread of animal and plant pests. The site has links to information on specific plant pests, pest detection and identification information, and plant protection and quarantine manuals.

*U.S. Department of Agriculture (USDA) Forest Service—North Central Research Station: Emerging Forest Insect Pests.*

http://www.ncrs.fs.fed.us/4501/focus/emerging_pests/ The North Central Research Station web site provides information on exotic forest insects, describes current research, and features publications and maps for a 20-state region spanning the Midwest and Northeast.

*Wisconsin Gypsy Moth.* http://gypsymoth.wi.gov/ The Wisconsin Gypsy Moth site has information on predicting defoliation, management options, identification, and life cycle and includes the phone number for the Gypsy Moth Information Line.

*Wisconsin's Emerald Ash Borer Resource.* http://emeraldashborer.wi.gov/ This site includes information on surveys, detection, and management, and includes an email address and phone number to report suspected infestations.

**All NNIS**

*National Invasive Species Council's Definition of Invasive.*
http://www.invasivespeciesinfo.gov/docs/council/isacdef.pdf

*National Invasive Species Management Plan.* http://www.invasivespeciesinfo.gov/council/nmp.shtml

*The Nature Conservancy (TNC)—Global Invasive Species Initiative*. http://tncweeds.ucdavis.edu This web site provides many resources designed to help conservationists deal most effectively with NNIS. It provides links to an introduction on NNIS management, planning and strategy, control methods, and photo archive and more.

*USDA Forest Service Invasive Species Program.* http://www.fs.fed.us/invasivespecies This web site serves as a portal to Forest Service NNIS information and related management and research activities across the agency and with partners. The program's goal is to reduce, minimize, or eliminate the potential for introduction, establishment, spread, and impact of NNIS across all landscapes and ownerships.

*Wisconsin Council on Invasive Species* http://dnr.wi.gov/invasives/iscouncil.htm

This site includes a link to the comprehensive state management plan.

*Wisconsin Department of Natural Resources (WDNR).* http://dnr.wi.gov/invasives

The NNIS webpage provides links to NNIS information including a photo gallery, complete plant and animal NNIS lists, and information on managing NNIS populations.

**General Sites of Interest**

**Forests may add information specific to them here:**

**WISCONSIN:**

*University of Wisconsin Extension.* http://www.uwex.edu/locations/ The Extension has offices in every county in Wisconsin.

*University of Wisconsin Forestry Extension.* http://www.forest.wisc.edu/extension/index.html This site has publications, internet resources, and other materials related to forests, their management, and the wood products industry in Wisconsin. It includes a link to the popular Forestry Facts series.

*Wisconsin Department of Natural Resources (WDNR). List of Native Plant Nurseries and Restoration Consultants in Wisconsin.* http://dnr.wi.gov/org/land/er/plants/nurseries.htm#Booming The list includes nurseries within 100 miles of Wisconsin that may be able to provide native seed and/or plants for your projects. Consultants provide services such as design, landscape installation, and maintenance services including prescribed burning.

*Wisconsin Department of Natural Resources (WDNR). State Nursery Program.* http://dnr.wi.gov/forestry/nursery/ The DNR operates three forest tree nurseries: the Wilson State Nursery in Boscobel; the Griffith State Nursery in Wisconsin Rapids; and the Hayward State Nursery in Hayward. Trees are sold for reforestation, wildlife habitat, and erosion control purposes.

*Wisconsin Family Forests (WFF).* http://www.wisconsinfamilyforests.org/

This organization is a non-profit that works with professional wildlife managers, foresters and experienced woodland owners who act as advisors to other forest owners.

*Wisconsin Forest Management Guidelines (PUB-FR-226 2003).*
http://www.dnr.state.wi.us/forestry/publications/Guidelines/toc.htm
The Guidelines serve as a practical reference guide to responsible resource management.

*Wisconsin Prescribed Fire Council.* http://www.prescribedfire.org/index.html The Wisconsin Prescribed Fire Council strives to make the use of prescribed fire in Wisconsin safer and more accepted for all practitioners. The site provides information and links on government relations, liability, training, weather, and fire implementation.

*Wisconsin Woodland Owners Association (WWOA).* http://wisconsinwoodlands.org

This organization is a nonprofit educational organization established to advance the interests of woodland owners and the cause of forestry, develop public appreciation for the value of Wisconsin's woodlands and their importance in the economy and overall welfare of the state, foster and encourage wise use and management of Wisconsin's woodlands for timber production, wildlife habitat and recreation, and educate those interested in managing Wisconsin's woodlands.

**General NNIS Plant Management (Control Methods)**

*Center for Invasive Plant Management (CIPM)—Weed Control Methods.*
http://www.weedcenter.org/management/control.htm

The Weed Control Methods web page offers information and links on the following control techniques: biocontrol, grazing, herbicides, mechanical and prescribed burning.

*Department of Conservation and Natural Resources NNIS Exotic Plant Tutorial for Natural Land Managers. NNIS Exotic Plants in Pennsylvania List.*

http://www.dcnr.state.pa.us/forestry/invasivetutorial/List.htm

Although this site is for Pennsylvania most of the species featured are also NNIS in Wisconsin. The site provides links to fact sheets and management and control recommendations.

*Garlic mustard (Alliaria petiolata)—Guide for identifying and controlling.*
http://www.for-wild.org/download/garlicmustard.pdf

*Illinois Nature Preserve Management Guidelines.*
http://dnr.state.il.us/INPC/Management_guidelines.htm The information presented gives guidance to landowners, managers, custodians and stewards of sites in the Illinois Nature Preserve Programs on control methods for common invasives.

*Invasive Plants of the Upper Midwest* by Elizabeth J. Czarapata. This book is a comprehensive, fully-illustrated guide to the identification and control of NNIS plant species. Available for purchase at www.ipaw.org.

*Plant Conservation Alliance—Alien Plant Invaders of Natural Areas.*

http://www.nps.gov/plants/alien/factmain.htm This web site features illustrated, easy-to-read fact sheets on select NNIS plants with native ranges; plant descriptions; ecological threats; US

distributions and habitats; background of introductions; plant reproduction and dispersal; management approaches; alternative native plants; and other useful information.

*The Nature Conservancy (TNC)—Weed Control Methods Handbook: Tools and Techniques for Use in Natural Areas.* http://tncweeds.usdavis.edu/handbook.html

The handbook provides detailed information on the use of manual and mechanical techniques, grazing, prescribed fire, biocontrol, and herbicides for use in controlling NNIS in natural areas.

*USDA Forest Service NNIS Program—Control and Management.* http://www.fs.fed.us/invasivespecies/controlmgmt/index.shtml This page provides links for more information on research, management planning, forest service activities, and pest-specific control and management.

*US Forest Service—Dangerous Travelers: Controlling Invasive Plants along America's Roadsides (Video).* http://www.fs.fed.us/invasivespecies/
The video outlines the best management practices that road crews should be following in their day-to-day operations. This is the first in a series on "Best Management
Practices for Invasive Species Prevention." The video can also be ordered on DVD by contacting: USDA Forest Service; San Dimas Technology and Development Center; 444 East Bonita Avenue; San Dimas, CA 91773; (909) 599-1267

*Wisconsin Department of Natural Resources (WDNR). Wisconsin Manual of Control Recommendations: Ecologically Invasive Plants.*

http://www.dnr.state.wi.us/invasives/pubs/intro.htm

**Biocontrol:**

*Invasive Plants of the Eastern U S—Biological Control of NNIS Plants in the Eastern United States. (USDA Forest Service Publication FHTET-2002-04, 413 p.)*
http://www.invasive.org/eastern/biocontrol This web site serves as a reference guide for field workers and land managers concerning the historical and current status of the biological control of select NNIS plants in the eastern United States.

*Cornell University. Biological Control: A Guide to Natural Enemies in North America.* http://www.nysaes.cornell.edu/ent/biocontrol/ This web site provides photographs and descriptions of biocontrol agents of insect, disease and weed pests in North America.

**Grazing:**

*University of Idaho Rangeland Ecology and Management. Targeted Grazing: A Natural Approach to Vegetation Management and Landscape Enhancement.* http://www.cnr.uidaho.edu/rx-grazing/Handbook.htm The handbook outlines the basics of applying targeted grazing for vegetation management. This handbook includes 18 chapters and represents a compilation of the latest research on harnessing livestock to graze targeted vegetation in ways that improve the function and appearance of a wide variety of landscapes.

**Prescribed fire:**

*California Invasive Plant Council—The Use of Fire as a Tool for Controlling NNIS Plants.* http://www.cal-ipc.org/ip/management/UseofFire.pdf

This document contains information on the following: Planning and Implementing Prescribed Burns, Control of NNIS Plant with Prescribed Fire, Using Prescribed Burning in Integrated Strategies, Effects of Fire on Plant Communities, Effects of Fire on Chemical, Physical, and Biotic Properties of Soil.

*Center for Invasive Plant Management (CIPM)—Fire As a Tool for Controlling Nonnative NNIS Plants.* http://www.weedcenter.org/management/burning_weeds.pdf This review focuses on the intentional use of fire, alone or integrated with other methods, to control exotic plants in North America.

*The Nature Conservancy (TNC)—Fire Management Manual.* http://www.tncfiremanual.org/index.htm The manual serves as the Conservancy's guiding document on all aspects of wildland fire management.

*USDA Forest Service—Fire Effects Information System (FEIS).* (http://www.fs.fed.us/databas/feis/). FEIS features a searchable database that summarizes and synthesizes research about living organisms in the United States —their biology, ecology, and relationship to fire.

*Wisconsin Prescribed Fire Council.* http://www.prescribedfire.org/index.html The Wisconsin Prescribed Fire Council strives to make the use of prescribed fire in Wisconsin safer and more accepted for all practitioners. The site provides information and links on government relations, liability, training, weather, and fire implementation.

## *Recreation Appendix B: Mowing Guidance*

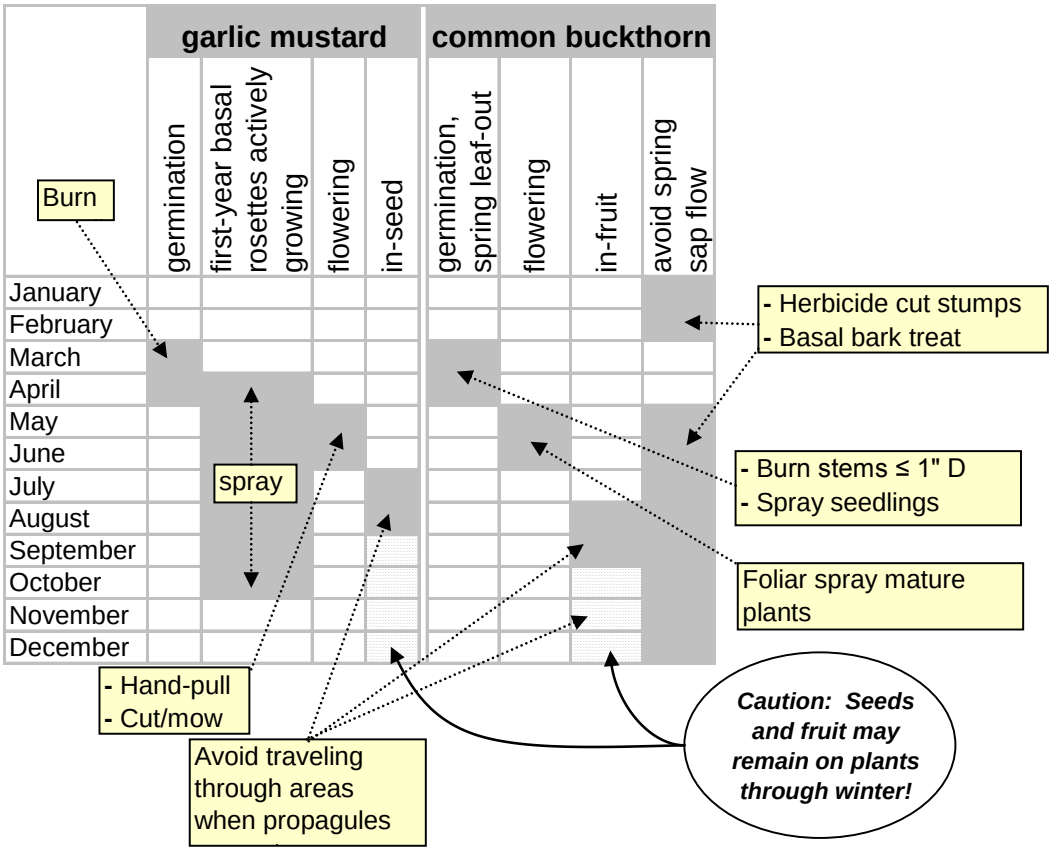
The following suggestions should be evaluated when developing mowing recommendations

- Mowing may be a good choice in places where gully formation is a potential problem for other required management options.
- Use discretion if soil conditions are wet to avoid compaction and damage to sod.
- Always control noxious weeds by spot spraying or spot clipping. This will reduce the potential for unintentional establishment of these species.
- Clean mowing equipment prior to moving out of fields with known noxious weeds or NNIS plant species to avoid spreading seed.

It is highly recommended that mowing be delayed until after September 1, reducing the chance of harming fledgling birds and other young wildlife. Mowing should not be delayed where necessary to control NNIS plant species.

- Verify that NNIS plant species are not present in levels exceeding required treatment thresholds. If treatment is needed, the mowing and/or herbicide application schedule in the NNIS plant species control plan shall be followed.
- Verify that mowing will enhance existing cover.

*Recreation Appendix C: Example Identifying Time Windows for NNIS Management / WISCONSIN*



# Transportation and Utility Rights-of-Way Best Management Practices

## Purpose and Scope Statements

### *Purpose Statement*

This guide describes practices that managers can use to minimize the introduction and spread of NNIS in utility and transportation corridors. The goal is to provide practices that reduce the impact of non-aquatic NNIS.

### *Scope Statement*

The best management practice (BMP) guidelines in this guide are intended to apply to utility and transportation corridor construction and maintenance activities. The use of this guide is voluntary and non-regulatory and is intended to help utility and transportation corridor managers make the most efficient use of limited resources to combat NNIS.

#### When and how will BMPs be implemented?

Effective implementation of BMPs will be a process of continuous learning. These BMPs were developed with the understanding that each situation or entity has different needs and resources. It is important to read this guide with the understanding that flexibility in regard to implementation is part of the structure of the guide. For instance, a BMP may be a general statement, with more specific language in the considerations to help understand the intent of the BMP. Adapting to the BMPs throughout the learning process is also a critical component of properly implementing them. These BMPs recognize extenuating circumstances may arise which would make following the guidelines difficult.

The BMPs identified in this guide are a best attempt to identify effective and realistic practices to integrate into routine right-of-way activities to limit the impact of NNIS. By taking reasonable precautions today, we can help protect the natural integrity of our Forests' landscapes.

This guide recognizes a wide range of possible response options to any NNIS situation. Response options will need to recognize the degree of threat posed by an NNIS, the objectives of the manager, the resources available for additional management activities, and the costs that will be borne by corridor managers as they adopt the BMPs.

Resource management as it is referred to in these BMPs for NNIS relates to the level of effort and type of method necessary to effectively control or eliminate the spread of NNIS during project activities. The level or method of management can be based on the following factors:

1. Day-to-day project activities versus planned projects
2. Size of project
3. Known NNIS in the area
4. Employee training
5. Revegetation options
6. Level or detail of planning

The delegation of responsibility of implementing the BMPs is to be determined by each entity given each situation. See ROW Appendix G for a checklist of responsibilities.

## Cooperative Weed Management Areas

A Cooperative Weed Management Area (CWMA) is a partnership of government organizations, agencies, tribes, individuals, and various interest groups that manage NNIS plants within a defined area. These groups may be available to conduct training sessions, help survey for NNIS, identify priority populations to contain, and assist with management. Most are eager to work with right-of-way (ROW) managers.

A local CWMA may be able to provide assistance in any of the following areas:

- Provide educational opportunities on NNIS identification, and management.
- Keep current on the changing information on NNIS that are a threat to your region
- Identify prairie remnants, rare species and other sensitive areas that should be priorities for keeping weed-free.
- Recommend priority sites and methods for management.
- Identify locations of common NNIS.
- Identify and help control new infestations of NNIS plants that are new to the area, including prohibited plants regulated by NR40.
- Assist with management where appropriate.
- Conduct training sessions and workshops for state, county, municipal and utility staff.
- Act as a point of local contact for any questions or concerns about vegetation management.
- Assist in seeking funding.

## How to use this guide

This guide provides BMPs to aid in preventing the spread of and the management and control of NNIS plants, insects, and diseases. In addition to the specific BMPs, the document contains information to help the user work through a process of assessing the threats posed by NNIS, in order to plan and implement a management strategy. The guide is structured as in the following example:

**Best Management Practice**:

→ **BMP Statement: Invasive species BMPs are in bold font and are set off from the body of the document. These statements are intended to describe voluntary practices that may reduce the impact of NNIS.**

Considerations:

a. BMP Considerations are listed below the BMP Statement.

b. BMP Considerations were written to give more information about why the BMP is important.

c. BMP Considerations introduce items that could be used to address the BMP; they do not apply to every species or situation, and the user does not necessarily have to follow them to address the BMP.

d. BMP Considerations may include details, suggestions, examples, and issues to consider about NNIS and applying the BMP.

### *Beyond the Scope Statement*

There are additional needs in NNIS management that are beyond the scope of this guide. These needs are being addressed by complementary efforts that address forestry practices, recreation, and urban forestry.

Throughout the guide, you will see that the chapters are separated into planning and activity BMPs. The planning BMPs address program and site-specific project planning recommendations for land stewardship activities. Strategic planning may include the development of system wide planning needed to investigate, determine level of effort and program resources needed for effective land management within planned corridors. Education is an integral component of both planning and activity based BMPs and is addressed in each chapter. Project and maintenance "Best Management Practices" are intended as specific guidelines for site-specific projects and maintenance activities.

## Introduction

### *What is a Corridor?*

The landscape is crossed by numerous linear corridors, most of which are used for transportation or utility-type infrastructure. Two terms, corridors and rights-of-way, are both commonly used when referring to these linear features. This guide uses both terms.

Transportation corridors are primarily roads and railroads. The rights-of-way (ROW) for roads are either owned by local or state governments or on easements across private property. Railroad ROWs are usually owned by the railroad company. A roadway consists of the road's pavement and adjacent shoulders. The area extending beyond the shoulders is called the roadside in this document. The roadside can include the outer edges of the underlying foundation for the road, or roadbed, which may require areas to be built-up or cut-out of the native topography. The roadside area (within the highway ROW) also includes drainage ditches, safety zones, and space for signs. Likewise, railroad corridors consist of the rail tracks themselves, the underlying supporting rail bed, space for any embankments or excavations needed to create a level rail surface, and space buffers with adjoining properties.

The utility-type corridors are used for a variety of lines and pipelines. Lines can be underground or above ground and used for transmitting electricity or telecommunications signals. Pipelines include natural gas, crude oil and refined petroleum products, water, and sewer pipelines. For simplicity's sake, the general term "utility line" is used in this document to refer to this whole group of lines and pipelines. Utility lines cross private lands on easements or are within publicly-owned road ROW. The line owner must obtain easements from the private landowners allowing the line to be built, operated and maintained on those properties, while governmental permits are needed for utility lines located in road ROW. A utility line ROW across private lands includes space for the line itself along with additional space buffering the line from nearby buildings and tall vegetation.

An easement gives a utility certain rights to build and maintain lines and pipelines. In some cases, these limited rights may inhibit its options for preventing the introduction and spread of NNIS.

The construction, operation and maintenance of transportation and utility corridors can lead to the introduction and spread of NNIS, which is discussed in the remainder of this document. Lands for access, staging areas, and laydown areas used for construction and maintenance of the corridors are also included in the scope of this guide.

Another group of linear corridors, recreational trails used by off road vehicles, bikes and pedestrians are discussed in a separate document on Recreation Best Management Practices.

## *What are Non-native Invasive Species (NNIS)?*

NNIS plants, animals, and microorganisms found outside of their natural range can become invasive. The majority of NNIS are harmless because they do not reproduce or spread abundantly in their new surroundings. However, a small percentage of NNIS can harm the economy, ecology, or human health in their new environment. These species thrive because they become established quickly, tolerate a wide range of conditions, are easily dispersed, and are no longer controlled by the diseases, predators, and parasites that kept their populations in check in their native range.

NNIS are nonindigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health. Non-native species include hybrids, cultivars, subspecific taxa, and genetically modified variants whose introduction causes or is likely to cause economic or environmental harm or harm to human health, and includes individual specimens, eggs, larvae, seeds, propagules and any other viable life-stages of such species.

NNIS cause a wide range of damages. For example, Wisconsin's three top industries – forestry, agriculture, and tourism are all heavily impacted by NNIS. NNIS plants take over forest floors and understories, eliminating native tree regeneration. They degrade pastures and crops and threaten the few remaining remnants of prairies and savannas left in Wisconsin. NNIS insects and pathogens kill forest and landscape trees and decrease yield in forests and in our agricultural crops. Several of the NNIS plants that spread from roadsides into adjacent pastures and farm fields are toxic to cattle. Hunting and hiking lands can become impassable as NNIS shrubs spread. Aquatic NNIS can make most water sports very difficult, and can severely impact fish habitat. Introduced organisms are the second greatest cause, after habitat destruction, of native species endangerment and extinction worldwide.

Whether intended or unintended, human actions remain the primary means of NNIS introductions. Introduced organisms are the second greatest cause, after habitat destruction, of species endangerment and extinction worldwide. An increased level of awareness will be necessary to prevent their spread, including ongoing education on NNIS identification and management.

The creation and upkeep of transportation and utility corridors results in soil and vegetation disturbance, along with the movement of people and vehicles along the corridors. These actions can contribute to the spread of NNIS. Whether intended or unintended, human actions remain the primary means of NNIS introductions.

Transportation and utility corridors act as conduits in which NNIS spread. Additional concerns with spreading NNIS along corridors include increased cost of corridor maintenance, compromised visibility and safety, and increased threat of wildfires.

This guide has been divided into four main sections that entail most activities along utility and transportation corridors.

1. Soil disturbance
2. Vegetation management and inspection / monitoring
3. Transport of materials
4. Revegetation and restoration

In addition, there are several appendices that provide additional information for right-of-way managers.

# Soil Disturbance

Soil disturbance is meant to describe any situation where soil is disturbed, including disturbance from excavation, vehicular traffic, soil displacement, etc. It includes any activity where soil is moved, removed, or brought in. Disturbed soil is often just what an NNIS needs to get started. Stabilizing the disturbance as soon as possible to prevent the germination and growth of NNIS is critical.

## *Soil Disturbance BMPs*

### Planning

**BMP SD 1: Prior to implementing activities inventory for, locate and document NNIS infestations.**

**BMP SD 2: Consider the need for actions based on: (1) the degree of invasiveness; (2) severity of the current infestation; (3) amount of additional habitat or hosts at risk for invasion; and, (4) feasibility of control with available methods and resources.**

**BMP SD 3: Plan activities to limit the potential for introduction and spread of NNIS, prior to construction.**

**BMP SD 4: Provide appropriate resources in identification of known NNIS for corridor workers.**

### Activities

**BMP SD 5: Minimize soil disturbance which may include using existing roads, access points, staging areas and/or alternative construction methods.**

**BMP SD 6: Avoid NNIS populations when feasible and minimize the spread of NNIS during soil disturbance activities.**

**BMP SD 7: Prior to moving equipment out of an infested area and then into an uninfested area, clean soils, seeds, plant parts, or invertebrates from exterior surfaces, to the extent practical, to minimize the risk of transporting propagules.**

**BMP SD 8: Stabilize disturbed soils using erosion control/stormwater management technical standards as soon as possible.**

**BMP SD 9: Use locally native seed or non-invasive, annual cover crops for revegetation.**

### Planning

→**BMP SD 1: Prior to implementing activities inventory for, locate and document NNIS infestations.**

Considerations:

Knowing which NNIS are present, and where they are located is necessary in evaluating threats. The following are some steps to consider when inventorying for NNIS.

a. Where feasible, integrate inventory of NNIS into normal inventory and monitoring.

b. The extent and intensity of inventorying should be appropriate to the threat posed by NNIS in or likely in the area, and by the potential effect of activities on the further spread, release, or management of those species.

c. The extent and intensity of inventory should be appropriate to the size of the property/project, type of activity and its degree of disturbance.

d. Inventory can occur both within and around the activity area.

e. Inventory for NNIS plants should occur at likely introduction sites such as access points, lay-down areas, and staging areas.

f. Inventory may also include consulting with resource managers to identify threats from NNIS plants, insects, or disease within the corridors.

g. Provide training and identification. (See also BMPs SD-4 and VM-4.)

h. Encourage corridor workers to report NNIS findings.

i. Coordinate among multi-use entities for the same project area.

j. Refer to ROW Appendices A, B, and H to find resources to help find out what NNIS species are in your area.

→**BMP SD 2: Consider the need for actions based on: (1) the degree of invasiveness; (2) severity of the current infestation; (3) amount of additional habitat or hosts at risk for invasion; and, (4) feasibility of control with available methods and resources.**

Considerations:

Whenever possible and consistent with project and scale objectives a threat assessment is the next step in identifying and mapping the NNIS present on the corridors, and operations and management modified to address further spread.

a. Degree of invasiveness –

   Some NNIS are able to invade habitats and hosts rapidly. Species that reproduce frequently and in high numbers, mature quickly, and have multiple ways of dispersing tend to be more NNIS. These species often pose a greater immediate threat than those with less invasive tendencies.

b. Severity of current infestation–

   Areas with severe infestations will have a lower threat level than adjacent areas with little or no infestation. Project plans should minimize movement from infested to no infested project areas. (See also Section 4: Transport of Materials)

c. Assess additional habitat or hosts at risk from NNIS–

   On properties where an NNIS is present in only part of the area, or its arrival is imminent, the threat level will be higher if there is additional suitable habitat (for plants), or host species (for insects and diseases) that can be invaded. Consider the corridor and adjacent lands.

d. Feasibility of control–

Controlling NNIS may be difficult and expensive. Consider control options and costs, as well as consequences and costs of not taking action. For species that do little damage, control may not be warranted. For large existing infestations, the level of effort required may be prohibitive. It is often more feasible to control small or intermediate infestations. For relatively small infestations of extremely damaging species, control is cost-effective in the long-term.

e. The potential for the intended activity to further spread the NNIS.

f. Allocate time and resources for post-treatment follow-up control measures, due to persistent seed bank and resprouting for several years.

→**BMP SD 3: Plan activities to limit the potential for introduction and spread of NNIS, prior to construction.**

Considerations:

Activity planning may include developing budgets, schedules, and management prescriptions. The planning phase allows for consideration and precautions to be taken if NNIS are present.

a. Consider the likely response of NNIS or target species when prescribing activities that result in soil disturbance or increased sunlight.

b. Timing for species control

- Consider the need for NNIS control efforts; determine whether planned control efforts should occur prior to, after or concurrent with the activity.
- Consider pre-treatment of NNIS, and postpone activity until an infestation can be treated. Effective pre-treatment may need to occur prior to soil disturbance.
- Consider seasonal timing that will minimize introduction and movement of NNIS.
- Opt out of activities where the spread of NNIS will likely jeopardize sensitive habitat.

c. Cleaning

- Plan for appropriate cleaning of equipment to limit the introduction and spread of NNIS. Make prior arrangements for cleaning that may be needed in conjunction with corridor activities. Consider the risks different types of equipment pose for the introduction and spread of NNIS.

d. Boundaries

- Position activity boundaries that exclude areas infested with NNIS.

e. Scheduling

- Consider the sequence of operations within an activity area. When feasible, plan to enter areas infested with NNIS last.

f. Ground Disturbance

- Where feasible, avoid creating soil and site conditions that promote NNIS plant germination and establishment. Minimize soil disturbance to no more than needed to meet corridor project objectives.
- Consider the impacts of different types of equipment where feasible. Plan to use equipment that minimizes soil and vegetation disturbance.
- Retain soil and native vegetation in and around the activity area to the greatest extent possible.

→**BMP SD 4: Provide appropriate resources in identification of known NNIS for corridor workers.**

Considerations:

a. Learn to identify locally important NNIS.

b. See ROW Appendices A, B, and H for additional resources

## Activities

**BMP SD 5: Minimize soil disturbance which may include using existing roads, access points, staging areas and/or alternative construction methods.**

Considerations:

NNIS plants could rapidly colonize areas of disturbed soil.

a. Determine the amount of necessary disturbance based on scale and intensity.

b. After a soil disturbance, encourage prompt regeneration of desirable vegetation or cover exposed soil with a layer of mulch to reduce germination or introduction of NNIS plants.

c. Ground disturbance may uproot existing vegetation and expose soil, creating a seedbed for NNIS plants that can overwhelm desirable vegetation.

d. After a soil disturbance, monitor the area and treat new NNIS plant infestations (see also BMP VM - 11).

→**BMP SD 6: Avoid NNIS populations when feasible and minimize the spread of NNIS during soil disturbance activities.**

Considerations:

a. Avoid potential adverse impacts related to NNIS.

b. Excavated material from areas containing NNIS may be reused within the exact limits of the infestation.

c. Excavated material that contains NNIS plant material and is not reused within the limits of the infestation may be stockpiled until the remaining NNIS plant material is destroyed.

d. Berm top soils: rather than importing topsoils with potential seed banks, berm existing topsoils along the perimeter of the project for later use.

→**BMP SD 7: Prior to moving equipment out of an infested area and then into an uninfested area, clean soils, seeds, plant parts, or invertebrates from exterior surfaces, to the extent practical, to minimize the risk of transporting propagules.**

Considerations:

a. Methods of cleaning include any one of the following, but are not limited to: (use most effective method that is practical)

   - Brush, broom, or other hand tools (used without water)
   - Carwashes
   - High pressure air (some equipment may have air tank, leaf blower)
   - Steam cleaning
   - Portable wash station that contains runoff from washing equipment
     *Note: Containment must be in compliance with wastewater discharge regulations, See ROW Appendix I, Accompanying Regulations, for more details.*

b. Clean equipment at the shop during routine equipment maintenance activities.

c. Preferred locations for cleaning are those where:

   - NNIS are already established or as near as practical to the infested area
   - Areas that are easily monitored and controlled, if necessary, for new infestations due to the cleaning activity, i.e., along an already infested road, at access points.

d. Do not clean equipment, vehicles or trailers in or near waterways as it may promote the spread of NNIS downstream.

e. Make prior arrangements to clean equipment in conjunction with the specific activity. Risk consideration varies with equipment types, with possible introduction and spread of NNIS.

→**BMP SD 8: Stabilize disturbed soils using erosion control/stormwater management technical standards as soon as possible.**

Considerations:

a. Use weed-free mulch.

b. Use weed-free sand and gravel.

c. See ROW Appendix H for additional resources.

d. Weed free materials may not be necessary for buried layers.

→**BMP SD 9: Use locally native seed or non-invasive, annual cover crops or revegetation.**

Considerations:

a. Use a non-persistent, annual cover crop, such as annual rye or oats that can be used to temporarily stabilize the soil, and discourage the establishment of NNIS.

b. Use weed-free locally appropriate seed mixes.

c. Use weed-free mulch.

d. Do not plant NNIS.

*e*. See also Vegetation Management and Inspection/Monitoring, Transport of Materials, and Revegetation and Landscaping sections.

f. See ROW Appendix D, Mowing Timing Guidance

# Vegetation Management and Inspection/Monitoring BMPs

## *Introduction*

Vegetation Management activities include, but are not limited to: mowing; guide clearing and trimming; mechanized clearing and trimming; herbicide application; burning (brush and prescribed); inspections; and monitoring. Some key concepts to prevent the introduction and spread of NNIS are discussed below.

### Early Detection and Rapid Response

Since the chances of controlling an NNIS are greatest immediately after introduction, early detection and rapid response are an important part of managing NNIS. **Early Detection** uses a comprehensive surveillance system to locate new populations of NNIS early when control is still feasible and less costly. Detection targets a) areas where introductions are likely, such as access points and travel corridors, b) areas with high ecological value, and c) vulnerable habitats or recently disturbed areas. **Rapid response** is a systematic effort to contain and control NNIS while the infestation is localized. Having a prioritized management plan will provide the most effective, organized, and efficient response to a new introduction or infestation.

### Control

Early detection and rapid response are critical to catching and containing new populations of NNIS plants. These may be new invaders to the area or new populations that are just starting. These are often just a few plants and can be easily removed prior to setting seed. This immediate control when the plants are first spotted can prevent costly outbreaks in the future. When populations are widespread or large and resources are limited, a more realistic management goal is to control the NNIS by reducing their populations to levels that will allow native species to thrive. For most plants this level of control is aimed at preventing seed production and spread. Control programs are usually ongoing and can include guide, mechanical, chemical, biological, and cultural components. Property owners and land managers should evaluate their site and life cycle characteristics of the NNIS to determine which control methods will be the most effective and economical while minimizing negative environmental impacts. There are many good resources to provide guidance on species control methods. (See ROW Appendix C.)

### Mowing

Preventing seed dispersal is crucial for preventing the spread of many NNIS. Mowing should be carefully considered to ensure that NNIS will not actually be spread by the practice. Timing of mowing is the most important factor in spreading seeds. If weeds are mowed after they have started to develop seeds, it is likely they will be spread extensively with mowing. Mowing prior to flowering or at the very early flowering stages will minimize the spread of maturing seed. Some species, such as garlic mustard, will continue developing seeds after the tops of the plants have been cut. Use of a mower that shreds the clippings will be more effective on such plants.

Some NNIS plants have the ability to sprout from stem and root fragments. Mowing these plants should be avoided whenever possible. Consider staking populations of these plants as "do not mow."

In areas where NNIS plants occur, an attempt should be made to mow the right-of-way prior to seed maturation. This could be accomplished by identifying specific roads that are either heavily infested with NNIS plants or roads that are in sensitive habitat areas, and making those roads a priority in the mowing schedule.

### Monitoring

Monitoring sites after activities may detect new or re-invasions early and help to evaluate the success of NNIS control efforts. Monitoring inspections can be integrated with other activities like ROW inspections and should be kept as simple as possible to meet NNIS management objectives. While monitoring sites for known NNIS, be alert for emerging NNIS threats like the Prohibited species (listed in ROW Appendix A) that may move into the area.

## *Vegetation Management and Inspection/Monitoring BMPs*

### Planning

**BMP VM 1: Prior to implementing activities inventory for, locate and document NNIS infestations.**

**BMP VM 2: Plan activities to limit the potential introduction and spread of NNIS, prior to construction.**

**BMP VM 3: Assess available resources and seek new resources to prevent NNIS spread.**

**BMP VM 4: Provide training in identification, control and prevention of known NNIS to employees and contractors performing vegetation management activities.**

### Activities

**BMP VM 5: Prior to moving equipment out of an infested area and then into an uninfested area, clean soils, seeds, plant parts, or invertebrates from exterior surfaces, to the extent practical, to minimize the risk of transporting propagules.**

**BMP VM 6: Inspect and clean clothing, footwear and gear for soils, seeds, plant parts, and invertebrates before and after activities.**

**BMP VM 7: Properly dispose of soils, seeds, plant parts or invertebrates found during inspection and cleaning.**

**BMP VM 8: Locate and use staging areas that are free of NNIS plants to avoid spreading seeds and other viable plant parts.**

**BMP VM 9: Consider the likely response of NNIS when conducting activities that result in disturbed soil, increased sunlight, fire, etc.**

**BMP VM 10: Ensure that NNIS control treatments are applied within the appropriate time window.**

**BMP VM 11: Monitor right-of-ways during day-to-day activities and post-management activities; determine necessary treatments based on the presence of NNIS.**

## Planning

**→BMP VM 1: Prior to implementing activities inventory for, locate and document NNIS infestations.**

Considerations:

a. Where feasible, integrate inventory of NNIS into normal inventory and monitoring.

b. The extent and intensity of inventory should be appropriate to the threat posed by NNIS in or likely in the area, and by the potential effect of activities on the further spread, release, or management of those species.

c. The extent and intensity of inventorying should be appropriate to the size of the property/project, type of activity and its degree of disturbance. Inventory can occur both within and around the activity area.

d. Inventory can occur both within and around the activity area.

e. Inventory for NNIS plants should occur at likely introduction sites such as access points, lay-down areas, and staging areas.

f. Inventory may also include consulting with resource managers to identify threats from NNIS plants, insects, or disease within the corridors.

g. Provide training and identification (see also BMP VM-4).

h. Encourage corridor workers to report NNIS findings.

i. Coordinate among multi-use entities for the same project area.

**→BMP VM 2: Plan activities to limit the potential introduction and spread of NNIS, prior to construction.**

Considerations:

a. Consider the need for NNIS control efforts and determine whether planned control efforts should occur before, during, or after the primary activity.

b. If pre-treatment of NNIS is necessary, postpone activity until the infestation can be treated. Effective pre-treatments sometimes need to occur one to two years prior to the activity.

c. Develop seasonal timing schedules for vegetation management to minimize the spread of NNIS at the local level.

d. See ROW Appendix D, Mowing Guidance, and ROW Appendix E, Invasive Species Time Window, as well as Timing for Species Control in the Soil Disturbance section.

e. Carry out work under conditions that minimize the risk of spread, e.g., frozen ground, snow cover, absence of seeds/propagules, etc. (See ROW Appendix E for a sample "Example Identifying Time Windows for Invasive Species Management.")

→**BMP VM 3: Assess available resources and seek new resources to prevent NNIS spread.**

Considerations:

a. Available resources include facilities, equipment, finances, and human resources.

b. Identify local and regional partners, such as Cooperative Weed Management Areas, with whom you may collaborate and share resources.

c. Assess information on grants, funding, and organizations.

→**BMP VM 4: Provide training in identification, control and prevention of known NNIS to employees and contractors performing vegetation management activities.**

Considerations:

a. Visit website resources and read guides, brochures, and pamphlets that refer to identification and control of NNIS.

b. Pay attention to signage at infested areas and trailheads, (e.g. "this is a picture of garlic mustard; you will see it along the west side of the trail")

c. Provide information about where to report sightings of NNIS and locations of new infestations.

d. Post informational items at places such as access points, shops, and work trailers.

e. See ROW Appendix H, Resources.

f. See ROW Appendix D, Mowing Timing Guidance.

## Activities

For each specific management activity undertaken, first inventory and document any NNIS present. Then conduct a risk assessment; consider threats to the property and identify options for managing NNIS. Limiting the potential spread and introduction of NNIS may include control efforts.

→**BMP VM 5: Prior to moving equipment out of an infested area and then into an uninfested area, clean soils, seeds, plant parts, or invertebrates from exterior surfaces, to the extent practical, to minimize the risk of transporting propagules.**

Considerations:

a. Equipment includes but is not limited to vehicles, trailers, machinery and materials.

b. Methods of cleaning include any one of the following, but are not limited to: (use most effective method that is practical)

   - Brush, broom, or other hand tools (used without water)
   - Carwashes
   - High pressure air (some equipment may have air tank, leaf blower)
   - Steam cleaning
   - Portable wash station that contains runoff from washing equipment
     Note: Containment must be in compliance with wastewater discharge regulations, See ROW Appendix I: Accompanying Regulations for more details.

c. Clean in an area that is easily accessible for monitoring and control if necessary.

d. Clean equipment at the shop during routine equipment maintenance activities.

e. Preferred locations for cleaning are those where:

   - NNIS are already established or as near as practical to the infested area
   - Areas that are easily monitored and controlled, if necessary, for new infestations due to the cleaning activity, i.e. along an already infested road, at access points.

f. Do not clean equipment, vehicles or trailers in or near waterways as it may promote the spread of NNIS downstream.

→**BMP VM 6: Inspect and clean clothing, footwear and gear for soils, seeds, plant parts, and invertebrates before and after activities.**

Considerations:

a. Especially when moving from infested to uninfested sites.

b. Plan for appropriate cleaning of clothing, footwear, and gear and inform workers about possible seeds carried on their clothing, footwear and gear.

c. Carry appropriate equipment (i.e. wire brush, small screwdriver, boot brush) to help remove soils, seeds, plant parts, seeds and invertebrates.

d. Preferred locations for cleaning are those where:

   - NNIS are already established.
   - Areas that are easily monitored for new infestations due to the cleaning activity, i.e., along a road, at access points.

e. Do not clean clothing, footwear, gear in or near waterways – it may promote the spread of NNIS species downstream.

f. Make prior arrangements to clean equipment in conjunction with the specific activity. Risk consideration varies with equipment types, with possible introduction and spread of NNIS.

**BMP VM 7: Properly dispose of soils, seeds, plant parts or invertebrates found during inspection and cleaning.**

Considerations:

a. Onsite disposal within an infested area is an option.

b. Place materials in a bag and send to landfill, where possible.

c. Materials may be composted but only if the compost pile reaches very high temperatures and the finished compost can be monitored for weed emergence.

d. Materials may be disposed of in piles. Locate the pile in an area that facilitates easy monitoring and control if infestations spread from the pile.

e. Materials may be burned. Locate the burn pile in an area that facilitates easy monitoring and control if infestations spread from the pile.

→**BMP VM 8: Locate and use staging areas that are free of NNIS plants to avoid spreading seeds and other viable plant parts.**

Considerations:

a. Set up activity boundaries to exclude areas with an NNIS infestation that could easily be disturbed by equipment, workers, or users.

b. Consider options for the sequence of operations within an activity area, and where feasible, plan to enter areas infested with NNIS last.

→**BMP VM 9: Consider the likely response of NNIS when conducting activities that result in disturbed soil, increased sunlight, fire, etc.**

Considerations:

a. Ground disturbance may uproot existing vegetation and expose soil, creating a seedbed for NNIS plants that can overwhelm native vegetation.

b. Mechanical means of soil disturbance, when combined with aggressive follow-up control measures, may be used to control NNIS within infested areas by depleting the seed bank.

c. After a soil disturbance, encourage prompt regeneration of desirable vegetation to limit introduction of NNIS.

d. After a soil disturbance, monitor the area and treat new NNIS plant infestations.

e. Consider options for the sequence of operations within an activity area. If feasible, enter the activity area which is infested with NNIS last.

f. Locate debris burn piles in an area that minimizes the NNIS plant establishment.

g. Incorporate NNIS considerations into the planning of prescribed burns.

**→BMP VM 10: Ensure that NNIS control treatments are applied within the appropriate time window.**

Considerations:

a. Consider the need for NNIS control efforts, and determine whether planned control efforts should occur prior to, after, or parallel with the primary activity.

b. When planning vegetation management activities, consider the need for NNIS control efforts and minimizing their spread. Time the vegetation management efforts to maximize control of the target NNIS in the area. ROW Appendix D provides guidance for timing of mowing for widespread NNIS. Adjust this schedule to your local area. Recognize that there are annual differences in phenology as well.

c. If pre-treatment of NNIS is warranted prior to a planned construction or maintenance project, postpone activity until the infestation can be treated. Effective pre-treatments sometimes need to occur one to two years prior to the activity.

d. Consider seasonal timing options to minimize the spread of NNIS, while still achieving management objectives, such as just prior to flowering or late in the season when seeds have already dropped.

e. Options include choosing not to carry out activities where spread of NNIS will likely jeopardize property goals and uses.

f. Consider life history of target NNIS in relation to timing of control methods (See ROW Appendix E for a sample "Example Identifying Time Windows for Invasive Species Management") chart; also see mowing considerations below.

g. Allow time and resources for post-treatment follow-up control measures, due to persistent seed bank and resprouting for several years. In some areas a second mowing may be necessary if the NNIS are beginning to flower a second time.

**→BMP VM 11: Monitor right-of-ways during day-to-day activities and post-management activities; determine necessary treatments based on the presence of NNIS.**

Considerations:

a. Monitor the site following a management activity, and check for new infestations of NNIS, or the spread of existing populations.

b. Revegetation and/or restoration if necessary, depending on site conditions.

c. Conduct periodic inspections of each site following a management activity. Anticipate response of NNIS to activities and check for new infestations or the spread of existing populations.

d. Determine appropriate control measures to respond to new infestations or spreading populations; continue monitoring.

e. Monitor areas where there were burn piles in order to preclude NNIS from establishment.

f. Incorporate NNIS considerations into the planning of prescribed burns.

g. Plan ahead to obtain resources for monitoring and for management if necessary.

# Transport of Material

Movement of materials such as: soil; mulch (woody and straw); aggregate; wood products (e.g., firewood, brush, etc.), landscape material (e.g., plants, seed, etc.), erosion control materials (e.g. silt fence, hay bales, geotextile, etc.), and packing/shipping materials have the potential to spread NNIS

## *Transport of Materials BMPs*

**BMP TM 1: Take steps to avoid the movement of NNIS to non-infested areas during transport activities**

**BMP TM 2: Prior to transporting materials, manage the load to limit the spread of NNIS**

**BMP TM 3: Prior to moving equipment out of an infested area and then into an uninfested area, clean soils, seeds, plant parts, or invertebrates from exterior surfaces, to the extent practical, to minimize the risk of transporting propagules**

**BMP TM 4: Dispose of soils, seeds, plant parts or invertebrates found during inspection and cleaning**

**BMP TM 5: Establish staging areas and temporary facilities in locations that are free of NNIS**

**BMP TM6: Use soil and aggregate material from sources that are free of NNIS**

**BMP TM 7: Manage stock piles to limit the spread of NNIS**

**BMP TM 8: Do not transport woody material that may contain NNIS**

**BMP TM 9: If you must transport woody material that may contain NNIS, bring them to a designated area for appropriate disposal**

**BMP TM 10: Keep and reuse onsite materials rather than importing new materials**

→**BMP TM 1: Take steps to avoid the movement of NNIS to non-infested areas during transport activities.**

Considerations:

a. To minimize movement of live plant parts or viable seed, consider excluding infested areas from equipment travel corridors and staging areas.

b. Carry out work under conditions that minimize the risk of spread, *e.g.*, frozen ground, snow cover, seed/propagules absence, etc.

c. Take reasonable steps to avoid small, isolated, populations of NNIS during transport activities.

d. If existing access roads are infested with NNIS, treat before using them.

e. Avoid constructing new access roads in areas infested with NNIS where possible.

f. Limit the number, width, and length of roads to help minimize soil disturbance, and to limit the risk of unintentionally transporting NNIS on equipment into uninfested areas.

→**BMP TM 2: Prior to transporting materials, manage the load to limit the spread of NNIS.**

Considerations:

a. Secure the load using methods such as tarps, rope or plastic sheets.

b. Reduce exposure of materials to weather elements that have the likelihood of spreading NNIS insects, diseases and propagules. (i.e., dumping infested soil in high winds)

c. Remove loose materials from side boards and tailgate prior to transport.

→**BMP TM 3: Prior to moving equipment out of an infested area and then into an uninfested area, clean soils, seeds, plant parts, or invertebrates from exterior surfaces, to the extent practical, to minimize the risk of transporting propagules.**

Considerations:

a. Methods of cleaning include any one of the following, but are not limited to: (use most effective method that is practical)

   - Brush, broom, or other hand tools (used without water)
   - Carwashes
   - High pressure air (some equipment may have air tank, leaf blower)
   - Steam cleaning
   - Portable wash station that contains runoff from washing equipment
     *Note: Containment must be in compliance with wastewater discharge regulations, See ROW Appendix I, Accompanying Regulations, for more details.*

b. Clean in an area that is easily accessible for monitoring and control if necessary.

c. Clean equipment at the shop during routine equipment maintenance activities.

d. Preferred locations for cleaning are those where:

   - NNIS are already established or as near as practical to the infested area
   - Areas that are easily monitored and controlled, if necessary, for new infestations due to the cleaning activity, i.e., along an already infested road, at access points.

e. Do not clean equipment, vehicles or trailers in or near waterways as it may promote the spread of NNIS downstream.

f. Make prior arrangements to clean equipment in conjunction with the specific activity. Risk consideration varies with equipment types, with possible introduction and spread of NNIS.

**→BMP TM 4: Dispose of soils, seeds, plant parts or invertebrates found during inspection and cleaning.**

Considerations:

a. Preferred locations for equipment cleaning areas are those where: equipment is unloaded and loaded and where NNIS are already established.

b. Do not clean equipment, vehicles or trailers in or near waterways – it may promote the spread of NNIS downstream.

***c.*** Materials may be composted but only if compost pile temperature reaches very high temperatures and the finished compost can be monitored for weed emergence.

***d.*** Do not dispose of soils, seeds, debris or invertebrates down a storm drain; place in plastic bags in the trash, or incinerate.

e. Burying the propagules may be an option if deep enough to prevent regeneration.

f. Clean transporting equipment prior to new load; consider using a liner if applicable.

g. Consider tracking pads as a means to remove soil from equipment. If tracking pads are used they need to be thoroughly cleaned.

**→BMP TM 5: Establish staging areas and temporary facilities in locations that are free of NNIS.**

Considerations:

a. If infested areas can't be avoided, consider pre-treatment as an option. Follow specifications in Vegetation Management and Inspection/Monitoring section.

**→BMP TM 6: Use soil and aggregate material from sources that are free of NNIS.**

Considerations:

a. Inspect the sources or specify in a contract or work order that the source is free of NNIS.

b. Option to use infested materials below uninfested material for the top if applicable.

**→BMP TM 7: Manage stock piles to limit the spread of NNIS.**

Considerations:

a. The first step is to plant cover crops to prevent the establishment of NNIS.

b. Mechanically disturb stockpiled soil to prevent growth of NNIS.

c. Cover exposed piles of soil or construction materials with plastic sheeting.

d. See the Soil Disturbance  section for additional guidance

**→BMP TM 8: Do not transport woody material that may contain NNIS.**

Considerations:

a. Consider chipping, burying or burning where allowed.

b. Be aware of quarantine areas and other restrictions on the movement of materials.

c. A quarantine is a system of rules administered by the USDA Animal and Plant Health Inspection Service and the WI Department of Agriculture, Trade and Consumer Protection.

For an example of an NNIS insect that may be transported by woody material, see: Wisconsin's Emerald Ash Borer Resource. http://emeraldashborer.wi.gov/ This site includes information on surveys, detection, and management, and includes an email address and phone number to report suspected infestations.

**→BMP TM 9: If you must transport woody material that may contain NNIS, bring them to a designated area for appropriate disposal.**

Considerations:

a. Designate an area for dumping woody material if it is infested with NNIS.

b. Prior to movement, identify whether material contain NNIS.

c. Pre-treat woody material prior to movement (more insect and disease related).

d. Consider end source of woody material before disposal (i.e., brush to chip, chip to mulch, bio-fuels)

e. Remove soil from stumps and trees.

**→BMP TM 10: Keep and reuse onsite materials rather than importing new materials.**

Considerations:

a. Consider keeping materials on-site to limit transport.

b. Remove soil and plant material from waste (concrete, packing materials, etc.) before transport.

c. Check shipping/packing materials for NNIS plant materials

d. See ROW Appendix H, Resources

e. Follow current state regulations on Invasive Species and monitoring.

**Aquatic Invasive Species:** To prevent the spread of aquatic NNIS, avoid moving water from one water body to another. This may include cleaning equipment that comes in contact with water infested with NNIS. For example, any equipment that draws water from one water body should not be drained into another water body. Part of general maintenance, equipment, portable pumps and hoses, should be flushed and run with clean water between uses. Also, water bodies with particularly virulent diseases (e.g. Viral Hemorrhagic Septicemia) should be recognized and operations adjusted to avoid transporting the disease. For more information see ROW Appendix I.

# Revegetation and Restoration

Very few disturbed areas will regenerate satisfactorily in a reasonable time without assistance. A properly managed revegetation program can ensure the effective return of the land to a self-sustaining condition. Revegetation should establish a sound basis for the ecosystem to develop over time. Site specific revegetation should address site preparation, species selection, and overall maintenance of the area. The activities to reduce NNIS are intended to compliment other practices addressing such things as erosion control, proper drainage, and protecting the initial investment in the infrastructure

It is recognized in this guide that there is overlap within cities, towns and villages in regard to revegetation within rights-of-way. The following BMPs for Revegetation were developed to accomplish these goals and are provided in greater detail below:

## *Revegetation and Landscaping BMPs*

### Planning

**BMP RV 1: Plan activities to limit the potential introduction and spread of NNIS, prior to revegetation.**

**BMP RV 2: Select locally native species for revegetation and restoration activities.**

### Activities

**BMP RV 3: Inspect and clean clothing, footwear and gear for soils, seeds, plant parts, or invertebrates before and after activities.**

**BMP RV 4: Prior to moving equipment out of an infested area and into an uninfested area clean soil and debris from exterior surfaces, to the extent practical, to minimize the risk of transporting propagules.**

**BMP RV 5: Revegetate disturbed soils as soon as feasible to minimize NNIS establishment.**

**BMP RV 6: Allow natural revegetation of the ground layer to occur only where site conditions permit.**

**BMP RV 7: Ensure the species specified in the plan are the ones being used.**

**BMP RV 8: Monitor the revegetation site for NNIS.**

### Planning

→**BMP RV 1: Plan activities to limit the potential introduction and spread of NNIS, prior to revegetation.**

Considerations:

a. Provide training in identification of locally known NNIS plants and pests to workers onsite.

b. Evaluate the level of infestation and land use on adjacent properties when planning revegetation.

c. Site preparation: think about the timing of activities to ensure the revegetation works.

d. Surface preparation should serve to optimize plant establishment and minimize soil erosion.

e. Have a detailed revegetation and landscaping plan and specify the timeline of monitoring.

→**BMP RV 2: Select locally native species for revegetation and landscaping activities.**

Considerations:

a. Identify sources of locally native materials.

b. When seeding and/or planting, use non-invasive, annual cover crops, or locally native seed or plants.

c. Prior to planting make sure seed chosen will not negatively impact the vegetation on adjacent land.

## Activities

→**BMP RV 3: Inspect and clean clothing, footwear and gear for soils, seeds, plant parts, or invertebrates before and after activities.**

Considerations:

a. Plan for appropriate cleaning of clothing, footwear, and gear and inform workers about possible seeds carried on their clothing, footwear and gear.

b. Carry appropriate equipment (i.e. wire brush, small screwdriver, boot brush) to help remove soil, plant parts, seeds and insects.

c. Preferred locations for cleaning are (1) those where NNIS are already established, and (2) areas that are easily monitored for new infestations due to the cleaning activity, i.e., at access points.

→**BMP RV 4: Prior to moving equipment out of an infested area and into an uninfested area clean soil and debris from exterior surfaces, to the extent practical, to minimize the risk of transporting propagules.**

Considerations:

a. Methods of cleaning include any one of the following, but are not limited to: (use most effective method that is practical)

   - Brush, broom, or other hand tools (used without water)
   - Carwashes
   - High pressure air (some equipment may have air tank, leaf blower)
   - Steam cleaning
   - Portable wash station that contains runoff from washing equipment
     Note: Containment must be in compliance with wastewater discharge regulations, See ROW Appendix I, Accompanying Regulations,for more details.

b. Preferred locations for cleaning are those where:

   - NNIS are already established or as near as practical to the infested area

- Areas that are easily monitored and controlled, if necessary, for new infestations due to the cleaning activity, i.e., along an already infested road, at access points.

c. Clean equipment at the shop during routine equipment maintenance activities.

d. Do not clean equipment, vehicles or trailers in or near waterways as it may promote the spread of NNIS downstream.

e. Make prior arrangements to clean equipment in conjunction with the specific activity. Risk consideration varies with equipment types, with possible introduction and spread of NNIS.

→**BMP RV 5: Revegetate disturbed soils as soon as feasible to minimize NNIS establishment.**

Considerations:

a. Prior to revegetating disturbed soils, inventory for and manage NNIS germinating or resprouting within disturbed area.

b. Treatment options include herbicide use, till under, etc.

c. Mulching may aid in revegetation in some scenarios. Mulch should be chosen carefully as it may contain NNIS seed. Choose weed-free mulch (see ROW Appendix H, Resources).

d. Utilize non-invasive, annual cover crops as temporary cover when delay between disturbance and planting (see ROW Appendix H, Resources).

→**BMP RV 6: Allow natural revegetation of the ground layer to occur only where site conditions permit.**

Considerations:

a. Situations in which natural revegetation may occur include:

- The adjacent landscape contains no NNIS plants (such as a prairie remnant or high quality sedge meadow).
- The adjacent landscape contains few NNIS plants and the topsoil has been left intact.
- The adjacent landscape contains few NNIS plants and the topsoil has been segregated and replaced during construction.
- The adjacent landscape is extensively infested by NNIS plants because actively revegetating will likely fail (such as reed canary grass dominated wetland).

b. While assessing the likelihood of natural revegetation, other than the presence of NNIS plants, it is important to consider other factors including:

- Soil type–less rich soils may revegetate slowly and may require monitoring to ensure natural revegetation.
- Moisture levels–low soil moisture or a droughty site will limit revegetation.
- Time of year–the heat of summer may not be conducive to revegetation or if the growing season is coming to a close.

- It may be necessary to use an annual cover crop to stabilize soils as natural revegetation occurs.

**→BMP RV 7: Ensure the species specified in the plan are the ones being used.**

Considerations:

a. Watch out for substitutions.

b. Watch out for naming inconsistencies.

c. Check label for purity, composition and germination consistent with entity requirements.

**→BMP RV 8: Monitor the revegetation site for NNIS.**

Considerations:

a. Monitor rights-of-way during routine activities; determine necessary treatments based on presence of NNIS.

b. Make sure the correct species have been used as specified.

c. Follow the revegetation plan.

d. Maintenance – effective maintenance is essential especially where seed and plants are placed in a challenging environment (i.e., low nutrient soil, dry, etc.). Maintaining new vegetation will ensure long-term establishment.

e. If control treatments are planned ensure that they are applied within the appropriate time window.

   - Consider life history of target NNIS in relation to timing of control methods.
   - Allow enough time for control prior to activity.
   - Allow time and resources for post-activity follow-up control measures, due to persistent seed bank and resprouting.

# References for Transportation and Utility Rights-of-Way Best Management Practices

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# Appendices for Transportation and Utility Rights-of-Way Best Management Practices

## *ROW Appendix A: Lists of Terrestrial Invasive Plants*

Eastern Region Forests should add information appropriate to their areas here:

### Wisconsin:

There exist both formal and informal NNIS plant lists for the state of Wisconsin and the surrounding region. Among these, no two lists are the same, in part because the agencies, organizations and groups who created them can have differing points of view about the invasiveness of some species. This is natural considering invasiveness varies due to location, habitat type, disturbance history, urban versus rural locations, proximity to propagules, and many other factors. In short, what may be NNIS in one environment may not be NNIS in another. Because no individual list will be able to meet the needs of every utility and transportation corridor worker in Wisconsin, we have put together a list of lists and have attempted to explain how they were compiled so that the user can decide for themselves which list best meets their needs. Keep in mind the lists are continually being updated as new NNIS plant species appear in Wisconsin and as additional research is being reported. It is important to remember that regardless if a particular species is included in a list, implementation of the BMPs should be effective at preventing or slowing the spread of any species.

### *Lists:*

***1) Wisconsin Department of Natural Resources*** *(WDNR)—Invasive Plant Species Regulated Under NR 40 and Plant Species Not Regulated by NR 40*
http://dnr.wi.gov/invasives/classification/
The species lists, developed as part of the Wisconsin DNR's Invasive Species Identification, Classification and Control rule– NR 40, were created with input from the DNR, the Wisconsin Council on Invasive Species, and Species Assessment Groups (SAGs) comprised of experts in their respective fields and stake-holder groups. The SAGs reviewed literature summaries and made recommendations to the Council. The rule identifies NNIS in each specific category based on criteria and will place restrictions on those species that are classified as prohibited or restricted. This list is not all-inclusive. Additional species are or will be under review and it will be periodically updated.

***2) Wisconsin Department of Natural Resources*** *(WDNR)—Invasive Species Plants.*
http://dnr.wi.gov/invasives/plants.asp
This is an informal list first created in 1992 by Wisconsin Department of Natural Resource staff with a great deal of input from land managers throughout the state. Species have been and continue to be added as they are brought to the attention of DNR staff. The list consists of species that appear to be anecdotally NNIS, are widespread or are known to be significantly NNIS outside of Wisconsin and have the potential to naturalize in our state. The list also includes native species with NNIS tendencies.

***3) Invasive Plants Association of Wisconsin****—IPAW Working List of the Invasive Plants of Wisconsin.*
http://www.ipaw.org/list/index.htm
The mission of IPAW, a private, nonprofit org is to advance understanding of NNIS plants and encourage their control to promote stewardship of the natural resources of Wisconsin. In order to carry out their mission, members of IPAW created a working list of plants that are NNIS in the natural plant communities and wild areas of Wisconsin. The list was created by a formal process that involved the collection of a wide variety of personal observations and experience of natural area and plant experts by

survey. The survey was conducted in 2002 and the list was published in March 2003. It has not been updated since. The IPAW list does not include agricultural weeds; it focuses on plants that invade natural plant communities. It does not include plants that are native to Wisconsin. Those non-native species that are not known to be currently NNIS in Wisconsin, but that are NNIS in similar eco-regions and may have the potential to become NNIS in the state, are presented separately in the "IPAW Working List of the Potentially Invasive Plants for Wisconsin". The IPAW list also does not take into consideration cultivar and varietal differences in potential invasiveness.

## *ROW Appendix B: Short List of Invasive Insects and Diseases for Wisconsin*

The lists below are provided for educational purposes for use in conjunction with the BMPs. The lists represent insects and diseases, native or non-native, that are the most destructive or threatening to Wisconsin's urban forests. Species are listed in alphabetical order; they are not listed in order of priority. These species may already be present in our state or they have the potential to be here in the near future. The lists may be updated as new NNIS appear in or threaten Wisconsin.

Those species assessed by Species Assessment Groups are **in bold**. Species Assessment Groups, comprised of experts in their respective fields and stake-holder groups, were asked to review literature summaries and to make recommendations to the Wisconsin Council on Invasive Species as how to categorize species for WDNR's Invasive Species Identification, Classification, and Control Rule (NR 40).

The lists are not comprehensive. Refer to **ROW Appendix H, Resources,** for links to more information about the species listed and other NNIS insect and disease species.

***Wisconsin:***

## NNIS Insects

| Common name | Scientific Name | Preferred Host Species |
|---|---|---|
| **European gypsy moth** | ***Lymantria dispar* (European race)** | *hardwoods; oaks preferred* |
| Japanese beetle | *Popillia japonica* | *many hosts* |
| **Emerald ash borer** | ***Agrilis planipennis*** | *all species of ash (Fraxinus spp.)* |
| **Asian longhorned beetle** | ***Anopliphora glabripennis*** | *hardwoods; maples preferred* |
| **Sirex woodwasp** | ***Sirex noctilio*** | *pines* |
| **Hemlock wooly adelgid** | ***Adelges tsugae*** | *Eastern and Carolina hemlock* |
| **Asian gypsy moth** | ***Lymantria dispar* (Asian race)** | *hardwoods & conifers* |
| | | |

## NNIS Diseases

| Common name | Scientific Name | Preferred Host Species |
|---|---|---|
| Diplodia shoot blight | *Diplodia pinea* | *pines; red, scots, jack & Austrian preferred* |
| *Cytospora spp*. | *Cytospora kunzei var. picea* | *Norway & Colorado blue spruce preferred* |
| Oak wilt | *Ceratocystis fagacearum* | *oaks; red/black family preferred* |
| **White pine blister rust** | ***Cronartium ribicola*** | *5-needled pines* |
| Dutch elm disease | *Ophiostoma ulmi* | *American elm most susceptible* |
| Fire blight | *Eweinaia amylovora* | *rose, apple, pear* |
| **Sudden oak death** | ***Phytophthora ramorum*** | *many hosts* |
| **Butternut canker** | ***Sirococcus clavigignenti-juglandacearum* (pathogen)** | *butternut* |

**Species in bold** were assessed by Species Assessment Groups comprised of experts in their respective fields and stake-holder groups. The Species Assessment Groups were asked to review literature summaries and to make recommendations to the Wisconsin Council on Invasive Species as how to categorize species for the Invasive Species Identification, Classification and Control Rule (NR 40). http://dnr.wi.gov/invasives/classification/

# *ROW Appendix C: Guidance to Assist Entities in Determining Priority Terrestrial Invasive Plant Species for Identification and Management*

This appendix is to help identify which NNIS plant species are in the area in order to schedule vegetation management activities to minimize the spread.

Introduction

Preventing seed dispersal is crucial for ***preventing the spread and introducing*** many NNIS. Mowing should be carefully considered to ensure that NNIS will not actually be spread by the practice.

Most NNIS plants are spread by seeds. Seeds come from flowers that have been pollinated. Many NNIS plants produce seeds only a few weeks after flowering begins. The flowers of some plants can continue developing seeds even after they are cut. Mowing or cutting just prior to flowering eliminates the possibility that seeds can develop and weakens the plants. Many plants can reflower several weeks after the initial mowing. A second mowing can again prevent seed set.

Recommendations

Vegetation management consists of mowing herbaceous plants, clearing woody plants (which may include mowing), and using herbicide for either. For this reason, the list of species to be considered needs to include a broad suite of NNIS plants. The intent is to not assume that each species is in any given ROW, rather to provide a process to understand the threats and as awareness increases, adjust to it. With the help of partners, the species of concern can be determined given any situation (see Inventory below). Either type of plant life form has the potential to spread from management activities, but the herbaceous plants are a greater threat due to greater seed production and timing of mowing.

Some species are only found in parts of a state, certain soil, or the correct level of moisture. In any given geographical area, there will likely be a few dominant ROW NNIS with others likely to invade if their seeds are introduced to the area. See below for a list of NNIS plants likely to be found in transportation and utility corridors.

The list of plants includes species that have different habitat types and is indicated as such within List A. This should aid in determining which species are or may be present.

Furthermore, the emergence, leaf-out and flowering times of plants vary by location. When using the mowing timing guidance, adjust for the difference. The concept behind the chart in Appendix D is to act as a guide; nothing in nature is as simple as a chart. Any given year there may be local climate issues, such as drought or cold, which will alter the timing schedule either direction from that listed in Appendix E. The best thing to do is actually go out and observe the particular species in your area or inquire with others to best determine the time to conduct any management.

By using a combination of identification tools during normal activities, partnering with others to help identify populations, and use of the distribution maps, forests should be able to develop a list of NNIS present on your ROWs. Assessing the abundance and location of each of these species will help guide Forests' mowing schedules.

Training and Identification

The hope is to develop a target list of species from List A below, which is a short list of species likely to be found in corridors. As crews and others then become more aware and can identify more species, the target list would grow.

Inventory

A major part of making the BMPs happen is having an understanding of what NNIS are in the corridors. Inventory activities can be done in two ways: during normal daily activities (cruising, inspections, surveying etc.) and by partners.

The use of partners includes CWMAs and other groups or individuals to assist in the identification and distribution of NNIS in your area. It would simplify matters if each entity (local unit of government, company) has a single point of contact to manage the information and then appropriately disseminate to the crews. For example, if the local CWMA is willing to map NNIS populations along county roads, they would then forward that information to the contact person at the county level. Then the information could be used to schedule vegetation management activities based on the distribution and the mowing guidance, among others.

This protocol would easily work for the species in List A. However, there are many species that are less common, locally abundant and in many ways a larger threat than the more common species. For instance, if there is a known population of a less common species in a specific county, that species should be identified and managed appropriately. This would take more coordination on some accounts. Therefore it is critical to develop the process of mapping the populations.

Management

Vegetation management will vary depending on the type of corridor, although there is overlap. In general, highway corridors vegetation management consists of mowing herbaceous plants. Prior to scheduling mowing times it is important to know what species you are trying to contain by mowing. The timing of the mowing is critical to prevent the spread. For the majority of species, it is best to mow just before the plants bloom. This should prevent seeds from developing. Some plants can successfully produce mature fruits even if mowed during flowering. In general, never mow through an infestation that has already set seed. It will just spread the seeds further. If possible, skip mowing that year.

Each eastern Region Forest should develop their NNIS list and add.

**List of Invasive Plants likely to be found in transportation and utility corridors/Wisconsin:**

Herbaceous plants:

- Bird's foot trefoil
- Common tansy
- Common teasel
- Cut-leaved teasel
- Crown vetch
- Dame's rocket
- Garlic mustard
- Japanese knotweed
- Leafy spurge
- Canada thistle
- Musk or nodding thistle
- Plumeless thistle
- Phragmites
- Purple loosestrife
- Reed canary grass
- Spotted knapweed
- Sweet clovers (white and yellow)
- Wild parsnip

Trees and shrubs:

- Autumn olive
- Black locust
- Common buckthorn
- Eurasian bush honeysuckles (Bell's Morrows, taratarian)
- Glossy buckthorn

Early Detection species: Example - One way to minimize the damage an NNIS may inflict on an ecosystem is to control or eliminate the species when its populations are still small, for example, an early detection survey could be used to determine whether purple loosestrife is present in a wetland.

**Wisconsin:**

Herbaceous plants:

- Black swallowwort
- Sericea lespedeza
- Cypress spurge
- European marsh thistle
- Japanese hedge parsley
- Japanese hops
- Japanese stilt grass
- Giant hogweed
- Hill mustard
- Hound's tongue
- Oriental bittersweet
- Poison hemlock
- Scotch broom
- Spreading hedge parsley
- Wild chervil
- Yellow star thistle

Trees and shrubs:

- Amur honeysuckle
- Japanese barberry
- Tree-of-heaven

Please note: (For further information see *Appendix E: Example Identifying Time Windows for NNIS Management* as well as *Appendix D: Mowing Timing Guidance)*

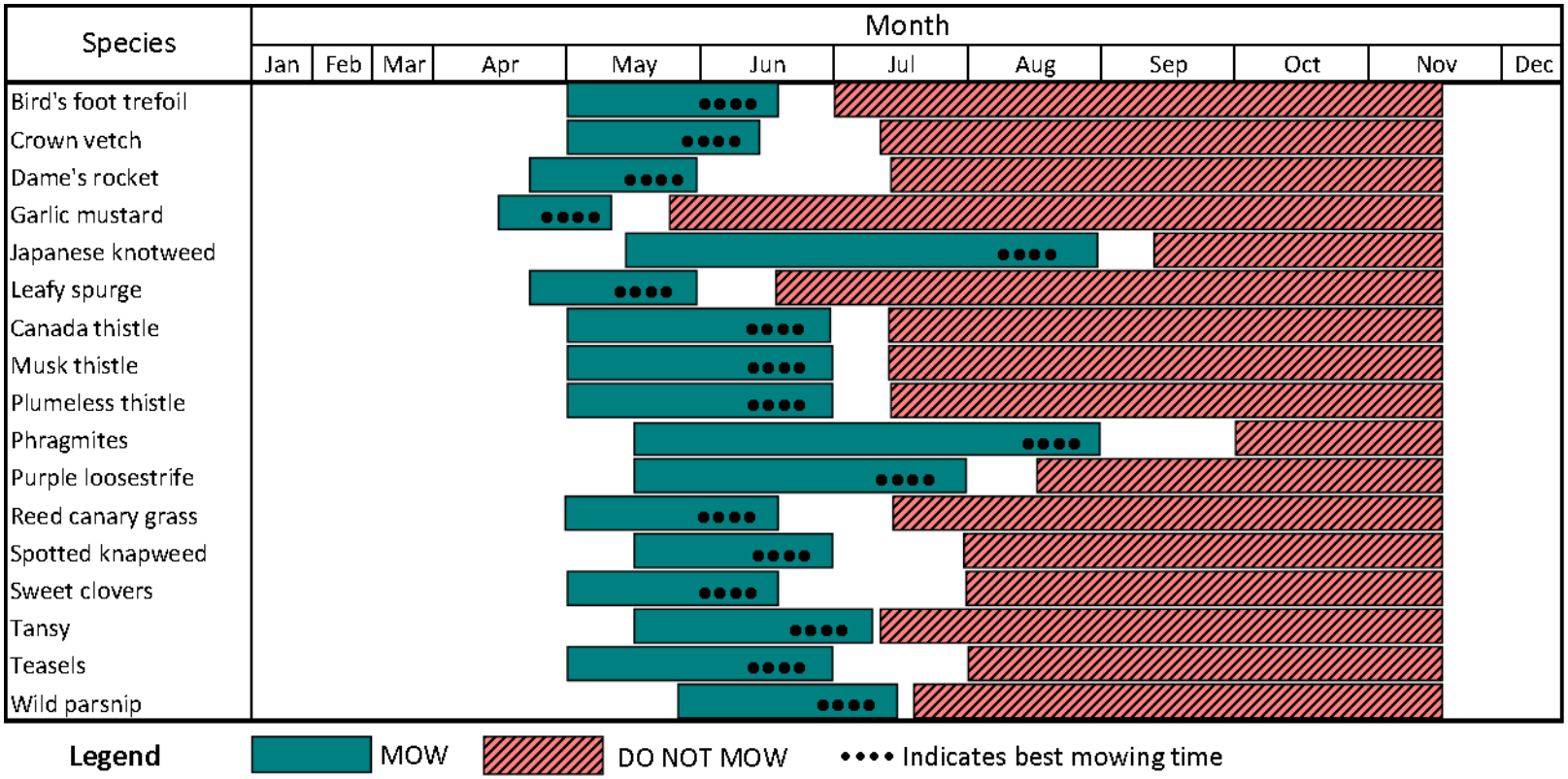
## *ROW Appendix D: Mowing Timing Guidance*

Forests should develop specific information for their locations.

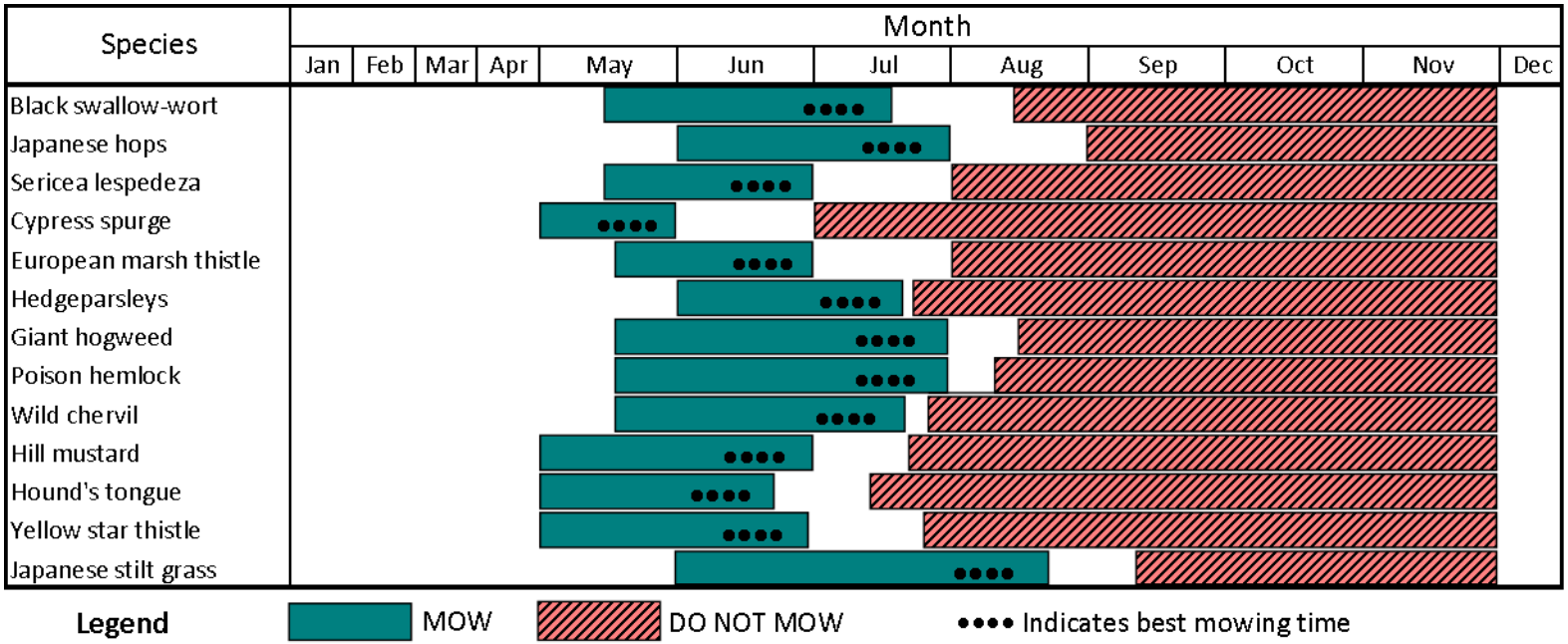
**Suggested mowing times for select species in southern Wisconsin**

Mowing can be an effective control for some NNIS; however it can spread those species if not timed correctly. Mowing can be done multiple times per growing season to prevent seed production and to deplete root reserves; however the first mowing should occur when the target NNIS is just about to flower or in the early flowering stage. Avoid mowing if seeds have already developed as this will spread them. Emergence, flowering and seeding times vary from year to year for most species; the charts show average times. These times become later as you move north or for areas near the Great Lakes.

**Mowing times for common NNIS in southern Wisconsin**



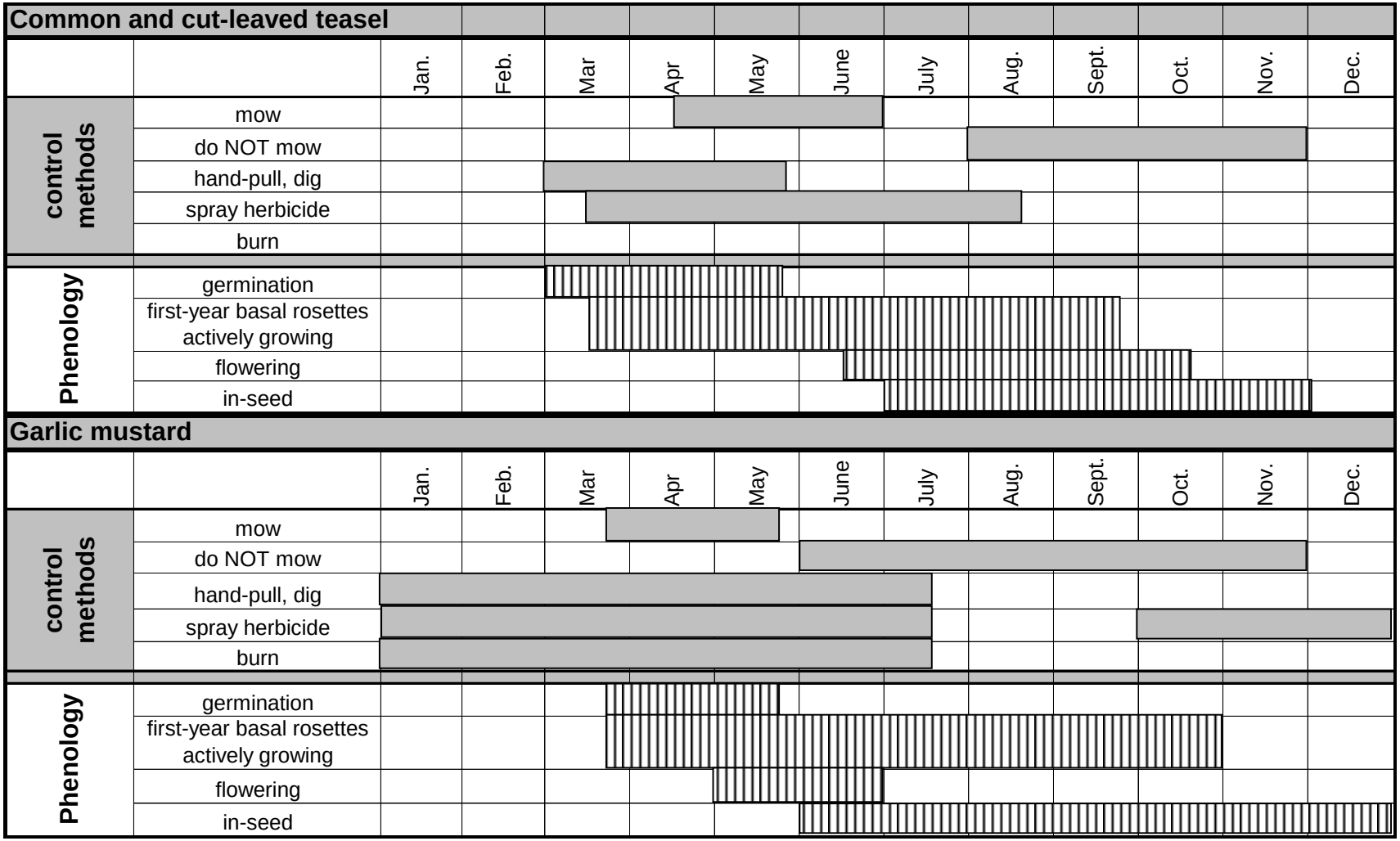
**Mowing times for less common* NNIS in southern Wisconsin**




* These species are not yet common in most of Wisconsin and need to be contained if found where prohibited.

## *ROW Appendix E: Examples: Identifying Time Windows for Invasive Species Management*

* These charts are intended as **examples,** while it is important to eventually determine the size of NNIS infestations in an ecosystem only identification and early detection can determine if a species is present or absent.




Most NNIS plants are spread by seeds. Seeds come from flowers that have been pollinated. Many NNIS plants produce seeds only a few weeks after flowering begins. The flowers of some plants can continue developing seeds even after they are cut. Mowing or cutting just prior to flowering eliminates the possibility that seeds can develop and weakens the plants. Many plants can re-flower several weeks after the initial mowing. A second mowing can again prevent seed set.

# *ROW Appendix F: Species Recommended for Revegetation*

Plant species listed in this appendix may be purchased at a variety of nurseries and sales outlets. Many species can be grown from seed, while others are typically sold as living plants, and some are available as both seed and plants.

Species chosen for seeding or planting must be appropriate for site conditions. If soil or moisture conditions are variable across the site, more than one seeding or planting mix may be needed. Using species unsuited to the site will not usually provide satisfactory revegetation, as survival is likely to be poor. Other important considerations when selecting seed mixes or plant materials include: project objectives, project size, budget, timeline, seed availability, and species already present on the site.

Seeding rate is the number of seeds or weight of seed needed for planting per unit area (acre, hectare, etc.). Seeding rates can vary greatly depending on species used (aggressive vs. less aggressive species, size of plant), site conditions (e.g. steep slopes, low moisture, weed competition, etc.) and seeding method (e.g., mechanical, hand broadcasting, hydroseeding, etc.). When using live plant materials, the density of planting (i.e., planting rate) will also need to be considered keeping in mind many of the above factors. Determining an appropriate seeding or planting rate is important because rates that are too high waste money and materials, and rates that are too low may not provide the desired revegetation.

It is important to use seed that does not contain weed seeds, especially NNIS weed seeds. One way to do this is to purchase Pure Live Seed. Pure Live Seed (PLS) is a measure of seed quality. A bag of seed often includes inert material such as dust, chaff, and empty seed; weed seed; and Pure Live Seed (PLS) of the desired species. Percentage Pure Live Seed is calculated by multiplying the *percent germination* by the *percent purity* of the seed; then dividing by 100.

For example: (95% germination × 80% purity)/100 = 76% PLS

Seeds with a low PLS will need to be sown at a higher rate than seed with a high PLS. Seed with a higher PLS costs more per unit, but more of what you plant will germinate, so less is needed. Not all species are tested for Pure Live Seed.

Sources:

Dorner, J. An Introduction to Using Native Plants in Restoration Projects. Plant Conservation Alliance, Bureau of Land Management and US Environmental Protection Agency. http://www.nps.gov/plants/restore/pubs/intronatplant/planting.htm Accessed 11/15/07.

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Eastern Region Forests should develop information for their locations.

**WISCONSIN:**

| Plant Species | | Revegetation Method | | | Site Characteristics | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Common Name | Scientific Name | Seedlings[1] | Seed | Life-cycle[2] | Dry | Dry-Mesic | Mesic | Wet | Shady | Open | Range in WI[3] |
| **Shrubs** | | | | | | | | | | | |
| Juneberry | *Amelanchier spp.* | √ | √ | P | • | • | • | | ♦ | ♦ | N, C, S |
| Black Chokeberry | *Aronia melanocarpa* | √ | √ | P | | • | • | • | | ♦ | N, C, S |
| Sweet Fern | *Comptonia peregrina* | √ | | P | • | • | | | | ♦ | N, C |
| Alt-leaved Dogwood | *Cornus alternifolia* | √ | √ | P | | • | • | | ♦ | ♦ | N, C, S |
| Silky Dogwood | *Cornus amomum* | √ | √ | P | | | • | • | | ♦ | N, C, S |
| American Hazelnut | *Corylus americana* | √ | √ | P | • | • | • | | | ♦ | N, C, S |
| Beaked Hazelnut | *Corylus cornuta* | √ | | P | • | • | • | | ♦ | ♦ | N, C |
| Northern Bush-Honeysuckle | *Diervilla lonicera* | √ | | P | • | • | • | | | ♦ | N, C, S |
| Winterberry | *Ilex verticillata* | √ | | P | | | • | • | ♦ | ♦ | N, C, S |
| Pin cherry | *Prunus pennsylvanica* | | √ | P | • | • | • | | | ♦ | N, C, S |
| Sand Cherry | *Prunus pumila* | √ | √ | P | • | • | | | | ♦ | N, C, S |
| Common Juniper | *Juniperis communis* | | √ | P | • | • | | | | ♦ | N, C, S |
| Early Wild Rose | *Rosa blanda* | √ | √ | P | • | • | • | | ♦ | ♦ | N, C, S |
| Upland Willow | *Salix humilis* | √ | | P | | • | • | | | ♦ | N, C, S |
| American Elder | *Sambucus canadensis* | √ | √ | P | | | • | • | | ♦ | N, C, S |
| Maple-leaved Viburnum | *Viburnum acerifolium* | √ | | P | | • | • | | ♦ | | N, C, S |
| Nannyberry | *Viburnum lentago* | √ | √ | P | | • | • | • | ♦ | ♦ | N, C, S |
| Arrow-wood | *Viburnum rafinesquianum* | √ | √ | P | | • | • | | ♦ | | N, C, S |
| **Grasses and Sedges** | | | | | | | | | | | |
| Big Bluestem | *Andropogon gerardii* | √ | √ | P | • | • | • | | | ♦ | N, C, S |
| Bluejoint Grass | *Calamagrostis canadensis* | √ | √ | P | | | • | • | | ♦ | N, C, S |
| Oval Sedge | *Carex bicknelli* | √ | √ | P | | • | • | | ♦ | | C, S |
| Poverty Oat Grass | *Danthonia spicata* | | √ | P | • | • | | | | ♦ | N, C, S |
| Canada Wild-Rye | *Elymus canadensis* | √ | √ | SP | | • | • | • | | ♦ | N, C, S |

| Plant Species | | Revegetation Method | | | Site Characteristics | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Common Name | Scientific Name | Seedlings[1] | Seed | Life-cycle[2] | Dry | Dry-Mesic | Mesic | Wet | Shady | Open | Range in WI[3] |
| Virginia Wild-Rye | *Elymus virginicus* | | √ | SP | | • | • | • | | ♦ | N, C, S |
| Common Rush | *Juncus effusus* | √ | √ | P | | | | • | | ♦ | N, C, S |
| Path Rush | *Juncus tenuis* | | √ | P | | • | • | • | ♦ | ♦ | N, C, S |
| June Grass | *Koeleria macrantha* | | √ | P | • | • | | | | ♦ | N, C, S |
| Switch Grass | *Panicum virgatum* | √ | √ | P | • | • | • | • | ♦ | ♦ | N, C, S |
| Little Bluestem | *Schizachyrium scoparium* | √ | √ | P | • | • | | | | ♦ | N, C, S |
| Indian Grass | *Sorghastum nutans* | √ | √ | P | • | • | • | | ♦ | ♦ | N, C, S |
| Prairie Cord Grass | *Spartina pectinata* | √ | √ | P | | | • | • | | ♦ | N, C, S |
| Needle Grass | *Stipa spartea* | √ | √ | P | • | • | | | ♦ | ♦ | C, S |
| **Forbs** | | | | | | | | | | | |
| Canada Anemone | *Anemone canadensis* | √ | √ | P | | | • | • | ♦ | ♦ | N, C, S |
| Thimbleweed | *Anemone cylindrica* | √ | √ | P | • | • | • | | ♦ | ♦ | C, S |
| Columbine | *Aquilegia canadensis* | √ | √ | SP | | • | • | | ♦ | ♦ | N, C, S |
| Common Milkweed | *Asclepias syriaca* | √ | √ | P | • | • | • | | | ♦ | N, C, S |
| Smooth Aster | *Aster laevis* | √ | √ | P | • | • | • | | | ♦ | N, C, S |
| New England Aster | *Aster novae-angliae* | √ | √ | P | | | • | • | ♦ | ♦ | N, C, S |
| Frost Aster | *Aster pilosus* | √ | √ | P | • | • | | | | ♦ | N, C, S |
| Swamp Aster | *Aster puniceus* | √ | √ | P | | | • | • | | ♦ | N, C, S |
| Flat-topped Aster | *Aster umbellatus* | √ | √ | P | | | • | • | | ♦ | N, C, S |
| Prairie Coreopsis | *Coreopsis palmata* | √ | √ | P | • | • | • | | | ♦ | N, C, S |
| Fireweed | *Epilobium angustifolium* | √ | √ | P | | • | • | | | ♦ | N, C, S |
| Joe-pye Weed | *Eupatorium maculatum* | √ | √ | P | | | • | • | | ♦ | N, C, S |
| Boneset | *Eupatorium perfoliatum* | √ | √ | P | | | • | • | | ♦ | N, C, S |
| Wild Strawberry | *Fragaria virginiana* | √ | √ | P | • | • | | | | ♦ | N, C, S |
| Wild Geranium | *Geranium maculatum* | √ | | P | | • | • | | | ♦ | N, C, S |
| Sweet everlasting | *Gnaphalium obtusifolium* | | √ | A | • | • | | | | ♦ | N, C, S |
| Sneezeweed | *Helenium autumnale* | √ | √ | P | | | • | • | | ♦ | N, C, S |
| Woodland sunflower | *Helianthus divaricatus* | √ | √ | P | • | • | • | | | ♦ | C, S |
| Saw-tooth Sunflower | *Helianthus grosseserratus* | | √ | P | • | • | • | | | ♦ | N, C, S |

| Plant Species | | Revegetation Method | | | Site Characteristics | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Common Name | Scientific Name | Seedlings[1] | Seed | Life-cycle[2] | Dry | Dry-Mesic | Mesic | Wet | Shady | Open | Range in WI[3] |
| Few-leaved Sunflower | *Helianthus occidentalis* | √ | √ | P | • | • | • | | | ♦ | N, C, S |
| Early Sunflower | *Heliopsis helianthoides* | √ | √ | P | • | • | | | | ♦ | N, C, S |
| Canada Hawkweed | *Hieracium Kalmii* | √ | √ | P | • | • | | | | ♦ | N, C, S |
| Round-headed Bush Clover | *Lespedeza capitata* | √ | √ | P | • | • | | | | ♦ | N, C, S |
| Rough Blazing Star | *Liatris aspera* | √ | √ | P | • | • | | | | ♦ | N, C, S |
| Northern Plains Blazing Star | *Liatris ligulistylis* | √ | √ | P | | • | • | | | ♦ | N, C, S |
| Wild Bergamot | *Monarda fistulosa* | √ | √ | P | | • | • | | | ♦ | N, C, S |
| Wood Betony | *Pedicularis canadensis* | √ | √ | P | • | • | | | | ♦ | N, C, S |
| Blue Phlox | *Phlox divaricata* | √ | √ | P | | • | • | | ♦ | | N, C, S |
| Yellow Cone Flower | *Ratibida pinnata* | √ | √ | P | • | • | • | | ♦ | ♦ | N, C, S |
| Black-eyed Susan | *Rudbeckia hirta* | √ | √ | B/P | • | • | | | | ♦ | N, C, S |
| Green-headed Coneflower | *Rudbeckia laciniata* | √ | √ | P | | | • | • | | ♦ | N, C, S |
| Zig-zag Goldenrod | *Solidago flexicaulis* | √ | √ | P | • | • | | | | ♦ | N, C, S |
| Early Goldenrod | *Solidago juncea* | √ | √ | P | • | • | | | | ♦ | N, C, S |
| Gray Goldenrod | *Solidago nemoralis* | √ | √ | P | • | • | | | | ♦ | N, C, S |
| Showy Goldenrod | *Solidago speciosa* | √ | √ | P | • | • | | | | ♦ | N, C, S |
| Elm-leaved sunflower | *Solidago ulmifolia* | √ | √ | P | • | • | | | ♦ | ♦ | C, S |
| Spiderwort | *Tradescantia ohiensis* | √ | √ | P | • | • | • | | ♦ | ♦ | N, C, S |
| Blue Vervain | *Verbena hastata* | √ | √ | B/P | | | • | • | | ♦ | N, C, S |
| Hairy Vervain | *Verbena stricta* | √ | √ | B/P | • | • | • | | ♦ | | N, C, S |
| Violets | *Viola spp.* | | √ | SP | • | • | • | • | ♦ | ♦ | N, C, S |
| Golden Alexander | *Zizia aurea* | √ | √ | P | | • | • | • | | ♦ | N, C, S |
| **Annual cover crops for short term erosion control (non-natives except as noted)** | | | | | | | | | | | |
| Oats | *Avena sativa* | | √ | A | | | | | | ♦ | |
| Canada Wild-Rye (native) | *Elymus canadensis* | √ | √ | SP | | • | • | | | ♦ | |
| Virginia Wild-Rye (native) | *Elymus virginicus* | √ | √ | SP | | • | • | • | | ♦ | |
| Wheat, winter also | *Triticum aestiva* | | √ | A | | | | | | ♦ | |

| Plant Species | | Revegetation Method | | | Site Characteristics | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Common Name | Scientific Name | Seedlings[1] | Seed | Life-cycle[2] | Dry | Dry-Mesic | Mesic | Wet | Shady | Open | Range in WI[3] |

[1] Propagation from seedlings, bare root stock, plugs, containers etc.
[2] Annual (A), Short-lived Perennial (SP), Perennial (P) or Biennial (B) life cycle.
[3] Plant is appropriate for Northern (N), Central (C), and/or Southern (S) Wisconsin.

## *ROW Appendix G: Checklist of Responsibilities*

Using the BMPs described below, it is easier to determine if NNIS have invaded an area because NNIS often first invade travel corridors. You may want to focus your search along these areas.
*****Any organization can establish the appropriate levels of responsibility for their staff.

| BMP # | BMPs | Responsible party | | | | Comments |
|---|---|---|---|---|---|---|
| | | Manage-ment | Project Managers | Supervisors/ Superinten-dents | Crews | |
| **Soil Disturbance** | | | | | | |
| SD-1 | Prior to implementing activities inventory for, locate and document NNIS infestations. | | | | | |
| SD-2 | Consider the need for action based on: 1) the degree of invasiveness; 2) severity of the current infestation; 3) amount of additional habitat or hosts at risk for invasion; 4) feasibility of control with available methods and resources. | | | | | |
| SD-3 | Plan activities to limit the potential for introduction and spread of NNIS, prior to construction. | | | | | |
| SD-4 | Provide appropriate resources in identification of known NNIS for corridor workers. | | | | | |
| SD-5 | Minimize soil disturbance which may include using existing roads, access points, staging areas and/or alternative construction methods. | | | | | |
| SD-6 | Avoid NNIS populations when feasible and minimize the spread of NNIS during soil disturbance activities. | | | | | |
| SD-7 | Prior to moving equipment out of an infested area and then into an uninfested area, clean soils, seeds, plant parts, or invertebrates from exterior surfaces, to the extent practical, to minimize the risk of transporting propagules. | | | | | |
| SD-8 | Stabilize disturbed soils using erosion control/stormwater management technical standards as soon as possible. | | | | | |
| SD-9 | Use non-invasive, annual or native seed for cover crops or revegetation. | | | | | |
| **Vegetation Management - Inspection and Monitoring** | | | | | | |
| VM-1 | Prior to implementing activities inventory for, locate and document NNIS infestations. | | | | | |

| BMP # | BMPs | Responsible party | | | | Comments |
|---|---|---|---|---|---|---|
| | | Manage-ment | Project Managers | Supervisors/ Superinten-dents | Crews | |
| VM-2 | Plan activities to limit the potential introduction and spread of NNIS, prior to construction | | | | | |
| VM-3 | Assess current available resources and seek new resources to prevent NNIS spread. | | | | | |
| VM-4 | Provide training in identification, control and prevention of known NNIS to employees and contractors performing vegetation management activities | | | | | |
| VM-5 | Prior to moving equipment out of an infested area and then into an uninfested area, clean soils, seeds, plant parts, or invertebrates from exterior surfaces, to the extent practical, to minimize the risk of transporting propagules. | | | | | |
| VM-6 | Inspect and clean clothing, footwear and gear for soils, seeds, plant parts, and invertebrates before and after activities. | | | | | |
| VM-7 | Properly dispose of soils, seeds, plant parts or invertebrates found during inspection and cleaning. | | | | | |
| VM-8 | Locate and use staging areas that are free of NNIS plants to avoid spreading seeds and other viable plant parts. | | | | | |
| VM-9 | Consider the likely response of NNIS when conducting activities that result in disturbed soil, increased sunlight, fire, etc. | | | | | |
| VM-10 | Ensure that NNIS control treatments are applied within the appropriate time window. | | | | | |
| VM-11 | Monitor right-of-ways during day-to-day activities and post management activities; determine necessary treatments based on the presence of NNIS. | | | | | |
| **Transport of Material** | | | | | | |
| TM-1 | Take steps to avoid the movement of NNIS to non-infested areas during transport activities. | | | | | |
| TM-2 | Prior to transporting materials, manage the load to limit the spread of NNIS. | | | | | |

| BMP # | BMPs | Responsible party | | | | Comments |
|---|---|---|---|---|---|---|
| | | Manage-ment | Project Managers | Supervisors/ Superinten-dents | Crews | |
| TM-3 | Prior to moving equipment out of an infested area and then into an uninfested area, clean soils, seeds, plant parts, and invertebrates from exterior surfaces to the extent practical , to minimize the risk of transporting propagules. | | | | | |
| TM-4 | Dispose of soils, seeds, plant parts or invertebrates found during inspection and cleaning. | | | | | |
| TM-5 | Establish staging areas and temporary facilities in locations that are free of NNIS. | | | | | |
| TM-6 | Use soil and aggregate material from sources that are free of NNIS. | | | | | |
| TM-7 | Manage stock piles to limit the spread of NNIS. | | | | | |
| TM-8 | Do not transport woody material that may contain NNIS. | | | | | |
| TM-9 | If you must transport woody material that may contain NNIS, bring to a designated area for appropriate disposal. | | | | | |
| TM-10 | Keep and reuse onsite materials rather that importing new materials. | | | | | |
| **Revegetation and Restoration** | | | | | | |
| RV-1 | Plan activities to limit the potential introduction and spread of NNIS, prior to revegetation. | | | | | |
| RV-2 | Select locally native species for revegetation and landscaping activities. | | | | | |
| RV-3 | Inspect and clean clothing, footwear and gear for soils, seeds, plant parts, or invertebrates before and after activities. | | | | | |
| RV-4 | Prior to moving equipment out of an infested area and into an uninfested area clean soil and debris from exterior surfaces, to the extent practical, to minimize the risk of transporting propagules. | | | | | |
| RV-5 | Revegetate disturbed soils as soon as feasible to minimize NNIS establishment. | | | | | |
| RV-6 | Allow natural revegetation of the ground layer to occur only where site conditions permit. | | | | | |
| RV-7 | Ensure the species specified in the plan are the ones | | | | | |

| BMP # | BMPs | Responsible party | | | | Comments |
|---|---|---|---|---|---|---|
| | | Manage-ment | Project Managers | Supervisors/ Superinten-dents | Crews | |
| | being used. | | | | | |
| RV-8 | Monitor the revegetation site for NNIS. | | | | | |

## *ROW Appendix H: Resources for Additional Information*

Each Eastern Region Forest should develop the specific information they require

***Wisconsin:***

**NNIS Plants** (See also *All NNIS*)**:**

*Center for Invasive Plant Management (CIPM).* http://www.weedcenter.org
This web site provides information on NNIS plant identification, biology, and impacts of NNIS. It also includes links to a resource guide, weed control methods, and NNIS plant management online textbook.

*Great Lakes Indian Fish and Wildlife Commission (GLIFWC)—Exotic Plant Information Center.* http://www.glifwc.org/invasives/ This site features a searchable database of NNIS accounts. It also provides distribution maps, educational materials, and a slide library.

*Invasive Plants Association of Wisconsin (IPAW).* http://www.ipaw.org
The mission of IPAW is to promote better stewardship of the natural resources of Wisconsin by advancing the understanding of NNIS plants and encouraging the control of their spread. Their web site offers a photo gallery, NNIS list, educational resources, news and events, and more.

*Midwest Invasive Plant Network (MIPN).* http://www.mipn.org/
This organization's mission is to reduce the impact of NNIS plant species in the Midwest. The web site provides information on prevention, early detection and rapid response, control and management, education, research, and more.

*Plant Conservation Alliance (PCA), Weeds Gone Wild, Alien Plant Invaders of Natural Areas.* http://www.nps.gov/plants/alien/ This web site provides a list of NNIS plants in the US, background information on the threats and impacts of NNIS, fact sheets, and relevant links.

*University of Wisconsin Herbarium.* http://www.botany.wisc.edu/wisflora
The Herbarium's web site is fully searchable for Wisconsin's vascular plant species. It includes photos, habitat information, distribution maps, and herbarium specimen data.

*Wisconsin Department of Natural Resources (WDNR)* http://dnr.wi.gov/
The Department of Natural Resources is dedicated to the preservation, protection, effective management, and maintenance of Wisconsin's natural resources.

*Wisconsin Department of Transportation (WisDOT)* http://www.dot.wisconsin.gov/
WisDOT supports all forms of transportation. The department is responsible for planning, building and maintaining Wisconsin's network of state highways and Interstate highway system as well as air, rail and water transportation, well bicycle and pedestrian facilities.

**NNIS Insects and Diseases** (See also *All Invasives*)**:**

*Department of Agriculture Trade and Consumer Protection (DATCP).*
http://www.datcp.state.wi.us/core/insectspesticides/insectspesticides.jsp
DATCP is responsible for the prevention, introduction and spread of plant pests. This webpage provides information on specific pests, rules, firewood restrictions, and firewood dealer certification.

*Department of Agriculture Trade and Consumer Protection (DACTP)—Wisconsin Pest Bulletin.* http://pestbulletin.wi.gov/index.jsp The most relevant links are: *Nursery and Forest*, *Exotic Pest of the Week*, and *DATCP Contacts*.
*Emerald Ash Borer: What you need to know.* http://www.emeraldashborer.info/ This web site is part of a multi-state effort to provide the latest information about EAB to the public.

*National Agricultural Pest Information System (NAPIS)—Pest Tracker.* http://ceris.purdue.edu/napis/ This web site has links to state information, pest information, survey maps and publications. Information presented here is derived, in part, from the National Agricultural Pest Information System (NAPIS), an agricultural pest tracking and database sponsored by the US Department of Agriculture Animal and Plant Health Inspection Service (APHIS) and Plant Protection and Quarantine (PPQ) Cooperative Agricultural Pest Survey, (CAPS).

*Wisconsin's Emerald Ash Borer Resource.* http://emeraldashborer.wi.gov/ This site includes information on surveys, detection, and management, and includes an email address and phone number to report suspected infestations.

**All NNIS:**

*National Invasive Species Council's Definition of Invasive Species.*
http://www.invasivespeciesinfo.gov/docs/council/isacdef.pdf
*National Invasive Species Management Plan.* http://www.invasivespeciesinfo.gov/council/nmp.shtml*The Nature Conservancy (TNC)—Global Invasive Species Initiative.* http://tncweeds.ucdavis.edu This web site provides many resources designed to help conservationists deal most effectively with NNIS. It provides links to an introduction on NNIS management, planning and strategy, control methods, and photo archive and more.

*USDA Forest Service Invasive Species Program.* http://www.fs.fed.us/invasivespecies This web site serves as a portal to Forest Service NNIS information and related management and research activities across the agency and with partners. The program's goal is to reduce, minimize, or eliminate the potential for introduction, establishment, spread, and impact of NNIS across all landscapes and ownerships.

*Wisconsin Council on Invasive Species.* http://dnr.wi.gov/invasives/iscouncil.htm
This site includes a link to the comprehensive state management plan.

*Wisconsin Department of Natural Resources (WDNR).* http://dnr.wi.gov/invasives
The Invasive Species webpage provides links to NNIS information including a photo gallery, complete plant and animal NNIS lists, and information on managing NNIS populations.

**General Sites of Interest:**

*University of Wisconsin Extension.* http://www.uwex.edu/locations/ The Extension has offices in every county in Wisconsin.

*Wisconsin Department of Natural Resources (WDNR). List of Native Plant Nurseries and Restoration Consultants in Wisconsin.*
http://dnr.wi.gov/org/land/er/plants/nurseries.htm The list includes nurseries within 100 miles of Wisconsin that may be able to provide native seed and/or plants for your projects. Consultants provide services such as design, landscape installation, and maintenance services including prescribed burning.

*Wisconsin Department of Natural Resources (WDNR). State Nursery Program.* http://dnr.wi.gov/forestry/nursery/
The DNR operates three forest tree nurseries: the Wilson State Nursery in Boscobel, the Griffith State Nursery in Wisconsin Rapids, and the Hayward State Nursery in Hayward. Trees are sold for reforestation, wildlife habitat, and erosion control purposes.

**General Invasive Plant Management:**

*Center for Invasive Plant Management (CIPM)—Weed Control Methods.*
http://www.weedcenter.org/management/control.htm
The Weed Control Methods web page offers information and links on the following control techniques: biocontrol, grazing, herbicides, mechanical and prescribed burning.

*Department of Conservation and Natural Resources Invasive Exotic Plant Tutorial for Natural Land Managers. Invasive Exotic Plants in Pennsylvania List.*
http://www.dcnr.state.pa.us/forestry/invasivetutorial/List.htm
Although this site is for Pennsylvania most of the species featured are also NNIS in Wisconsin. The site provides links to fact sheets and management and control recommendations.

*Garlic mustard (Alliaria petiolata)—Guide for identifying and controlling.*
http://www.for-wild.org/download/garlicmustard.pdf

*Illinois Nature Preserve Management Guidelines.* http://dnr.state.il.us/INPC/Management_guidelines.htm The information presented gives guidance to landowners, managers, custodians and stewards of sites in the Illinois Nature Preserve Programs on control methods for common NNIS.
*Invasive Plants of the Upper Midwest* by Elizabeth J. Czarapata. This book is a comprehensive, fully-illustrated guide to the identification and control of NNIS plant species. Available for purchase at www.ipaw.org.

*Plant Conservation Alliance—Alien Plant Invaders of Natural Areas.*
http://www.nps.gov/plants/alien/factmain.htm This web site features illustrated, easy-to-read fact sheets on select NNIS plants with native ranges; plant descriptions; ecological threats; US distributions and habitats; background of introductions; plant reproduction and dispersal; management approaches; alternative native plants; and other useful information.

*The Nature Conservancy (TNC)—Weed Control Methods Handbook: Tools and Techniques for Use in Natural Areas.* http://tncweeds.usdavis.edu/handbook.html
The handbook provides detailed information on the use of guide and mechanical techniques, grazing, prescribed fire, biocontrol, and herbicides for use in controlling NNIS in natural areas.

*USDA Forest Service Invasive Species Program—Control and Management.*
http://www.fs.fed.us/invasivespecies/controlmgmt/index.shtml This page provides links for more information on research, management planning, forest service activities, and pest-specific control and management.

*US Forest Service—Dangerous Travelers: Controlling Invasive Plants along America's Roadsides (Video).*
http://www.fs.fed.us/invasivespecies/ The video outlines the best management practices that road crews should be following in their day-to-day operations. This is the first in a series on "Best Management Practices for Invasive Species Prevention." The video can also be ordered on DVD by contacting: USDA Forest Service; San Dimas Technology and Development Center; 444 East Bonita Avenue; San Dimas, CA 91773; (909) 599-1267

*Wisconsin Department of Natural Resources (WDNR). Wisconsin Manual of Control Recommendations: Ecologically Invasive Plants.*
http://dnr.wi.gov/invasives/publications/manual/manual_toc.htm

**Biocontrol:**

*Cornell University. Biological Control: A Guide to Natural Enemies in North America.*
http://www.nysaes.cornell.edu/ent/biocontrol/ This web site provides photographs and descriptions of biocontrol agents of insect, disease and weed pests in North America.

**Grazing:**

*University of Idaho Rangeland Ecology and Management. Targeted Grazing: A Natural Approach to Vegetation Management and Landscape Enhancement.* http://www.cnr.uidaho.edu/rx-grazing/Handbook.htm The handbook outlines the basics of applying targeted grazing for vegetation management. This handbook includes 18 chapters and represents a compilation of the latest research on harnessing livestock to graze targeted vegetation in ways that improve the function and appearance of a wide variety of landscapes.

**Prescribed Fire:**

*California Invasive Plant Council—The Use of Fire as a Tool for Controlling Invasive Plants.* http://www.cal-ipc.org/ip/management/UseofFire.pdf
This document contains information on the following: planning and implementing prescribed burns, control of NNIS plants with prescribed fire, using prescribed burning in integrated strategies, effects of fire on plant communities, effects of fire on chemical, physical, and biotic properties of soil.

*Center for Invasive Plant Management (CIPM)—Fire As a Tool For Controlling Nonnative Invasive Plants.* http://www.weedcenter.org/management/burning_weeds.pdf
This review focuses on the intentional use of fire, alone or integrated with other methods, to control exotic plants in North America.

*Wisconsin Prescribed Fire Council.* http://www.prescribedfire.org/index.html The Wisconsin Prescribed Fire Council strives to make the use of prescribed fire in Wisconsin safer and more accepted for all practitioners. The site provides information and links on government relations, liability, training, weather, and fire implementation.

**Herbicide:**

*Department of Agriculture Trade and Consumer Protection (DATCP)—Pesticide Database Searches.* http://www.kellysolutions.com/wi/ Use this site to search for registered pesticide products, the companies that sell and use pesticides, and the people that apply them.

*Herbicide safety information—Material Data Safety (MDS) sheets and product labels.* http://www.cdms.net/LabelsMsds/LMDefault.aspx?t=.

*The Nature Conservancy (TNC)—Safe Herbicide Handling in Natural Areas: A Guide for Land Stewards and Volunteer Stewards.* http://tncweeds.ucdavis.edu/products/library/herbsafe.pdf

*The Nature Conservancy (TNC)—Upkeep and Maintenance of Herbicide Equipment: A guide for natural area stewards.* http://tncweeds.ucdavis.edu/products/library/herbupkeep.pdf

**Early Detection and Rapid Response:**

*iMapInvasives: Geotracking NNIS exotic species.* http://imapinvasives.org/index.html
A consortium developed an on-line GIS-based NNIS mapping tool designed to aid in Early Detection and Rapid Response efforts. The site allows one to display maps and query by NNIS or contributing organization. Currently the site has only sample plant data for the state of New York. Long-term goals for the site include seeking participation of additional states and/or provinces.

*National Biological Information Infrastructure (NBII). National Framework for Early Detection, Rapid Assessment, and Rapid Response to Invasive Species.*
http://159.189.176.5/portal/community/Communities/Ecological_Topics/Invasive_Species/Early_Detection,_Rapid_

Response_(EDRR)/ This framework includes seven main components: 1) identification and validation, 2) reporting, 3) expert verification, 4) occurrence databases, 5) rapid assessment, 6) planning, 7) rapid response.

http://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/wra.pdf *The Nature Conservancy (TNC)—Weed Information Management System (WIMS).* http://tncweeds.ucdavis.edu/wims.html WIMS is a Microsoft Access-based relational database application that is designed to assist natural resource managers in managing their weed data.

*The North American Weed Management Association.* http://www.nawma.org/ The North American Weed Association has developed a data collection standard for NNIS plant monitoring in the western United States and it has been adopted by several federal agencies, including US Forest Service and the National Park Service. At the home page, scroll down to "Mapping Standards" link.

*USDA Forest Service. The Early Warning System for Forest Health Threats in the United States.*
http://www.fs.fed.us/foresthealth/publications/EWS_final_draft.pdf
This is a monitoring framework for early detection and response to environmental threats (e.g., insects, diseases, NNIS, and fire) to forest lands. The framework is based on the following steps: 1) identify potential threats, 2) detect actual threats, 3) assess impacts, and 4) respond.

*Herbarium—Invasive Plants of the Future.* http://dnr.wi.gov/invasives/futureplants/
This monitoring and early reporting project has three main goals: 1) identify and report populations of high-risk early-stage target weed species in Wisconsin; 2) eliminate or contain those populations before they spread; and 3) coordinate long-term monitoring of occurrence sites. All land managers are encouraged to participate in this program.

**Prioritizing Management:**

*NatureServe—An Invasive Species Assessment Protocol: Evaluating Non-Native Plants for Their Impacts on Biodiversity.*
http://www.natureserve.org/library/invasiveSpeciesAssessmentProtocol.pdf
The Invasive Species Assessment Protocol was developed as a tool for assessing, categorizing, and listing non-native NNIS vascular plants according to their impact on biodiversity in a large area such as a nation, state or province, or ecological region. This protocol is designed to make the process of assessing and listing NNIS plants objective and systematic.

*Animal and Plant Health Inspection Service (APHIS)—Weed-Initiated Pest Risk Guidelines for Qualitative Assessments.*

This document provides a template for conducting pest risk analysis: initiating the process by identifying a pest that may qualify as a quarantined pest, and/or pathways that may allow introduction or spread of a quarantine pest; and assessing pest risk (determining which pests are quarantine pests, characterized in terms of likelihood of entry, establishment, spread, and economic importance.)

**Invasive Species Plant Lists:**

*Chequamegon-Nicolet National Forest, Invasive Plants of Immediate Concern.*
http://www.fs.fed.us/r9/cnnf/natres/nnis/species_list.html)

*Invasive Plant Association of Wisconsin, Working List of Invasive Plants in Natural Plant Communities and Wild Areas of the State.*
http://www.ipaw.org/list/list1.htm?n0

*USDA Forest Service, Invasive Plants Field and Reference Guide: An Ecological Perspective of Plant Invaders of Forests and Woodlands.*
http://www.na.fs.fed.us/pubs/misc/ip/ip_field_guide.pdf

*USDA PLANTS Database. Invasive and Noxious Weeds.* http://plants.usda.gov/java/noxiousDriver This database provides information about the vascular plants, mosses, liverworts, hornworts, and lichens of the US, including NNIS plants. It includes species distribution, characteristics, species abstracts, images, references and links to more information.

*Wisconsin DNR, Program Feasibility Study: Invasive Plants in Forests*
*Plants Currently a Problem in Wisconsin's Forests (p.6-12).*
http://dnr.wi.gov/org/land/forestry/Publications/pdf/InvasivePlantStudy.pdf

*WDNR Target Invasive Plants of the Future.*
http://dnr.wi.gov/invasives/futureplants/target.htm

**Insects and Diseases Lists:**

*Wisconsin DNR Forest Health Protection Unit's Annual Report:*
*Forest Health Conditions in Wisconsin, 2005.*
http://dnr.wi.gov/org/land/forestry/fh/pdf/AnnualReport2005.pdf

*The Nature Conservancy's Invasive Species Initiative Regional List of Pests, 2004 (scroll down to Midwest region, but note that this covers from MI to ND, south to TX).*
http://tncweeds.ucdavis.edu/products/gallery/regionlist.html

*WDNR- WPDES General Wastewater Discharge Permits- this link provides regulatory information regarding suspended solid, erosion control, Ch. 30 & WPDES permitting among many others.*
http://dnr.wi.gov/runoff/

## *ROW Appendix I: Accompanying Regulations*

Each Forest should develop the specific information they require and add here:

**Invasive Plant Statutes and Codes**

**Wisconsin Statutes** http://www.legis.state.wi.us/rsb/stats.html
See left navigation area to search for a specific Statute in the website's *Info-base* or go to a Statute Chapter.

**15.34 Department of natural resources; creation.**
**15.347 Same; councils.**
**(18)** INVASIVE SPECIES COUNCIL
**History:** 1973 c.74; 1991 a.316; 2001 a.16.

**23.22 Invasive species.**
**Cross Reference:** See also ch. NR 198, Wis. adm. code.
**History:** 2001 a. 109 ss. 72t, 72xd; 2003 a. 33.

**23.235 Nuisance weeds.**
**History:** 1987 a. 41; 1999 a. 150 s. 616; Stats. 1999 s. 23.235; 2001 a. 16; 2001 109 ss. 72td to 72wj.

**26.02 Council on forestry.**
**History:** 2001 a. 109.

**66.0407 Noxious weeds.**
**History:** 1975 c. 394 s. 12; 1975 c. 421; Stats. 1975 s. 66.96; 1983 a. 112, 189; 1989 a. 56 s. 258; 1991 a. 39, 316; 1997 a. 287; 1999 a. 150 ss. 617 to 619; Stats. 1999 s. 66.0407.

**94.38 Agricultural and vegetable seeds; definitions.**
**History:** 1975 c. 39, 308; 1983 a. 189; 1985 a. 138; 1993 a. 112.

**94.39 Seed labeling requirements.**
**History:** 1975 c. 39, 308; 1985 a. 138.

**94.41 Prohibitions.**
**History:** 1973 c. 194, 195; 1985 a. 138; 1993 a. 492.

**94.45 Powers and authority of the department** [Department of Agriculture].
**History:** 1975 c. 39, 308; 1983 a. 189 s. 329 (20).
**Cross Reference:** See also ch. ATCP 20, Wis. adm. code.

Administrative Code http://www.legis.state.wi.us/rsb/code.htm
See left navigation area to search for a specific Statute in the website's *Infobase* or go to a Code Chapter (look under "NR Natural Resources".) http://www.legis.state.wi.us/rsb/code/codtoc.html

**NR 150.025 Policy.**
**History:** Register, February, 1981, No. 302, eff. 3-1-81; renum. (2) (g) and (h) to be (2) (h) and (i), cr. (2) (g), Register, February, 1984, No. 338, eff. 3-1-84; am. (2) (e), Register, January, 1987, No. 373, eff. 2-1-87.

**NR 44.04 Master plan development, adoption and public involvement.**
**History:** Cr. Register, August, 1996, No. 488, eff. 9–1–96.

**Insects and Diseases Statutes**

WISCONSIN:
Wisconsin Statutes http://www.legis.state.wi.us/rsb/stats.html
See left navigation area to search for a specific Statute in the website's *Infobase* or go to a Statute Chapter:
http://www.legis.state.wi.us/rsb/Statutes.html

*Wisconsin Statutes that apply to the Department of Natural Resources (WDNR):*

**26.30 Forest insects and diseases; department jurisdiction; procedure.**
**History:** 1977 c. 29 s. 1650m (1); 1979 c. 32 s. 92 (9); 1979 c. 110 s. 60 (11); 1983 a. 189; 1985 a. 13; 1991 a. 316; 2003 a. 33, 57.
**Cross Reference:** See also s. NR 47.910, Wis. adm. code.

*Wisconsin Statutes that apply to the Department of Agriculture, Trade and Consumer Protection (WDATCP):*

**94.01 Plant inspection and pest control authority.**
**History:** 1975 c. 394 s. 18; Stats. 1975 s. 94.01.
**Cross Reference:** See also ch. ATCP 21, Wis. adm. code.

**94.02 Abatement of pests.**
**History:** 1975 c. 394ss. 5, 19; 1975 c. 421; Stats. 1975 s. 94.02; 1977 c. 418; 1981 c.20.

**94.10 Nursery stock; inspection and licensing.**
**History:** 1975 c. 394 ss. 20, 22; 1975 c. 421; Stats. 1975 s. 94.10; 1983 a. 189; 1989 a. 31; 1993 a. 16; 1995 a. 27; 1999 a.9.

**94.685 Pesticides; licensing of dealers and distributors of restricted-use pesticides.**
**History:** 1987 a. 27; 1991 a. 269; 1993 a. 16, 490; 1997 a. 27.
**Cross Reference:** See also chs. ATCP29, 30, and 31 and ss. ATCP 160.19 and 160.21, Wis. adm. code.

**94.69 Pesticides; rules.**
**History:** 1975 c. 94s. 91 (10); 1977 c. 106; 1983 a. 410; 1997 a. 27, 237.
**Cross-reference:** See s. 94.709 for prohibition of use of DDT and exceptions to the prohibition.
**Cross Reference:** See also chs. ATCP 29, 30, and 31 and ss. ATCP 160.19 and 160.21, Wis. adm. code.

*Wisconsin Statutes that apply to both the Department of Agriculture, Trade and Consumer Protection (WDATCP) and the Department of Natural Resources (WDNR):*

**146.60 Notice of release of genetically engineered organisms into the environment.**
**History:** 1989 a. 15; 1993 a. 213; 1995 a. 27 s. 9126 (19); 1997 a. 283; 2001 a. 109.

# Urban Forestry Best Management Practices

## Purpose and Scope Statements

### *Purpose*

Forest non-native invasive species (NNIS) can pose a threat to urban forests which provide important environmental, social and economic services such as reduced storm water run-off, improved air quality, energy conservation, improved public health, and increased property values. Urban forestry professionals and homeowners alike can play a role in reducing the impacts of NNIS by following the practices outlined in this guide. The goal is to provide guidance by incorporating NNIS considerations into routine urban forestry activities so as to prevent the introduction and slow the spread of non-native invasive species.

### *Scope*

The best management practice (BMP) statements in this guide are intended to apply to a wide variety of urban forestry activities (including land use planning, landscape design, species selection, planting, maintenance, sanitation and debris disposal, and transportation) on urban forests comprised of all ownerships. The BMPs cover terrestrial plants, insects and diseases of the urban forest.

### *Beyond the Scope*

There are additional needs in NNIS management that are beyond the scope of this guide. These needs are being addressed by complementary efforts that focus on additional vectors and broader scales which are not fully covered in this guide. These include non-regulatory efforts like additional BMP tracks including those that address traditional forestry, recreation, and utility and transportation corridor rights-of-way. Other efforts focus on regulatory programs at regional or national scales including quarantine and port of entry regulations that address movement of NNIS and infested material into and within the United States and federal agency actions to strengthen inspection and management. The BMPs were not intended to provide species-specific control and management recommendations.

## *How to use this Guide*

This guide provides BMPs to aid in the prevention and management of NNIS plants, insects, and diseases in and around cities, towns, villages, and other built environments. The BMPs identified in this guide are our best attempt to identify effective and realistic practices that can be integrated into routine urban forestry activities to limit the impact of NNIS.

This BMP guide was written for arborists, urban foresters, nursery growers and retailers, landscape architects, grounds managers, landscape contractors and other urban forestry professionals. However, professionals and homeowners alike can play a role in helping to reduce the impacts of NNIS by following the practices outlined in this guide. Ultimately, everyone involved in the care and management of trees, shrubs and other vegetation shares in the responsibility of preventing and controlling NNIS. By taking reasonable and practical precautions today, we can help protect urban forests and other lands into the future.

The guide recognizes a wide range of possible response options to any NNIS situation. Determining appropriate action in response to the large number of current and potential NNIS involves complex decisions that are context-dependent. For that reason, practitioners applying BMPs need to be allowed a great deal of latitude to select strategies and responses appropriate for their circumstances. This guide does not give priority to any particular BMP. Practitioners will need to decide how best to prioritize and implement the BMPs for their particular situation. Response options will need to recognize the degree of threat posed by an NNIS, the objectives of the homeowner or client, the resources available (if any) for additional management activities, and the costs that will be borne by those implementing the BMPs.

The guide is structured as in the following example:

→ **BMP Statement: NNIS BMPs are in bold font and are set off from the body of the document with an arrow. These statements are intended to describe voluntary practices that may reduce the impact of NNIS.**

Considerations:

a. BMP Considerations are listed below the BMP Statement.

b. BMP Considerations were written to give more information about why the BMP is important.

c. BMP Considerations introduce items that could be used to address the BMP; they do not apply to every species or situation, and the user does not necessarily have to follow them to address the BMP (i.e., they are optional).

d. BMP Considerations may include details, suggestions, examples, and issues to consider about NNIS and applying the BMP.

See Appendices as directed for more information.

# Chapter 1. Introduction

## *What are Non-native Invasive Species (NNIS)?*

NNIS are species that are not native to the ecosystem under consideration whose introduction causes or is likely to cause economic or environmental harm or harm to human health (National Invasive Species Council 2001, 2008). Essentially, NNIS are plants, animals and pathogens that are "out of place." A species is regarded as NNIS if it has been introduced to a location, area, or region where it did not previously occur naturally (i.e. is not native), becomes capable of establishing a breeding population in the new location without further intervention by humans, and spreads widely throughout the new location.

Invasive species often exhibit aggressive reproductive qualities, such as rapid growth, abundant seed production, widespread seed dispersal, and vigorous vegetative spread. They are highly adaptable and are able to tolerate a wide range of environmental conditions. Invasive species often leave their predators, parasites, competitors and diseases behind in their native ecosystems without which they are better able to reproduce rapidly and out-compete native species.

Invasive species have been introduced in a variety of ways. Some species initially introduced for beneficial reasons, later turned out to be invasive. Examples include Asian bush honeysuckle and purple loosestrife introduced for use as ornamental and landscape plants; reed canary grass introduced for forage and erosion control; garlic mustard introduced for use as a culinary herb; and gypsy moth introduced in an attempt to breed a hardier silkworm. Increases in domestic and international trade are resulting in an increasing rate of unintentional introductions. These include the Asian longhorned beetle which likely arrived in the United States on solid wood packing material carried in cargo ships or airplanes from its native Asia.

Because most initial introductions occur in urban areas, the impacts of NNIS generally first occur in our urban forests. In turn, urban forests are often a source of invasive problems for our natural areas and rural landscapes.

> The term **invasive disease** is used throughout this document. Although diseases themselves are not technically invasive, the pathogens that cause plant diseases (including but not limited to fungi, bacteria, viruses and phytoplasmas) can be invasive when they infect a susceptible host and conditions are favorable for disease to develop.

## *What is the Urban Forest and Urban Forestry?*

The urban forest is comprised of all the trees, shrubs, groundcovers and associated vegetation, native and non-native, in and around a city, village or town in association with the buildings, infrastructure, soil, water, air, topography, animals and people. The urban forest includes landscaped private properties, trees along our streets, vegetation in our parks, trails, natural areas and more. Some of this vegetation was willfully planted and is carefully managed by the owners, while other vegetation is an accident of land-use decisions, economics, topography or neglect (Miller 1997). This mosaic or patchwork of highly altered landscapes spans properties, ownerships and jurisdictions.

**The Urban Forest, Oshkosh, WI.** Photo by Bill Sturm

Examples of the Urban Forest:

**The state capitol grounds Madison, WI.** Photo by Jeff Roe, WDNR

**Parking lot.** Photo by WDNR

The Urban Forest...

The Urban Forest...

**Office park in Neenah, WI.** Photo by Trevor Fink

**Urban riverway, Wausau, WI.** Photo by Bob Queen, WDNR

**Development adjacent to a conservancy area, Middleton, WI.** Photo by Andy Adams, Wisconsin DNR

**A rain garden planting on school grounds, Milwaukee, WI.** Photo by Bob Queen, Wisconsin DNR

Urban Forestry is the art, science and technology of managing the urban forest landscape for the environmental, ecological, physiological, sociological, economic and aesthetic benefits that trees, shrubs, groundcovers and associated vegetation provide. This includes arboricultural practices as well as horticulture, gardening, landscaping and lawn care. Urban forest landscapes are best managed on various levels of scale because they come in all shapes and sizes and can span properties, ownerships and jurisdictions.

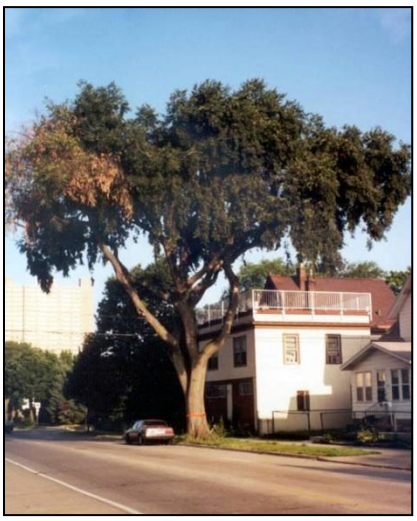
Boundaries of the urban forest are *not solid.* The urban forest can include a subdivision surrounded by farm fields. Likewise, a residential yard on property out in the country can be considered part of the urban forest because it is managed as such. A forested area in the center of town is also considered part of the urban forest.

## What impacts have NNIS had in the Urban Forest?

NNIs plants, insects and diseases can alter ecological relationships in our urban and community forests, as well as, negatively affect the economic, social and environmental benefits our urban and community forests provide.

NNIS can displace, weaken or kill desirable plants resulting in loss of diversity; pose human health risks; degrade wildlife habitat; interfere with recreational activities; disrupt urban ecosystems, and divert millions of dollars for their control. In the United States, expenses associated with ecological damage and control of NNIS is estimated at $137 billion per year and increasing (Pimental et al. 2001). NNIS have left our communities with exorbitant control costs, decreased economic, environmental and social benefits, and decreased biodiversity.

The American elm (*Ulmus americana*) was once a major component of Wisconsin's residential and street tree populations until an Asian fungus (*Ophiostoma ulmi)* was introduced on European logs. The disease, coined Dutch elm disease, was spread by two beetle species, one European and one native, and by 1980 had killed the majority of elm trees. At one time, elms accounted for 50 to 75 percent of the total urban forest in many Wisconsin communities, and as much as 95 to 99 percent in some communities (Hafstad et al. 1965). Local governments, their residents and property owners bore the brunt of removal costs. The impact and economic loss caused by the Dutch elm disease epidemic has been huge; it lead to an estimated loss of 60 million trees in the United States, with a financial loss in the billions (Allison 1989).



**Tree marked for removal due to Dutch elm disease.** Photo by WDNR.

Gypsy moth (*Lymantria dispar*), originally from Europe Asia, and North Africa, was accidentally released in Massachusetts in 1867 in a failed attempt to raise a hardier silkworm. The larvae now defoliate approximately one million acres of oak and aspen forest annually from Maine to Virginia and west to Wisconsin. While gypsy moth has not caused significant mortality, it is an additional stressor that slows growth and often contributes to mortality in trees that have been weakened by previous defoliation or other stressors such as compaction and drought. In large numbers, they can become quite a nuisance for property owners. Additionally, some people can experience allergic reactions when they come in contact with the caterpillar's hair. Wisconsin has taken an aggressive stance to detect, control and slow the spread of the gypsy moth. An estimated 20-30 million dollars has been spent on gypsy moth management in Wisconsin since it first became

established along Lake Michigan in the 1980s. Since then, over two million acres have been treated in Wisconsin alone.


**Defoliation by gypsy moth.** Photo by Tim Tigner, Virginia Department of Forestry, Bugwood.org.


**The adult Emerald Ash Borer.** Photo by Krista Hamilton, WI DATCP.

Emerald ash borer (EAB) is another serious invasive pest which was recently discovered in Wisconsin. Its arrival puts our state's 727 million forest ash and 5 million urban ash in peril. The larvae stage of the insect feeds under the bark of ash trees, cutting off the flow of water and nutrients. Infested trees gradually die over a 3- to 5-year period. About 20 percent of Wisconsin's street trees are ash, the loss of which would be devastating to many communities. Removal costs will again be borne by local governments and property owners. (For an up-to-date map showing EAB distribution, go to http://www.emeraldashborer.wi.gov/.)

NNIS plants are a particular problem in the urban forest due to their ability to quickly colonize areas with high levels of disturbance. Our communities are full of opportunities for these plant invaders to establish themselves. Urban areas experience high use and development which leads to soil compaction, erosion and pollution. Invasive species are better able to take advantage of these conditions than our native species and can quickly populate disturbed sites.

NNIS shrubs such as common buckthorn have taken over parks, woodlands, open spaces and backyards, reducing the richness of desirable species. Common buckthorn (*Rhamnus cathartica*) spreads aggressively once introduced and has been shown to alter soil ecology, making control and restoration of infested sites difficult (Heneghan et al. 2006). It forms dense thickets that negatively impact the establishment of new plantings and makes accessing infested sites difficult (Frappier et al. 2003, 2004).

NNIS forbs are major problem in the urban forest. The invasive plant garlic mustard (*Alliaria petiolata*) is found in backyards, parks, and woodlands alike. It quickly reproduces and out-competes other forbs and seedlings in the area. Garlic mustard appears to suppress tree regeneration by disrupting beneficial associations between tree seedling roots and fungi (mycorrhizal associations), which may help explain its ability to invade undisturbed sites (Stinson et al. 2006).

**Garlic mustard infestation.** Photo by WDNR

NNIS are now widespread across an increasing number of acres in the United States, posing threats

to habitats and economies in areas as diverse as agriculture, forestry, urban forestry, livestock, fisheries, water bodies and recreation. NNIS have spread to a wide range of ecosystems and now rank just behind habitat loss as the leading cause of native and rare species declines (Wilcove et al. 1998).

## What can urban forestry practitioners, landscape and tree managers, governments, property owners and special interest groups do about NNIS?

NNIS do not respect boundaries. They, like urban forests, are best managed on various levels of scale. Individual property owners, urban forestry practitioners, professionals, local, state and federal governments and special interest groups all have a hand in the management of NNIS in our urban and community forests.

Managing existing NNIS infestations is difficult, expensive and often requires years of effort. For that reason, three of the most important NNIS concepts to consider include preventing the occurrence, limiting the spread and reducing impacts. Limiting the spread of NNIS means working to contain an infestation within a defined area. Preventive measures may include restricting activities and minimizing travel through infested areas, especially during certain times of year. Other practices like inspecting clothing and equipment may also limit the spread of NNIS. Following the voluntary BMPs outlined in this guide will help to prevent the introduction and limit the spread of NNIS. Reducing impacts implies that if control and containment methods fail to manage an infestation, a final option may be to reduce the impact on desirable species and the ecosystem. Through this method, the focus shifts from managing NNIS populations to preserving desirable species.

Six elements for managing NNIS include:

- **Prevention–**An awareness of NNIS and an understanding of their mode of invasion are important aspects of planning.
- **Early Detection and Rapid Response–**Detecting new populations early and responding rapidly increases the likelihood of successful control while keeping costs down.
- **Control**–In many cases an NNIS may be too widespread and abundant to eradicate. In those cases, it may be cost-effective to slow the spread of the species through integrated control and management planning.
- **Monitoring**–The periodic inspection of target areas (e.g., travel corridors, access points, post-activity areas and areas with previously treated infestations) can lead to earlier detection and more successful treatment in the long run.
- **Restoration**–NNIS are more likely to colonize sites that have been disturbed. The earlier a land manager can return the land to desirable vegetation or find ways to minimize site disturbance, the less vulnerable a site will be to invasion.
- **Communication and Education**–Educate yourself, employees, volunteers, clients, customers, and users about NNIS. Inform NNIS specialists about new infestations as well as about control methods undertaken and outcomes. This information may be useful for research projects.

# Chapter 2. Elements of Invasive Species Management

In urban forest ecosystems we have a situation that is very different from traditional forested environments. A great diversity of vegetation, native and non-native, can be found in our communities. This includes landscaped private properties, trees along our streets, vegetation in our parks, trails, natural areas and more. Some of this vegetation was willfully planted and is carefully managed by the owners, while other vegetation is an accident of land-use decisions, economics, topography or neglect (Miller 1997). This mosaic or patchwork of highly altered landscapes spans properties, ownerships and jurisdictions. NNIS do not respect boundaries. They, like urban forests, are best managed on various scales. Individual property owners, urban forestry practitioners, professionals, local, state and federal governments and special interest groups all have a hand in the management of NNIS.

NNIS management programs across the country have incorporated several common elements including: Prevention, Early Detection and Rapid Response, Control and Restoration. These elements serve as guiding principles of the National NNIS Management Plan and form the basis for the USDA-Forest Service NNIS Program. Elements of NNIS management include physical means, but they may also include legislative, education and planning components as well. These elements can help guide the actions of those who are concerned about NNIS within our urban forests. For example, these elements can assist homeowners and companies managing individual properties. Municipal tree managers may use the elements to manage NNIS for an area that includes hundreds of different properties within their community. A multi-agency or multi-partner approach would be needed for even broader scales.

## *Prevention*

An effective, economical and ecologically sound approach to managing NNIS is to prevent their introduction in the first place. This guide addresses practices that attempt to prevent the introduction and spread of NNIS in urban forests.

Resources are often limited for NNIS management. Once an NNIS population becomes established, the management can be expensive, and in many cases, eradication may be impossible. While it is still necessary to attempt to control the spread of established populations into non-infested areas, resources might be spent more efficiently on proactive management that focuses on the prevention of new invasions.

Elements of prevention can include:

- Education and identification outreach and training
- Preventing the deliberate planting of NNIS species
- Preventing the introduction of seeds/eggs/organisms into an area
- Developing local ordinances and state and federal legislation to address NNIS
- Early detection and eradication of small populations of NNIS
- Periodically inspecting high-risk areas such as in and near travel corridors and access points
- Maintaining healthy and vigorous trees and other vegetation to best compete with NNIS
- Minimizing disturbance of desirable vegetation

- Mulching, revegetating or treating areas of bare soil
- Periodically evaluating the effectiveness of prevention efforts

When planning urban forestry projects that are in or near infested areas or will occur during peak transmission times, it may be beneficial to consider NNIS management as a part of project decisions in order to prevent the movement of NNIS.

## *Early Detection and Rapid Response*

One of the most difficult aspects of managing NNIS is that they are usually widespread before they are recognized as harmful. Some species, like small insects or fungi, are so inconspicuous that populations can go unnoticed for many years after introduction. Others species are non-invasive at first, but become invasive later due to adaptation, because wildlife begin to spread them (e.g. multiflora rose) or because population sizes reach the point where exponential growth allows them to increase rapidly.

Figure 3 illustrates this problem using a hypothetical population with a growth rate of 1.5x each generation. For the first 30 generations population growth is barely detectable; this is called the lag phase. After that, the species reaches a population threshold that allows for a rapid increase in the next ten generations – the exponential growth phase. Often a species is not recognized as invasive until it reaches the exponential phase, but by this point control is very difficult and eradication usually impossible. Gaining an advantage in controlling such species may require taking action during the lag phase, rather than assuming that these species will not become invasive in the future. Recognizing invasive characteristics and taking action early in the invasion process will make control efforts more effective and less costly.

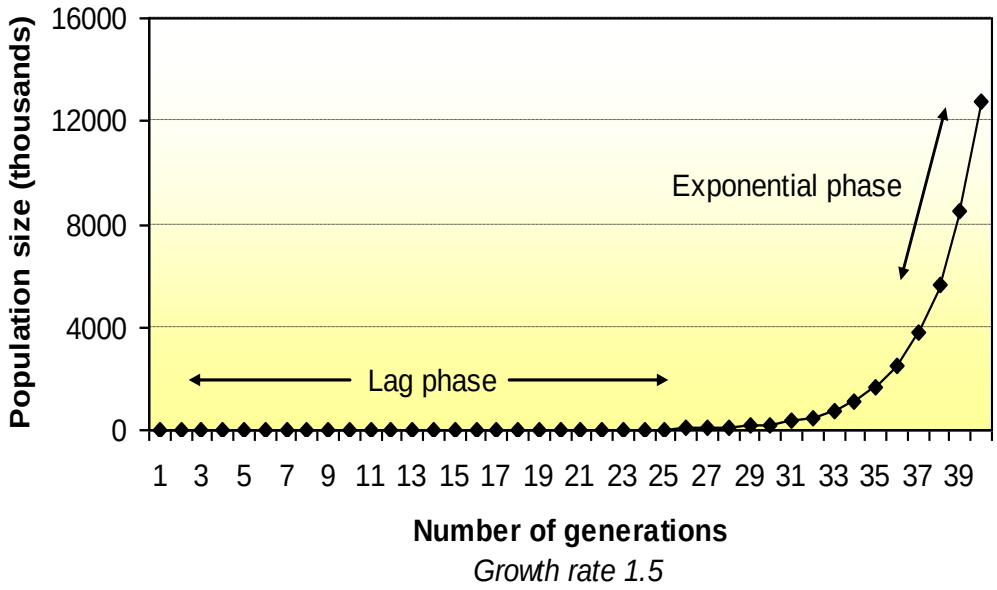



**Figure 3. Population growth curve, illustrating the lag and exponential phases for a hypothetical population with a growth rate of 1.5x each generation. Population growth rates vary by species. A species with a growth rate higher than 1.5x (e.g. musk thistle, at 2.2x (Shea and Kelly 2004)) would have a shorter lag phase, and one with a lower growth rate (e.g., spotted knapweed, at 1.17x (Emery and Gross 2005)) would have a longer lag phase.**

> *Even the best prevention efforts cannot stop all introductions. Early detection of incipient invasions and quick, coordinated responses are needed to eradicate or contain NNIS before they become too widespread and control becomes technically and/or financially impossible. Populations that are not addressed early may require costly ongoing control efforts.*
> -National Invasive Species Management Plan, 2001

It is widely agreed that exclusion is the most effective approach to the problem of NNIS. However, there is a similar consensus that in the current climate of trade and travel, more introductions are inevitable. Because the chances for eradication or control are greatest immediately after introduction, early detection and rapid response will be an important part of managing NNIS (Worall 2002).

**Early Detection**, as applied to NNIS, is a comprehensive, integrated system of active or passive surveillance to find new populations of NNIS as early as possible, when eradication and control are still feasible and less costly. It may be targeted at: a.) areas where introductions are likely such as ports of entry, municipal campgrounds or natural areas that border residential properties, b.) areas with high ecological value to the urban forest where impacts are likely to be significant, and c.) vulnerable habitats or recently disturbed areas (Worall 2002).

**Rapid response** is a systematic effort to eradicate, control or contain NNIS while the infestation is still localized. It may be implemented in response to new introductions or to isolated infestations of a previously established species. Preliminary assessment and subsequent monitoring may be part of the response. It is most effective when based on a plan organized in advance so that the response is rapid and efficient (Worall 2002). Everyone involved in the response should understand the priority for this effort in a world with many and often conflicting priorities.

It is ultimately up to property owners and managers to stay vigilant and take action for NNIS on their property. They must be ready and willing to alert the proper authorities in the case of regulated species, such as emerald ash borer. Of course, federal, state, and local governments have a role to play in supporting the efforts of the private citizen, as well as, urban forestry practitioners who have a responsibility to educate and inform their clients, report findings and, if possible, offer solutions.

## *Control and Management*

There are control strategies and control methods. The control strategies described below are: eradication, containment and reducing impacts. Control strategies are different approaches to addressing NNIS based on, for example, the size of an infestation, the source of infestation, the quality of the invaded site, the amount of resources available, etc.

Control methods are measures employed to carry out control strategies. They include manual (pulling and burning); mechanical (cutting and tilling); chemical (targeted pesticide use); biological (use of the fungus *Bacillus thuringiensis* (BT) for insect pests); and cultural methods (planting non-host tree species). Usually no one method is effective at controlling NNIS. To determine the best method or combination of methods to use, one should evaluate the site and the life cycle of the NNIS of concern.

When a combination of control methods is used it is referred to as integrated pest management (IPM). In the urban forest context, integrated pest management can be defined as the maintenance of destructive agents (plants, insects and diseases) at tolerable levels by the planned use of a variety of preventive, control or regulatory strategies that are ecologically and economically efficient as well as socially acceptable.

**Eradication** is the elimination of the entire population of an NNIS in a defined geographical area. Site level eradication of some invasive populations can be an attainable goal if new introductions are detected

early, resources are available and infestations are not large or pervasive. When limited resources or the degree of infestation rule out eradication, a more realistic management goal may be to slow the spread or reduce the impacts of NNIS.

**Slowing the spread of NNIS**, or **containment**, refers to the process or goal of containing an infestation within a defined geographical area (Moore 2005). Containment to a defined area can be very effective at limiting the regional spread of an NNIS. However, containing a species in a defined area requires constant attention and control of the species at the boundary of the defined area. Steps must be taken to prevent spread and new infestations must be located early so control measures can be implemented quickly. Steps in a containment program may include inventory and prioritization of populations for treatment, restricting activities in certain areas or during certain times of year, inspecting and cleaning clothing and equipment to minimize species transport, and locating and controlling new infestations promptly. Successful containment can be costly and difficult to achieve.

Another strategy is to **reduce the impact of NNIS** on the local and regional urban forestry ecosystems to a level necessary to meet site management goals. At this level, the focus shifts from managing NNIS populations to managing the local and regional urban forestry ecosystems. Methods for reducing the impacts of well-established and widespread NNIS can include planting a diversity of tree species or planting species less susceptible to invasive insects and diseases. This strategy can be used simultaneously and in conjunction with the other strategies, especially for species known to be difficult to control.

Control strategies must strike a balance between the ecological impacts of allowing NNIS to spread and the economic realities of control methods. Not all control methods are practical, effective, economically feasible or environmentally sound for application in the urban environment. Control strategies should be integrated in ways that maximize management objectives while minimizing negative environmental impacts. Furthermore, control methods continue to develop based on ongoing research. Therefore, the most recent science should be consulted to determine an appropriate course of action.

## *Monitoring*

Monitoring is the periodic inspection of sites to detect new invasions and evaluate the success of applied management plans and control measures. The early detection of new infestations in recently treated areas may make control measures more successful and may reduce costs.

Monitoring can be an informal process, or it can be highly formal. Most urban forestry managers will not need complex monitoring programs; monitoring should be kept as simple as possible and can be integrated with other urban forestry activities. Monitoring can be simplified by setting priorities, including identifying specific areas to visit, identifying specific species to monitor and using a list of prioritized target species likely to be encountered in an area (Colorado Natural Areas Program 2000). Target areas can include areas susceptible to invasion, such as transportation corridors and recently disturbed areas, and/or previous infestations that have undergone control measures. Target species can include those susceptible to specific invasive insects or diseases. Periodic visits to these areas and of these species will allow urban forestry managers to detect new invasions and assess the success of their control efforts.

## *Restoration*

Restoration that establishes and maintains healthy plant communities may prevent NNIS infestations or prevent reoccurrence after NNIS removal. Urban forest restoration seeks to reestablish the ecological health of the urban forest by returning some of its structure and function lost through development,

mismanagement or the neglect of time. Options for restoration sites include: yards, vacant lots, shopping centers, schoolyards, parks, industrial parks, brown fields and waterways (Duryea et al. 2000). Successful projects should have the support of the community and a well laid-out restoration plan. Examples include: eliminating mowing or leaf-raking in a park to re-establish a natural forest floor, planting non-invasive, site-appropriate species to decrease erosion or planting a rain garden in a residential yard. Additional benefits to urban forest restoration include improved storm-water management, increased wildlife habitat, and increased biodiversity. By returning the urban forest to a form which is more ecologically sustainable, it can contribute to a community instead of being a drain on its resources.

## *Communication and Education*

We all have a stake in reducing the negative impacts of NNIS. The prevention and control of NNIS will require modifying behaviors, values and beliefs and changing the way decisions are made. A successful plan to address NNIS issues will depend on the understanding and acceptance of the magnitude and urgency of the NNIS problem and the actions needed to protect our valuable resources. A wide variety of education, outreach and training programs are needed: to raise awareness of the causes of establishment and consequences of NNIS, to educate people about their management options, to keep them abreast of the most current information and to help motivate them to take action.

# Chapter 3. Planning

NNIS introduction and spread can be minimized with proper planning. Long term costs can be decreased and resources can be used more effectively and efficiently when land use and activity planning take NNIS into account. This chapter is divided into these two major types of planning activities: land use planning and activity planning.

***Land Use Planning***

**BMP 3.1: Know which NNIS affect or could affect your region and property.**

**BMP 3.2: Assess the extent of NNIS on and near the property by scouting and documenting infestations.**

**BMP 3.3: Assess current available resources and explore additional resources to prevent the introduction and manage the spread of NNIS.**

**BMP 3.4: Develop a plan for managing NNIS.**

**BMP 3.5: Provide training on identification, management, and prevention techniques of known NNIS to employees, contractors, volunteers, elected officials, owners, users, and the public.**

***Activity Planning***

**BMP 3.6: When planning for a specific management/maintenance activity, scout for NNIS both within and around the activity area.**

**BMP 3.7: Plan urban forest management/maintenance activities to limit the introduction and spread of NNIS.**

**BMP 3.8: Plan to monitor each site following management/maintenance activities; determine necessary treatments based on presence of NNIS.**

**BMP 3.9: As opportunities arise, interact with and engage researchers to further our understanding of NNIS.**

## *Land Use Planning*

Land use planning is a conceptual process that can be done for any property. It may consist of ideas and approaches that are never committed to paper, or can result in a detailed written document. Land use planning is a good way to identify long-term goals, set priorities, develop a timeline and identify tools needed and available resources. It considers the rationale for various aspects of management and maintenance, including sustainability and providing services to its users. By evaluating the potential risk of NNIS on the property, one can develop a plan for managing those NNIS; thus, helping achieve success for the overall management plan. Keep in mind that a good plan will be flexible and adaptive; for instance, priorities may change over time or impacts of invasion may be over- or under-estimated.

## NNIS and urban forest management

There are many types of managed urban forest lands, including residential properties, subdivisions, street easements, city parks, school grounds, golf courses, corporate campuses, cemeteries, public gardens or arboreta, zoos, natural areas and nature centers to name a few. Land managers may be the residents, owners, employees, contractors or even volunteers. They may or may not be trained in land management and landscape maintenance.

Land managers often find that their ability to meet site management goals and users' needs is inhibited, if not prevented, by the presence of NNIS. For example, invasive thorny shrubs may limit use by park visitors; invasive insects and diseases can kill trees and other vegetation; and some invasive plants, such as wild parsnip and giant hogweed, may present health risks. Furthermore, NNIS control efforts may divert resources from other property management and development activities.

Land management and NNIS control efforts can become more complicated when users, equipment and property staff inadvertently spread seeds, soil and propagules from infested sites to uninfested sites. Failure to promptly address new infestations of NNIS can lead to a greater drain on future resources.

**Propagule** (prŏp′ ə gyool) = Any reproductive structure or part of an organism that can grow independently of its parent source. In plants, this may be a fruit, seed, bud, tuber, root, stem with rooting structures or shoot. In forest insects, this may be an egg, larva, pupa or adult. In forest diseases, this may be a spore, mycelial fragment (similar to roots) or a fruiting body.

**→BMP 3.1: Know which NNIS affect or could affect your region and property.**

Considerations:

a. See Appendices *C: Terrestrial Invasive Plants in Wisconsin* and *D: Short List of Invasive Insects and Diseases for Wisconsin*.

b. Know which plant species on your property are susceptible to invasive insects and diseases.

c. Understand how NNIS impact your valued resources.

**→BMP 3.2: Assess the extent of NNIS on and near the property by inventorying and documenting infestations.**

Considerations:

Knowing which NNIS are present, and their location, is the first piece of information needed to evaluate threats. There are several steps to consider when inventorying for NNIS:

a. Inventory for NNIS at probable introduction sites such as access points (trails, roads, parking lots, rest stops, major ports of entry e.g., shipping ports and other examples), transportation corridors, new plantings, construction areas, other disturbed areas and stands of dead/dying/stressed trees, wood waste sites, wood product companies, greenways, drainage ways, waterways and elsewhere.

b. Identify specific management activities that will be occurring on and near the property in the short and long term. Inventory for NNIS both within and around those activity areas.

c. Document NNIS in a manner consistent with established effective record-keeping practices. (See *Urban Forestry Appendix A, Monitoring,* for examples.)

d. Confer with forest health specialists or other resource managers to identify forest health threats or invasive plant, insect or disease infestations of concern in the area.

e. Cooperate with partners especially when dealing with NNIS on a broader geographical scale or when multi-agency issues are involved.

**→BMP 3.3: Assess current available resources and explore additional resources to prevent the introduction and manage the spread of NNIS.**

Considerations:

a. Available resources include facilities, equipment, funding, knowledge base and human resources (both staff and volunteers).

b. Identify local and regional partners, such as neighborhood groups, with whom you may collaborate.

c. Identify individuals or groups with a primary focus on NNIS; if these are volunteers, provide staff support and ways to sustain their commitment.

d. Access information on grants, funding and supportive organizations.

e. Know which regulatory tools are available. For example, federal and state governments may utilize quarantines.

**→BMP 3.4: Develop a plan for managing NNIS.**

Considerations:

The extent of the plan should take into consideration property size and management goals. An NNIS management plan may include some or all of the following elements, as appropriate:

a. Preventative measures to limit introductions of NNIS to the property.

b. Early detection of NNIS populations.

c. Measures for an assessment of NNIS threats (prioritization) that considers the impact of NNIS on the property and feasibility of control.

d. Goals for reducing impacts of NNIS present on the property. Sample goals might include:

- Reduce abundance of host species [for insects and diseases] or habitat [for plants] by increasing vegetative diversity.
- Revegetate disturbed areas with desirable, non-invasive plants and cover exposed soil with mulch in a timely manner to prevent the establishment of NNIS.
- Use regular monitoring and early detection to identify and control small populations of NNIS.
- Use appropriate methods to prevent the introduction of soil, seeds and propagules into uninfested areas (e.g., slow spread, reduce abundance, eradicate).

e. Methods for managing NNIS (e.g., guide, mechanical, chemical, biological and cultural). Keep in mind the resources you have available to control NNIS. Identify key staff and volunteers, budget, and equipment.

f. Methods for educating and informing users, staff, contractors and volunteers on NNIS including identification, impacts and prevention.

g. Discussions with neighbors and other land managers in your area. Consider cooperative projects and share your findings.

→**BMP 3.5: Provide training on identification, management, and prevention techniques of known NNIS to employees, contractors, volunteers, elected officials, owners, users, and the public.**

Considerations:

a. Encourage prevention as part of land management activities.

b. Post NNIS messages and prevention strategies at prominent locations on the property and surrounding community.

c. Use methods to reach a broad audience such as including NNIS information in your local newspaper or community newsletter.

d. Provide information to your local representatives whose decisions influence NNIS management as well as to the community tree and park managers.

e. Provide information about where to report sightings of NNIS and locations of new infestations.

f. Post informational signs at locations where NNIS management efforts are being implemented; explain impacts, control methods and spread prevention strategies.

g. Present targeted messages during peak use seasons and peak seasons of biological importance i.e. seed production, flowering.

h. Provide incentives for users, volunteers, and employees to support NNIS control and management goals; recognize those who contribute to these efforts.

## *Activity Planning*

Once established, many NNIS can increase even as a result of well-intentioned management or maintenance activities. However, with planning routine management and maintenance activities can help prevent or minimize the spread of NNIS. An *activity*, for purposes of this section, may include any practice that influences vegetation, soils or other habitat conditions such as planting and installation, pruning, mowing or tree removal.

Activity planning may occur on properties of all sizes, uses and types of ownership. Activity plans may be written documents; however, in many cases, activity planning is performed informally by land managers and not committed to paper. Recognizing that planning for activities is accomplished in a variety of ways, the goal of this chapter is to identify a set of steps and considerations that managers can utilize to prevent or minimize the spread of NNIS.

**→BMP 3.6: When planning for a specific management/maintenance activity, inventory for NNIS both within and around the activity area.**

Considerations:

a. Identify management/maintenance activities that will be occurring on and near the property in the short and long term.

b. Determine how management/maintenance activities may affect or may be affected by NNIS on and near the property.

**→BMP 3.7: Plan urban forest management/maintenance activities to limit the introduction and spread of NNIS. (See also BMP 7.1.)**

Considerations:

The planning phase is the time to consider whether special precautions for NNIS are needed and how they will affect the planned activity. The following BMP Considerations are examples of possible ways to address the BMP Statement.

a. Timing

- Consider the need for NNIS control efforts, and determine whether those efforts should occur prior to, after or concurrent with the planned urban forest management/maintenance activity.
- If pre-treatment of NNIS is warranted, postpone activity until the infestation can be treated. Effective pre-treatments sometimes need to occur one to two years prior to the activity or even longer to deplete the seedbank.
- Consider practical seasonal timing options that minimize the risk of introducing or moving an NNIS. (See Figure 4.)
- Consider not carrying out an urban forest management/maintenance activity where spread of NNIS is likely.
- Prioritize and concentrate activities based on the most serious threat to make the most of limited human resources.

b. Boundaries

- Set up activity boundaries to exclude areas infested with NNIS that could be moved by equipment and workers.
- Make sure those involved in the activity are aware of the boundary locations and reasoning for their placement. Consider using signage so people not involved in the activity will be aware of the boundaries.
- Locate and use staging areas that are free of invasive plants to avoid spreading seeds and other viable plant parts.

c. Sequence

- Consider options for the sequence of operations within the activity area and, where feasible, plan to enter areas infested with NNIS last.

d. Cleaning

- Plan for appropriate cleaning of workers and equipment to limit the introduction and spread of NNIS. Make prior arrangements for any cleaning that may be needed in conjunction with the activity. Consider the risks different types of equipment pose to introducing/spreading NNIS. (See also Chapter 8: *Sanitation and Debris Disposal*.)

e. Compaction and Ground disturbance

- Where feasible, avoid creating soil and site conditions that promote invasive plant germination and establishment. Minimize soil disturbance to no more than needed to meet project objectives.
- Consider the impacts of different types of equipment and, where feasible, plan to use equipment that minimizes soil disturbance and compaction.
- Use erosion control techniques to help prevent movement of soil which may contain invasive plants and their propagules.
- Plan ahead of soil disturbing activities to have planting materials and ground covers ready to install to prevent invasion.
- Plan to remediate soil disturbance and compaction caused during projects to allow for establishment of desirable species.

**Wisconsin:**

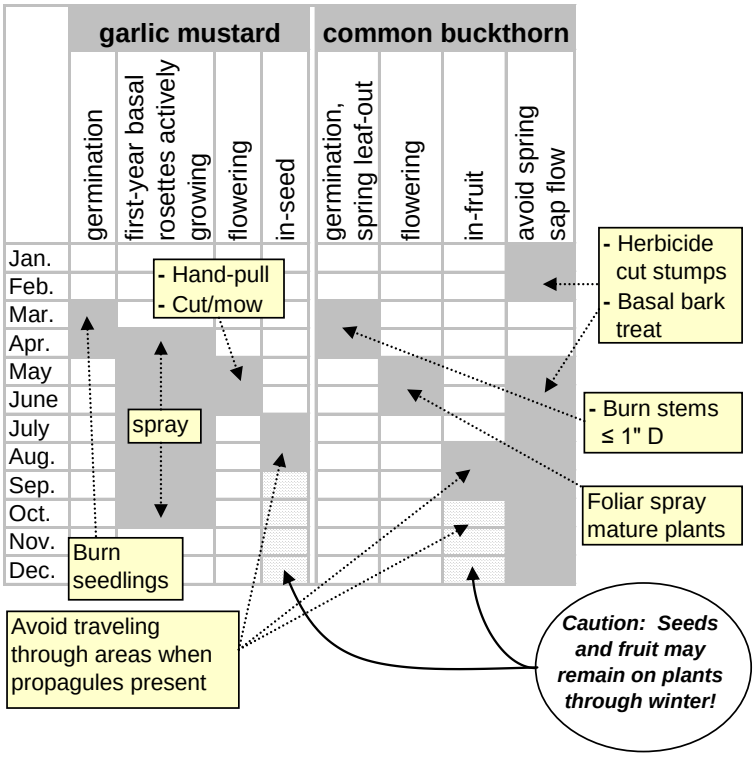



**Figure 4:** Identifying time windows for NNIS species management. Time site preparation activities to avoid spreading invasive seeds and other propagules. The goal of this chart is to present basic planning concepts.

**→BMP 3.8: Plan to monitor each site following urban forestry management/maintenance activities; determine necessary treatments based on presence of NNIS. (See also *Chapter 9: Monitoring and Research.*)**

Considerations:

a. Conduct periodic inspections of each site following management/maintenance activities, anticipate responses of NNIS to activities and check for new infestations or the spread of existing populations. Inspect on an annual basis, at a minimum, for as long as there is an invasive problem.

b. Consider monitoring the entire property on a regular basis. This depends on the size and location of the property as well as the scale, extent and type of NNIS present.

c. Monitoring should be kept as simple as possible to meet NNIS management objectives. It can be integrated with other activities.

d. Determine appropriate control measures to respond to new infestations or spreading populations. Communicate these options with property owner ahead of time in case they don't want to use chemicals. You may need to allow time for other options.

e. While monitoring sites for known NNIS, land managers should be alert for emerging invasive threats such as the emerald ash borer.

**→BMP 3.9: As opportunities arise, interact with and engage researchers to further our understanding of NNIS. (See also BMP 9.6.)**

Our understanding of NNIS ecology and prevention is increasing but still insufficient to contain or control NNIS in many situations in which they occur. Our ability to predict what new species may become invasive and what landscape practices may provide habitat for these NNIS is even more limited. Research conducted by universities and institutions is one source for learning about NNIS. Researchers can also benefit by interacting with practitioners and discussing the emerging NNIS issues in the practice of urban forestry and landscaping.

Considerations:

a. Develop on-going communications and partnerships with area universities, colleges and institutions where the potential for research in matters of interest to urban forestry occur.

b. Consider the potential for cooperative research opportunities when undertaking new controls or practices for which little information is available.

c. Researchers could be key partners in a monitoring program to help gauge which new plants, insects and diseases may become invasive and in which situations.

# Chapter 4. Design

Good landscape design can result in a healthier, more aesthetically pleasing, more ecologically sound and more user friendly urban forest. The absence of a good design could actually contribute to NNIS infestations by intentionally introducing them or by ignoring existing NNIS populations and environmental site conditions. Planting species that are not appropriate for the site can lead to poor growth and less disease and insect resistance. NNIS will often move in, taking advantage of such a situation. If NNIS are already present, this may influence the species used and the overall design.

**BMP 4.1: Conduct a site assessment prior to site design.**

**BMP 4.2: Conduct an inventory for NNIS as part of a site assessment.**

**BMP 4.3: Do not include NNIS in planting designs.**

**BMP 4.4: Design using plant materials that are site appropriate and less susceptible to highly damaging/detrimental pests and diseases.**

**BMP 4.5: Design planting conditions that foster the establishment and health of plants.**

**BMP 4.6: Diversify the planting material within the context of your design.**

**BMP 4.7: Design with long-term management/maintenance in mind.**

## →BMP 4.1: Conduct a site assessment prior to site design.

Considerations:

a. A site visit to conduct the assessment is necessary. Multiple site visits to conduct the assessment may be necessary depending upon the time of year, ground cover, climatic conditions etc.

b. Factors to consider include: existing hardscapes, below and above ground utilities, neighboring properties, soils, types of ecosystems, microclimate, topography, slope, aspect, hydrology, wildlife, cultural resources, land use and trees and other vegetation including NNIS and potential invaders.

c. Proper site assessment enables selection of vegetation appropriate for the site and therefore more resistant to insects and disease. It locates existing desirable species and conditions that may be utilized in the design. The process identifies areas of NNIS that may need to be treated before implementing a planting plan.

**→BMP 4.2: Conduct an inventory for NNIS as part of a site assessment. (See also *Chapter 9: Monitoring and Research*.)**

Considerations:

Knowing which NNIS are present, their location and extent is the first piece of information needed to evaluate threats. These are some steps to consider in inventorying NNIS:

a. The extent and intensity of inventories should be appropriate to the threat posed by NNIS in or likely to be in the area and by the potential effects of development/design on the spread, release or control of those species.

b. Inventories for invasive insects and diseases should occur at likely introduction sites such as roads and trails, construction sites, new plantings and stands of dead/dying/stressed trees.

c. If possible, include adjacent properties in NNIS inventories.

d. Inventories could also include discussions with forest health specialists or other resource managers to identify invasive plants, insects or diseases of concern in the area as well as any other forest health threats.

e. Be aware of species that look very similar to NNIS.

**→BMP 4.3: Do not include NNIS in planting designs. (See also BMPs 5.1 & 6.2.)**

Considerations:

a. See Urban Forestry Appendix B, Terrestrial Invasive Plants in Wisconsin.

b. Consider replacing existing invasive plants in the final planting design.

**→BMP 4.4: Design using plant materials that are site appropriate and less susceptible to highly damaging/detrimental pests and diseases. (See also BMP 6.4.)**

Considerations:

a. Site-appropriate species are those that are suited to the climate, microclimate (includes wind and sun/shade) and soil type (pH, texture, moisture and drainage) where they are to be planted. In the urban environment, plant material must also be compatible with the hardscapes and maintenance needs.

b. Plant materials (including seeds/seed mixes) from similar hardiness zones or provenances are more likely to be adapted to local growing conditions. Avoid mail orders from sources outside your region unless the contents are guaranteed to be non-invasive.

c. Design with plants which may fulfill multiple needs, e.g., ecological, aesthetic, and wildlife.

**Provenance** (prov' *uh* n*uh* ns) = The geographic seed source (i.e. where the seed or seedling originated). Assures that the seed or seedling will be adaptable to the general climatic conditions of that geographic area.

**Microclimate** = The climate of small spaces, such as an inner city, a residential area, or a mountain valley. Microclimate includes: sun/shade, wind, temperature, and precipitation.

**→BMP 4.5: Design planting conditions that foster the establishment and health of plants.**

Considerations:

a. Healthy vegetation is better able to withstand infestations, infections, and competition from invasive plants.

b. Minimize the amount and severity of soil disturbance to reduce introduction of NNIS to the site.

c. Preserve the existing soil structure if it is intact to foster plant establishment and health; otherwise consider the need for soil amendments.

**→BMP 4.6: Diversify the planting material within the context of your design. (See also BMP 6.5.)**

Considerations:

a. Increased species diversity may reduce the impacts of invasive insects or diseases.

b. A diversity of species may inhibit the spread of invasive insects and diseases.

c. For designs other than natural areas or turf grass, consider striving for a species diversity of no more than 20 percent in one family, no more than 10 percent in one genus and no more than 5 percent of any single species, including cultivars and varieties.

~~d.~~ Consider the existing regional landscape and other designs in the region when diversifying your planting design.

e. Consider a long-term planting strategy to increase age diversity. Increased age diversity may reduce the overall impacts if invasive insects or diseases prefer to attack trees of a certain age or size.

f. Consider plants that are hosts for beneficial insects and birds to improve their habitat and function.

**→BMP 4.7 Design with long-term management/maintenance in mind.**

Considerations:

a. It may be prudent to delay planting or plant in stages to allow time for existing NNIS infestations to be treated prior to planting.

b. Be familiar with NNIS in your region and those that are on their way.

c. Recognize the duration, costs and funding for treatments for plants that are susceptible to invasive insects or diseases.

# Chapter 5. Sales

Some of our worst plant invaders were introduced as ornamentals. Research has shown that 85 percent of woody NNIS in North America were introduced for the landscape trade (Reichard and Hamilton 1997, Snow 2002). The green industry is driven by consumer demand; people are always searching for the latest-and-greatest plants, and new plant introductions are key to the multi-billion dollar industry. Most introduced plants do not cause problems; however, those that do have significant economic and environmental costs. Therefore it is very important to educate the consumer about not using invasive plants and offer non-invasive alternatives.

When it comes to introduced invasive insects and diseases, the green industry is itself a victim. Stock infested or infected with invasive pests may need to be treated or destroyed, and the threat of pests can severely affect demand for host species. Once a big seller, sales of ash species has bottomed out with the increasing threat of emerald ash borer. It becomes even more important for green industry professionals to be vigilant about recognizing and responding to suspected invasive pest problems.

**BMP 5.1: Do not purchase, sell or propagate known invasive plant species or their propagules.**

**BMP 5.2: Do not purchase or sell plant or landscape material you suspect may be infested or infected with invasive pests.**

**BMP 5.3: When available and appropriate, purchase, sell and propagate species, cultivars and varieties known to be less susceptible to invasive pests as alternatives to more susceptible ones.**

**BMP 5.4: Plant propagators, wholesalers and retailers should educate themselves and their customers about invasive plants and potential invasive insect and disease issues associated with host plant materials.**

→**BMP 5.1: Do not purchase, sell or propagate known invasive plant species or their propagules. (See also BMPs 4.3 and 6.2.)**

Considerations:

a. See Urban Forestry Appendix B, Terrestrial Invasive Plants in Wisconsin.

b. In general, lists on websites are updated more often than hard copy lists.

c. Agencies, organizations and groups often have differing points of view about which species are invasive. This is natural considering invasiveness varies due to location, habitat type, disturbance history, urban versus rural, proximity to propagules and many other factors. What may be invasive in one environment may not be invasive in another.

d. The United States Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) regulates the importing and exporting of plant, plant product and soil through the United States. Permits are required for the importation into the U.S. of regulated plants and plant products for consumption and propagation. APHIS does not generally regulate the movement of plants from one state to another, with the exception of parasitic plants, federal noxious weeds (which require a pest permit for interstate movement) and host plants regulated under specific domestic quarantines. The

APHIS State Plant Health Director should be contacted to find out if a domestic quarantine applies to your plants.

**→BMP 5.2: Do not purchase or sell plant or landscape material you suspect may be infested or infected with invasive pests. (See also BMP 6.3.)**

Considerations:

a. See Urban Forestry Appendix C, Short List of Invasive Insects and Diseases for Wisconsin.

b. See Urban Forestry Appendix D, Resources, Sections 3 and 4 for more information on invasive insects and diseases.

c. Inspect plant and landscape material for signs and symptoms of NNIS.

d. Be familiar with invasive plants and the signs and symptoms of invasive insects and diseases that affect or may affect your area.

e. Plants should be purchased only from Licensed Nurseries or from a dealer that has a Grower's License. The Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) inspects and licenses nursery growers and certifies nursery stock to prevent the spread of pests. They also inspect sod to assure it is healthy and free of pests and disease before it is shipped to other states. Licenses assure the purchaser that these nurseries and dealers are in federal compliance and have obtained the proper Certificates necessary to ship outside of quarantined areas and out of state. Licenses are displayed for public view at all companies that are reputable nurseries.

**→BMP 5.3: When available and appropriate, purchase, sell and propagate species, cultivars and varieties known to be less susceptible to invasive pests as alternatives to more susceptible ones.**

Considerations:

a. Examples of this are the elm cultivars which are less susceptible to Dutch elm disease than the standard American elm.

b. Educate buyers about these choices; this could be used as a marketing piece.

c. This should not preclude the use of certain species to achieve biodiversity (e.g., red oak, which is susceptible to oak wilt disease).

**→BMP 5.4: Plant propagators, wholesalers and retailers should educate themselves and their customers about invasive plants and potential invasive insect and disease issues associated with host plant materials.**

Considerations:

a. Plant propagators, wholesalers and retailers should provide guidance to their customers about the invasive potential of these species and where they should or should not be used.

b. Invasive potential should be assessed by the propagator or qualified experts using emerging risk assessment methods that consider plant characteristics and prior observations or experience with the plant elsewhere in the world.

c. Additional insights may be gained through on-going monitoring in the nursery for potential invasiveness.

# Chapter 6. Planting and Installation

Planting and installation activities can introduce and spread NNIS. Disturbed ground provides opportunities for NNIS to germinate. Plant and construction materials brought onto the site may be invasive or may harbor NNIS. Equipment used for planting and installation activities, as well as boots and clothing of personnel, may carry NNIS or their propagules.

**BMP 6.1: Limit the introduction and spread of NNIS during site preparation activities.**

**BMP 6.2: Do not plant NNIS.**

**BMP 6.3: Do not plant material that you suspect may be infested or infected with invasive pests.**

**BMP 6.4: Select plant materials that are site appropriate, healthy and less susceptible to highly damaging/detrimental pests and diseases.**

**BMP 6.5: Diversify the planting material within the context of your planting project.**

**BMP 6.6: Prepare site and plant trees according to current arboriculture industry standards for optimum tree health.**

**BMP 6.7: Reduce the introduction of pathogens and insects by avoiding unnecessary wounding of trees and other vegetation.**

**BMP 6.8: Avoid unnecessary soil disturbance.**

**BMP 6.9: Stabilize disturbed soils in a timely manner to prevent the establishment of NNIS.**

**BMP 6.10: Use landscape materials that are free of NNIS and their propagules.**

**BMP 6.11: Monitor sites following planting and installation activities; determine necessary treatments based on presence of NNIS.**

**BMP 6.12: Prior to relocating equipment, vehicles and trailers, remove soil and debris from exterior surfaces by scraping, brushing, washing or using other methods to minimize the risk of transporting propagules.**

**BMP 6.13: Remove soil, seeds, vegetative matter and other debris from shoes, clothing and tools prior to leaving an area.**

## →BMP 6.1: Limit the introduction and spread of NNIS during site preparation activities.

Site preparation methods should be determined by site conditions and site preparation objectives. Site preparation can be accomplished by mechanical or chemical methods or with the use of fire. Often these methods are used in conjunction to control competing vegetation.

Site preparation methods may involve disturbing the soil bed by removing existing vegetation and exposing soil to create a favorable growing environment for trees or other desirable vegetation. It is important to keep in mind that the majority of site preparation methods will create conditions favorable to invasive plant colonization. New NNIS may become established and existing populations may spread.

Considerations:

a. In areas where NNIS are known to be present, including in the seed bank, it may be necessary to treat NNIS as part of the site preparation process. Keep in mind it is almost always easier to treat NNIS before an area is planted to its desired vegetation.

b. Spot application of herbicides or fire (with the use of a weed torch) may reduce the impact to non-target plants.

c. One goal of site preparation might be to promote invasive plant species germination or growth from the existing soil seedbank or root system—then treating—in order to eliminate some of the seedbank competition before planting desired vegetation.

d. While ground disturbance may be necessary to aid the germination and establishment of desirable vegetation (especially when planting by seed), it should not extend beyond the area where revegetation is desired.

e. Some seed planting may be accomplished by methods requiring little to no soil disturbance (e.g. no till drilling or broadcast seeding prairie in late autumn before first snow.)

f. Avoid damaging branches, stems or roots of trees and other vegetation to be retained in the landscape during mechanical site preparation. Reference *American Standards for Tree Care Operations – Management of Trees and Shrubs During Site Planning (ANSI A300 Part 5)*

g. Time site preparation activities to avoid spreading invasive seeds and other propagules. (See Figure 4.)

h. Inspecting areas at highest risk of invasion following soil disturbance activities may help to detect new invasions.

**Soil seedbank** = The collective name for the store of unsprouted seeds in the soil. For example, although most seeds sprout in the first few years after they fall onto the soil, some spotted knapweed seeds last 10 years in the soil before they sprout.

**→BMP 6.2: Do not plant NNIS. (See also BMP 4.3.)**

Considerations:

a. See Urban Forestry Appendix B, Terrestrial Invasive Plants in Wisconsin.

b. See Urban Forestry Appendix D, Resources, Section 2 for plants to use as an alternative to NNIS.

c. In general, lists on websites are updated more often than hard copy lists.

d. Agencies, organizations and groups often have differing points of view about which species are invasive. This is natural considering invasiveness varies due to location, habitat type, disturbance history, urban versus rural locations, proximity to propagules and many other factors. What may be invasive in one environment may not be invasive in another.

e. The United States Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) regulates the importing and exporting of plant, plant product and soil through the United States.

Permits are required for the importation into the U.S. of regulated plants and plant products for consumption and propagation. APHIS does not generally regulate the movement of plants from one state to another, with the exception of parasitic plants, federal noxious weeds (which require a pest permit for interstate movement) and host plants regulated under specific domestic quarantines. The APHIS State Plant Health Director should be contacted to find out if a domestic quarantine applies to your plants.

**→BMP 6.3: Do not plant material that you suspect may be infested or infected with invasive pests. (See also BMP 5.2.)**

Considerations:

a. See Urban Forestry Appendix C, Short List of Invasive Insects and Diseases for Wisconsin.

b. See Urban Forestry Appendix D, Resources, Sections 3 and 4 for more information on invasive insects and diseases.

c. Inspect plant and landscape material for signs and symptoms of NNIS.

d. Be familiar with invasive plants and the signs and symptoms of invasive insects and diseases that affect or may affect your area.

e. A purchasing contract from the vendor supplying stock may help insure pest free materials if it is specified in the contract.

f. Recognize that NNIS may inhabit the soil associated with nursery stock, e.g. invasive plant propagules, specific invasive insect stages, invasive diseases and even non-native earthworms.

**→BMP 6.4: Select plant materials that are site appropriate, healthy and less susceptible to highly damaging/detrimental pests and diseases. (See also BMP 4.4.)**

Considerations:

a. Healthy trees are less susceptible to insect and disease outbreaks than stressed trees.

b. Site appropriate species are those that are suited to the climate, microclimate (includes wind and sun/shade) and soil type (pH, texture, moisture and drainage) where they are to be planted. In the urban environment, plant material must also be compatible with the hardscapes and maintenance needs.

c. Plant materials (including seeds/seed mixes) from similar hardiness zones or provenances are more likely to be adapted to local growing conditions. Avoid mail orders from sources outside your region unless the contents are guaranteed to be non-invasive.

d. Examine stock before planting—be sure it is not diseased, infested with insects or mislabeled. All plant material shall conform to *American Standards for Nursery Stock* (ANSI Z60.1). (Note: It is not common for stock to be diseased. However, a disease like gall rust could easily be identified, and those plants could be culled.)

e. Some trees and other vegetation are host species or alternative hosts for native diseases and insects. If the potential for damage is low, this should not preclude their use. If the potential for damage is a concern, consider using resistant varieties or a completely different species.

f. Plant species that fulfill multiple needs, e.g. ecological, aesthetic and wildlife.

**→BMP 6.5: Diversify the planting material within the context of your planting project. (See also BMP 4.6.)**

Considerations:

a. Increased species diversity may reduce the impacts of invasive insects or diseases.

b. A diversity of species may inhibit the spread of invasive insects and diseases.

c. For designs other than natural areas or turf grass, consider striving for a species diversity of no more 20 percent in one family, no more than 10 percent in one genus and no more than 5 percent of any single species, including cultivars and varieties.

~~d.~~ Consider the existing regional landscape and other designs in the region when diversifying your planting design.

e. Consider a long term planting strategy to increase age diversity. Increased age diversity may reduce the overall impacts if invasive insects or diseases prefer to attack trees of a certain age or size.

f. Consider plants that are hosts for beneficial insects and birds to improve their habitat and function.

**→BMP 6.6: Prepare site and plant trees according to current arboriculture industry standards for optimum tree health.**

Considerations:

a. Proper site preparation can lead to healthier trees which may be better able to withstand infestations, infections and competition from invasive plants.

b. Selecting a tree to a site that meets the tree's optimum growing conditions will assist the tree in having a less stressful environment and thus, better able to become established in the landscape.

c. Avoid using soils known to be contaminated by herbicide residue or by salt and oil from vehicles and roadways for a better planting medium.

d. See *American Standards for Tree Care Operations- Transplanting* (ANSI A300 Part 6) and its companion publication *Best Management Practices: Tree Planting* from the International Society of Arboriculture.

**→BMP 6.7: Reduce the introduction of pathogens and insects by avoiding unnecessary wounding of trees and other vegetation. (See also BMP 7.4.)**

> **Pathogen** (păth'ə-jən) = An agent that causes disease, especially a living microorganism such as a bacterium or fungus.

Considerations:

a. Avoid wounding during periods of high risk transmission.

b. Erect barriers to protect existing trees and other vegetation from injury during planting and installation activities occurring in the same general area. See *American Standards for Tree Care Operations – Management of Trees and Shrubs During Site Planning (ANSI A300 Part 5).*

**→BMP 6.8: Avoid unnecessary soil disturbance. (See also BMP 7.7.)**

Considerations:

a. Ground disturbance may uproot existing vegetation and expose soil, creating a seedbed for invasive plants that can overwhelm desirable vegetation.

b. Topsoil may be lost to wind or water erosion; local ordinances for silt fencing and other erosion control practices may apply.

c. Soil disturbance, when combined with aggressive follow-up control measures, may be used to control NNIS within infested areas by depleting the seed bank.

d. Disking or tillage operations may propagate invasive plants that spread by rhizomes, root fragments or seed and should, therefore, be used cautiously.

e. After a soil disturbance, encourage prompt regeneration of desirable vegetation or cover exposed soil with a layer of mulch to reduce germination or introduction of invasive plants.

f. After a soil disturbance, monitor the area and treat new invasive plant infestations.

**→BMP 6.9: Stabilize disturbed soils in a timely manner to prevent the establishment of NNIS. (See also BMP 7.8.)**

Considerations:

a. After a soil disturbance, encourage prompt regeneration of desirable vegetation or cover exposed soil with a layer of mulch to reduce germination or introduction of invasive plants.

b. Stabilizing disturbed soils includes: revegetating, mulching (straw, wood, and leaf), the use of biologs or erosion matting, etc.

c. A non-invasive cover crop like annual rye or oats can be used to temporarily stabilize the soil and discouraging the establishment of NNIS.

d. Use weed-free oat or wheat straw where available; “marsh hay” may contain reed canary grass.

e. In areas where NNIS are known to be in the seed bank, treat NNIS before revegetating.

f. You may purposely not plant a disturbed area if your goal is to promote invasive plant species germination from the existing seedbank—then treating it—in order to eliminate some of the invasive seedbank.

g. Inspecting areas at highest risk of invasion following soil disturbance activities may help to detect new invasions.

**→BMP 6.10: Use landscape materials that are free of NNIS and their propagules. (See also BMPs 7.6. and 8.7.)**

Considerations:

a. Landscape materials include: fill, top soil, soil amendments, compost, erosion control materials, stone and mulch.

b. Knowing the source of landscape materials may help you avoid infested source material.

c. Treat infested source material to render NNIS as non-viable prior to its use.

d. Stockpile displaced topsoil for future use on the same site in an NNIS free area. Be aware that if the topsoil is piled too deep, advantageous fungi may be destroyed. This effect varies by soil type, climate and other factors.

e. Keep stockpiled material free of NNIS.

f. Use weed-free oat or wheat straw where available; "marsh hay" may contain reed canary grass.

g. Avoid contaminants such as salt, oil and herbicide residue for a better planting medium.

h. Consider reusing or recycling landscape materials on site to avoid potentially transporting NNIS.

**→BMP 6.11: Monitor sites following planting and installation activities; determine necessary treatments based on presence of NNIS.**

Considerations:

a. Anticipate responses of NNIS to planting and installation activities and check for new infestations or the spread of existing populations.

b. Determine appropriate control measures to respond to new infestations or spreading populations.

c. Monitoring should be kept as simple as possible to meet NNIS management objectives.

**→BMP 6.12: Prior to relocating equipment, vehicles and trailers, remove soil and debris from exterior surfaces by scraping, brushing, washing or using other methods to minimize the risk of transporting propagules. (See also BMPs 7.11 and 8.1.)**

**Equipment cleaning**

NNIS can spread by equipment used in urban forestry, landscaping and maintenance activities, as well as by the workers themselves. Seeds, plant parts, and fungal spores can move in soil or mud in undercarriages, tire tread and on other areas of equipment. Insects in all life stages can also be moved by equipment. Mud and debris stuck to boots, clothing or tools can also transport invasive plant material, insects and disease. NNIS covered under this BMP include plants (fruit, seed, bud, tuber, root, etc.), insects (egg, larvae, pupae, overwintering adults, etc.) or diseases (fungi, bacteria, viruses, etc.).

For purposes of these BMPs:

- "equipment" refers to off-road, rubber-tired and tracked equipment including mowers, skid steers, bucket loaders, dozers, graders, chippers and other construction equipment.
- "relocating" refers to moving off the work site OR moving within the work site from an infested to a non-infested area.
- "disposal" refers to methods to dispose of NNIS which can include burning, treating and containment, i.e., bagging. (See also *Chapter 8: Sanitation and Debris Disposal*.)

Considerations:

a. Equipment should be free of NNIS when it arrives at the work site.

b. Clean equipment after operating in an area with NNIS and before relocating to an area free of NNIS. Cleaning would occur before leaving the project site, at the site of infestation.

c. Preferred locations for equipment cleaning areas are those where:
   - Equipment is unloaded and loaded.
   - Invasives are less likely to spread from cleaned equipment (e.g. a blacktopped parking lot). Collect, bag and dispose of properly. (See also BMP 8.5.)
   - NNIS are already established.
   - Monitoring can be conducted at a later date.

d. To limit the spread of NNIS downstream, do not clean equipment, vehicles or trailers in or near waterways or storm sewers.

e. Contain or filter wash water on-site, if possible.

**→BMP 6.13: Remove soil, seeds, vegetative matter and other debris from shoes, clothing and tools prior to leaving an area. (See also BMPs 7.12 and 8.2.)**

Considerations:

a. Preferred locations for cleaning your person are those where:

   - Equipment is cleaned.
   - Invasives are less likely to spread (e.g., a blacktopped parking lot). Collect, bag and dispose of properly. (See also BMP 8.5.)
   - NNIS are already established.

b. Check places like hoods, pockets, seams and Velcro fasteners.

# Chapter 7. Management/Maintenance

Proper care is essential for maintaining and improving the health of our urban and community forests. Routine maintenance and/or management helps to maximize the benefits they provide and minimize the costs associated with their management. However, these activities often unknowingly introduce and spread NNIS. Maintenance/management activities include, but are not limited to: pruning, removals, mulching, watering, fertilizing and lawn care.

**BMP 7.1: Plan management/maintenance activities to limit the introduction and spread of NNIS.**

**BMP 7.2: When working in an area infested or previously infested with NNIS, utilize monitoring surveys and control records for the property prior to the current work being conducted.**

**BMP 7.3: Minimize the movement of NNIS to non-infested areas during management/maintenance activities.**

**BMP 7.4: Reduce the introduction of pathogens and insects by avoiding unnecessary wounding of trees and other vegetation.**

**BMP 7.5: Perform activities in a way that promotes healthy plants.**

**BMP 7.6: Use landscape materials that are free of NNIS and their propagules.**

**BMP 7.7: Avoid unnecessary soil disturbance.**

**BMP 7.8: Stabilize disturbed soils in a timely manner to prevent the establishment of NNIS.**

**BMP 7.9: Keep records of activities that could affect NNIS.**

**BMP 7.10: If possible, monitor recent work sites for NNIS.**

**BMP 7.11: Prior to relocating equipment, vehicles and trailers, remove soil and debris from exterior surfaces by scraping, brushing, washing or using other methods to minimize the risk of transporting propagules.**

**BMP 7.12: Remove soil, seeds, vegetative matter and other debris from shoes, clothing and tools prior to leaving an area.**

**BMP 7.13: Properly treat or dispose of NNIS or materials that may harbor invasive propagules, insects or diseases.**

**BMP 7.14: If pre- or post-activity NNIS control treatments are planned, ensure they are applied within the appropriate time window and environmental conditions.**

**→BMP 7.1: Plan management/maintenance activities to limit the introduction and spread of NNIS. (See also BMP 3.7.)**

Considerations:

The planning phase is the time to consider whether special precautions for NNIS are needed and how they will affect the planned activity. The following BMP Considerations are examples of possible ways to address the BMP Statement.

a. Timing

- Consider the need for NNIS control efforts, and determine whether those efforts should occur prior to, after or concurrent with the planned urban forest management/maintenance activity.
- If pre-treatment of NNIS is warranted, postpone activity until the infestation can be treated. Effective pre-treatments sometimes need to occur one to two years prior to the activity or even longer to deplete the seedbank.
- Consider practical seasonal timing options that minimize the risk of introducing or moving an NNIS. (See Figure 2.)
- Consider not carrying out an urban forest management/maintenance activity where spread of NNIS is likely.
- Prioritize and concentrate activities based on the most serious threat to make the most of limited human resources.

b. Boundaries

- Set up activity boundaries to exclude areas infested with NNIS that could be moved by equipment and workers.
- Make sure those involved in the activity are aware of the boundary locations and reasoning for their placement. Consider using signage so people not involved in the activity will be aware of the boundaries.
- Locate and use staging areas that are free of invasive plants to avoid spreading seeds and other viable plant parts.

c. Sequence

- Consider options for the sequence of operations within the activity area and, where feasible, plan to enter areas infested with NNIS last.

d. Cleaning

- Plan for appropriate cleaning of workers and equipment to limit the introduction and spread of NNIS. Make prior arrangements for any cleaning that may be needed in conjunction with the activity. Consider the risks different types of equipment pose to introducing/spreading NNIS. (See also *Chapter 8: Sanitation and Debris Disposal*.)

e. Compaction and ground disturbance

- Where feasible, avoid creating soil and site conditions that promote invasive plant germination and establishment. Minimize soil disturbance to no more than needed to meet project objectives.
- Consider the impacts of different types of equipment and, where feasible, plan to use equipment that minimizes soil disturbance and compaction.
- Use erosion control techniques to help prevent movement of soil which may contain invasive plants and their propagules.
- Plan ahead of soil disturbing activities to have planting materials and ground covers ready to install to prevent invasion.
- Plan to remediate soil disturbance and compaction caused during projects to allow for establishment of desirable species.

→**BMP 7.2: When working in an area infested or previously infested with NNIS, utilize monitoring surveys and control records for the property prior to the current work being conducted.**

Considerations:

a. This can help you plan the sequencing of operations so that you're working from non-infested to infested areas.

b. This will also let you know whether or not previous NNIS management techniques have been working and what you could do to achieve better success.

→**BMP 7.3: Minimize the movement of NNIS to non-infested areas during management/maintenance activities.**

Considerations:

a. Locate and use staging areas that are free of invasive plants to avoid spreading seeds and other viable plant parts.

b. Set up activity boundaries to exclude areas with an NNIS infestation that could easily be disturbed by equipment, workers or users.

c. Clean equipment before moving from infested to non-infested areas.

~~d.~~ Carry out work under conditions that minimize the risk of spread, e.g. frozen ground, snow cover, absence of seeds/propagules, etc. (See Figure 4)

e. Exclude infested areas from equipment travel corridors.

f. Disinfect pruning equipment between cuts when pruning out diseased portions of plants.

g. Take measures to minimize the spread of pests when management cannot occur at optimal times. For example, immediately paint wounds on oak trees when they must be pruned during the active oak wilt season.

h. Check for compliance with local ordinances when conducting maintenance activities and when disposing of debris that is infested or infected with NNIS.

**→BMP 7.4: Reduce the introduction of pathogens and insects by avoiding unnecessary wounding of trees and other vegetation. (See also BMP 6.7.)**

Considerations:

a. Avoid wounding during periods of high risk transmission. Refer to current research and literature for specifics, for example, oak wilt and Dutch elm disease. Be sure to check your local ordinances first; local ordinances may use more restrictive dates than the state recommends.

b. Erect barriers to protect existing trees and other vegetation from injury during planting and installation activities occurring in the same general area. See *American Standards for Tree Care Operations – Management of Trees and Shrubs During Site Planning (ANSI A300 Part 5)*.

**→BMP 7.5: Perform activities in a way that promotes healthy plants.**

Considerations:

a. Healthy plants are better able to survive and compete against invasive plants, insects and diseases.

b. Follow ANSI (American National Standards Institute) A300 Standards for Tree Care Operations. For example follow proper pruning, watering, mulching, fertilizing, etc.

**→BMP 7.6: Use landscape materials that are free of NNIS and their propagules. (See also BMPs 6.9. and 8.7.)**

Considerations:

a. Landscape materials include: fill, top soil, soil amendments, compost, erosion control materials, stone and mulch.

b. Knowing the source of landscape materials may help you avoid infested source material.

c. Treat infested source material to render NNIS as non-viable prior to its use.

d. Stockpile displaced topsoil for future use on the same site in an NNIS free area. Be aware that if the topsoil is piled too deep, advantageous fungi may be destroyed. This effect varies by soil type, climate and other factors.

e. Keep stockpiled material free of NNIS.

f. Use weed-free oat or wheat straw where available; "marsh hay" may contain reed canary grass.

g. Avoid contaminants such as salt, oil and herbicide residue for a better planting medium.

h. Consider reusing or recycling landscape materials on site to avoid potentially transporting NNIS.

**→BMP 7.7: Avoid unnecessary soil disturbance. (See also BMP 6.8.)**

Considerations:

a. Ground disturbance may uproot existing vegetation and expose soil, creating a seedbed for NNIS plants that can overwhelm desirable vegetation.

b. Topsoil may be lost to wind or water erosion; local ordinances for silt fencing and other erosion control practices may apply.

c. Soil disturbance, when combined with aggressive follow-up control measures, may be used to control NNIS within infested areas by depleting the seed bank.

d. Disking or tillage operations may propagate invasive plants that spread by rhizomes, root fragments or seed and should, therefore, be used cautiously.

e. After a soil disturbance, encourage prompt regeneration of desirable vegetation or cover exposed soil with a layer of mulch to reduce germination or introduction of NNIS plants.

f. After a soil disturbance, monitor the area and treat new NNIS plant infestations.

→**BMP 7.8: Stabilize disturbed soils in a timely manner to prevent the establishment of NNIS. (See also BMP 6.9.)**

Considerations:

a. After a soil disturbance, encourage prompt regeneration of desirable vegetation or cover exposed soil with a layer of mulch to reduce germination or introduction of invasive plants.

b. Stabilizing disturbed soils includes: revegetating, mulching (straw, wood, and leaf), the use of biologs or erosion matting, etc.

c. An annual cover crop like rye or oats can be used to temporarily stabilize the soil and discouraging the establishment of NNIS.

d. Use weed-free oat or wheat straw where available; “marsh hay” may contain reed canary grass.

e. In areas where NNIS are known to be in the seed bank, treat NNIS before revegetating.

f. You may purposely not plant a disturbed area if your goal is to promote invasive plant species germination from the existing seedbank—then treating it—in order to eliminate some of the invasive seedbank.

g. Inspecting areas at highest risk of invasion following soil disturbance activities may help to detect new invasions.

**→BMP 7.9: Keep records of activities that could affect NNIS. (See also *Chapter 9: Monitoring and Research*.)**

Considerations:

a. This BMP refers to records of maintenance activities such as pruning, removals, mulching, watering, fertilizing and lawn care. It does not refer to records of invasive control techniques, although that may be part of the maintenance activities. If NNIS control techniques are part of the activities, consider using monitoring methods specific to infestations.

b. Record keeping should be consistent with your current management/maintenance recording methods.

c. Records should be complete and accurate.

d. Records should be easily accessible for future reference.

e. Examples of information to include in your records are: times, places, activities and maps.

f. See Urban Forestry Appendix A, Monitoring, for examples of recording sheets.

**→BMP 7.10: If possible, monitor recent work sites for NNIS. (See also BMP 9.3.)**

Considerations:

a. Conduct periodic inspections of each site following management/maintenance activities.

b. Anticipate responses of NNIS to activities and check for new infestations, infections or the spread of existing populations during the appropriate life stage timing for the specific invasive in question.

c. Determine appropriate control measures to respond to new infestations or spreading populations.

**Equipment cleaning**

NNIS can spread by equipment used in urban forestry, landscaping and maintenance activities, as well as by the workers themselves. Seeds, plant parts, and fungal spores can move in soil or mud in undercarriages, tire tread and on other areas of equipment. Insects in all life stages can also be moved by equipment. Mud and debris stuck to boots, clothing or tools can also transport invasive plant material, insects and disease. NNIS covered under this BMP include plants (fruit, seed, bud, tuber, root, etc.), insects (egg, larvae, pupae, overwintering adults, etc.) or diseases (fungi, bacteria, viruses, etc.).

For purposes of these BMPs:

- "equipment" refers to off-road, rubber-tired and tracked equipment including mowers, skid steers, bucket loaders, dozers, graders, chippers and other construction equipment.
- "relocating" refers to moving off the work site OR moving within the work site from an infested to a non-infested area.
- "disposal" refers to methods to dispose of NNIS which can include burning, treating and containment, i.e. bagging. (See also Chapter 8: Sanitation and Debris Disposal.)

**→BMP 7.11: Prior to relocating equipment, vehicles and trailers, remove soil and debris from exterior surfaces by scraping, brushing, washing or using other methods to minimize the risk of transporting propagules. (See also BMPs 6.12 and 8.1.)**

Considerations:

a. Equipment should be free of NNIS when it arrives at the work site.

b. Clean equipment after operating in an area with NNIS and before relocating to an area free of NNIS. Cleaning should occur before leaving the project site, at the site of infestation.

c. Preferred locations for equipment cleaning areas are those where:

   - Equipment is unloaded and loaded.
   - Invasives are less likely to spread from cleaned equipment (e.g. a blacktopped parking lot). Collect, bag and dispose of properly. (See also BMP 8.5.)
   - NNIS are already established.
   - Monitoring can be conducted at a later date.

d. To limit the spread of NNIS downstream, do not clean equipment, vehicles or trailers in or near waterways or storm sewers.

e. Contain or filter wash water on-site, if possible.

**→BMP 7.12: Remove soil, seeds, vegetative matter and other debris from shoes, clothing and tools prior to leaving an area. (See also BMPs 6.13 and 8.2.)**

Considerations:

a. Preferred locations for cleaning your person are those where:

   - Equipment is cleaned.
   - Invasives are less likely to spread (e.g. a blacktopped parking lot). Collect, bag and dispose of properly. (See also BMP 8.5.)
   - NNIS are already established.

b. Check places like hoods, pockets, seams and Velcro fasteners.

**→BMP 7.13: Properly treat or dispose of NNIS or materials that may harbor invasive propagules, insects or diseases. (See also BMP 8.5.)**

Considerations:

a. Place plant materials in a sturdy clear plastic bag labeled “Invasive plants – please landfill” and dispose of as you would with regular garbage.

b. Materials may be disposed of in piles. Locate the pile in an area that facilitates easy monitoring and control if infestations spread from the pile.

c. Materials may be burned. Regulations and permits may apply.

d. Materials may be buried. Burial depth is specific to the invasive. An average minimum depth would be three feet, but some NNIS need to be buried even deeper. For example, Japanese knotweed can grow through five feet of soil. Be aware that if you later dig into this soil you may be exposing propagules.

e. Materials might be utilized for value added products e.g. fuel, furniture, etc.

f. Chipping woody debris may kill invasive pests if chipped to a size specific to the target insect. However, wood chips may still contain other NNIS propagules that may spread if the chips are used in an area other than from where they originated.

g. Material taken from sites that contain invasive plants should not be used away from the site of infestation until all viable plant material is destroyed. Material from areas containing invasive plants may be reused within the *exact* limits of the infestation.

h. Any excavated material that contains viable plant material and is not reused within the limits of the infestation should be stockpiled on an impervious surface until viable plant material is destroyed (Perron 2008).

*i.* Do not dump yard waste in parklands, natural areas and waterways.

*j*. Do not home compost NNIS or their propagules. Backyard compost piles and bins do not reliably generate enough heat for a long enough period of time to destroy weed seeds.

k. If possible, use NNIS control options that don't create waste. For example, use a basal bark treatment on woody NNIS which kills the NNIS as it is left in place instead of a cut stump treatment which creates woody debris.

→**BMP 7.14: If pre- or post-activity NNIS control treatments are planned, ensure they are applied within the appropriate time window and environmental conditions.**

Considerations:

a. Consider life history of target NNIS in relation to seasonal timing of control methods. (See Figure 4.)

b. The party responsible for creating activity plans should be responsible for planning pre- or post-activity NNIS treatments.

c. Allow time and resources for post-activity follow-up control measures, due to persistent seedbank, resprouting and other factors.

d. Allow enough time for control prior to activity.

e. Determine appropriate control measures to respond to new infestations or spreading populations. Communicate these options with property owner ahead of time in case they don't want to use chemicals. You may need to allow time for other options.

f. Environmental conditions are very important for the proper application of herbicides; rain, sun, temperature and wind can all affect the application's effectiveness. Federal law requires the applicator to always follow label instructions.

# Chapter 8. Sanitation and Debris Disposal

The spread of NNIS has been perpetuated by the improper disposal of NNIS and invasive propagules. Inadequate sanitation procedures of equipment used or located in an area that includes NNIS only compounds the problem. Most often, improper disposal and sanitation results from a lack of knowledge about NNIS and the damage they cause, rather than from intentional means. The spread of NNIS and new introductions can be reduced by properly disposing of debris and by using effective sanitation procedures.

**BMP 8.1: Prior to relocating equipment, vehicles and trailers, remove soil and debris from exterior surfaces by scraping, brushing, washing or using other methods to minimize the risk of transporting propagules.**

**BMP 8.2: Remove soil, seeds, vegetative matter and other debris from shoes, clothing and tools prior to leaving an area.**

**BMP 8.3: Minimize the offsite transport of NNIS and materials that may contain NNIS.**

**BMP 8.4: When necessary to transport NNIS and materials that may contain NNIS off site, cover or otherwise contain those materials.**

**BMP 8.5: Properly treat or dispose of NNIS or materials that may harbor invasive propagules, insects or diseases.**

**BMP 8.6: Allow compost piles to heat to appropriate temperatures and times and with proper procedures to reduce the viability of NNIS contained within.**

**BMP 8.7: Avoid the use of wood chips and compost that may contain invasive propagules.**

## Equipment cleaning

NNIS can spread by equipment used in urban forestry, landscaping and maintenance activities, as well as by the workers themselves. Seeds, plant parts, and fungal spores can move in soil or mud in undercarriages, tire tread and on other areas of equipment. Insects in all life stages can also be moved by equipment. Mud and debris stuck to boots, clothing or tools can also transport invasive plant material, insects and disease. NNIS covered under this BMP include plants (fruit, seed, bud, tuber, root, etc.), insects (egg, larvae, pupae, overwintering adults, etc.) or diseases (fungi, bacteria, viruses, etc.).

For purposes of these BMPs:

- “equipment” refers to off-road, rubber-tired and tracked equipment including mowers, skid steers, bucket loaders, dozers, graders, chippers and other construction equipment.
- “relocating” refers to moving off the work site OR moving within the work site from an infested to a non-infested area.
- “disposal” refers to methods to dispose of NNIS which can include burning, treating and containment, i.e. bagging. (See also *Chapter 8: Sanitation and Debris Disposal.*)

→**BMP 8.1: Prior to relocating equipment, vehicles and trailers, remove soil and debris from exterior surfaces by scraping, brushing, washing or using other methods to minimize the risk of transporting propagules. (See also BMPs 6.12 & 7.11.)**

Considerations:

a. Equipment should be free of NNIS when it arrives at the work site.

b. Clean equipment after operating in an area with NNIS and before relocating to an area free of NNIS. Cleaning should occur before leaving the project site, at the site of infestation.

c. Preferred locations for equipment cleaning areas are those where:

   - Equipment is unloaded and loaded.
   - Invasives are less likely to spread from cleaned equipment (e.g. a blacktopped parking lot). Collect, bag and dispose of properly. (See also BMP 8.5.)
   - NNIS are already established.
   - Monitoring can be conducted at a later date.

d. To limit the spread of NNIS downstream, do not clean equipment, vehicles or trailers in or near waterways or storm sewers.

e. Contain or filter wash water on-site, if possible.

→**BMP 8.2: Remove soil, seeds, vegetative matter and other debris from shoes, clothing and tools prior to leaving an area. (See also BMPs 6.13 & 7.12.)**

Considerations:

a. Preferred locations for cleaning your person are those where:

   - Equipment is cleaned.
   - Invasives are less likely to spread (e.g., a blacktopped parking lot). Collect, bag and dispose of properly. (See also BMP 8.5.)
   - NNIS are already established.

b. Check places like hoods, pockets, seams and Velcro fasteners.

## Long-range Transport

Movement of NNIS occurs naturally in a wide variety of ways. Some species of plants, insects and fungi have very small reproductive propagules that can be moved long distances by wind, water and animals, without the influence of human activity.

**Be aware of all state and federal quarantine rules related to transportation of regulated articles out of a quarantined area.**

## Regulatory Considerations

It is a violation of state and federal laws to transport designated regulated articles outside of a quarantined area. USDA Animal Plant Health Inspection Service (APHIS) and the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) are responsible for designating quarantined areas, determining what materials will be regulated and enforcing the quarantines. Movement of regulated articles may be allowed under certain circumstances; details of exceptions are provided in a compliance agreement, which is issued by USDA APHIS and/or DATCP. Additionally, be aware of county and municipal ordinances related to the transportation of invasive materials.

**→BMP 8.3: Minimize the offsite transport of NNIS and materials that may contain NNIS.**

Considerations:

a. Consider storing and reusing excavated materials, such as soil, on the same site. Use proper topsoil storage techniques to help ensure survival of advantageous fungi and microbes (e.g. beneficial organisms found in topsoil may die if the soil is piled to high which affects oxygen and temperature levels.) Treat infested excavated material to remove NNIS prior to reuse.

b. Consider using NNIS control options that don't create waste, and thus, don't require the removal and transport of debris. For example, use a basal bark treatment on woody NNIS which kills the invasive as it is left in place instead of a cut stump treatment which creates woody debris.

c. Consider leaving NNIS material and pests within the area of infestation (e.g., pile NNIS brush at a site within the infested area).

d. Time the removals of NNIS plants so the removals will occur when there are the fewest propagules present (e.g., NNIS brush removal and transport should occur after the fruit has dropped).

**→BMP 8.4: When necessary to transport NNIS and materials that may contain NNIS off site, cover or otherwise contain those materials.**

Considerations:

a. Materials may include but are not limited to: woody debris, propagules and soil.

b. Be aware of all state and federal quarantine rules related to the transportation of regulated articles out of a quarantine area. Secure compliance agreements for moving this material out of quarantined areas when necessary.

c. Be aware of local ordinances related to the transportation of invasive materials.

d. Covering and containment are not necessary if invasive propagules are not present. For example, bush honeysuckle debris would not need to be covered if it's removed when fruits are not present.

**→BMP 8.5: Properly treat or dispose of NNIS or materials that may harbor invasive propagules, insects or diseases. (See also BMP 7.13.)**

Considerations:

a. Place plant materials in a sturdy clear plastic bag labeled "Invasive plants – please landfill" and dispose of as you would with regular garbage.

b. Materials may be disposed of in piles. Locate the pile in an area that facilitates easy monitoring and control if infestations spread from the pile.

c. Materials may be burned. Regulations and permits may apply.

d. Materials may be buried. Burial depth is specific to the invasive. An average minimum depth would be three feet, but some NNIS need to be buried even deeper. For example, Japanese knotweed can grow through five feet of soil. Be aware that if you later dig into this soil you may be exposing propagules.

e. Materials might be utilized for value added products e.g. fuel, furniture, etc.

f. Chipping woody debris may kill invasive pests if chipped to a size specific to the target insect. However, wood chips may still contain other invasive propagules that may spread if the chips are used in an area other than from where they originated.

g. Material taken from sites that contain invasive plants should not be used away from the site of infestation until all viable plant material is destroyed. Material from areas containing invasive plants may be reused within the exact limits of the infestation.

h. Any excavated material that contains viable plant material and is not reused within the limits of the infestation should be stockpiled on an impervious surface until viable plant material is destroyed (Perron 2008).

i. Do not dump yard waste in parklands, natural areas and waterways.

j. Do not home compost NNIS or their propagules. Backyard compost piles and bins do not reliably generate enough heat for a long enough period of time to destroy weed seeds.

k. If possible, use invasive control options that don't create waste. For example, use a basal bark treatment on woody NNIS which kills the invasive as it is left in place instead of a cut stump treatment which creates woody debris.

→**BMP 8.6: Allow compost piles to heat to appropriate temperatures and times and with proper procedures to reduce the viability of NNIS contained within.**

Considerations:

a. For in-vessel or static aerated pile composting, maintain a temperature of 131 – 170 °F for 3 consecutive days.

b. For windrow composting, maintain a temperature of 131 – 170 °F for 15 days during which, the compost is to be turned a minimum of five times.

c. Legumes or other hard coated seeds will likely not be destroyed during composting.

d. Backyard compost piles and bins do not reliably generate enough heat for a long enough period of time to destroy weed seeds.

e. Consider landfilling debris containing NNIS instead of composting it. Place plant materials in a sturdy clear plastic bag labeled "Invasive plants – please landfill" and dispose of as you would with regular garbage.

**→BMP 8.7: Avoid the use of wood chips and compost that may contain invasive propagules. (See also BMPs 6.10. and 7.6.)**

Considerations:

a. Woodchips and compost suspected of containing invasive materials should be used in a manner that will minimize the reintroduction of propagules back into the environment (e.g., Don't use woodchips containing buckthorn fruit in wooded areas that will not be chemically treated.)

b. Knowing the source of woodchips and compost may help you avoid infested material.

c. Notify the public that wood chips and compost could harbor NNIS. They may need to monitor and treat if used.

d. If material is used that may contain NNIS propagules, monitor the site and treat if necessary.

# Chapter 9. Monitoring and Research

Monitoring is the periodic inspection of post-activity sites to detect new invasions and evaluate the success of NNIS management plans and control measures. It records specific information in a constant manner over time to help better understand the invasive and its management. Inventorying refers to an inspection to locate NNIS. Research is crucial to further our understanding of NNIS, future NNIS and ways to control them. Both monitoring and inventorying provide opportunities to cooperate with universities, groups or individuals who are conducting research.

Monitoring and inventorying can be informal processes, or they can be highly formal. While powerful tools like Geographic Positioning Systems (GPS), Geographic Information Systems (GIS) and computer software do exist to aid these processes; efforts should be kept as simple as possible to meet NNIS management objectives. The ability to perform monitoring or inventorying depends on who is doing it, the extent of the property and the resources available. For example, property managers may be better equipped to inventory and monitor a property on a regular basis. Those hired to carry out a one-time job may not be able to follow-up with monitoring.

**BMP 9.1: Create an NNIS monitoring plan for properties under your management.**

**BMP 9.2: Assess the extent of NNIS on and near the property by inventorying, locating and documenting infestations.**

**BMP 9.3: Monitor sites under your management following management/maintenance activities; determine necessary follow-up based on presence of NNIS.**

**BMP 9.4: Keep records when inventorying and monitoring.**

**BMP 9.5: Report new infestations of known NNIS to the appropriate authority.**

**BMP 9.6: As opportunities arise, interact with and engage researchers to further our understanding of NNIS.**

## →BMP 9.1: Create an NNIS monitoring plan for properties under your management.

Considerations:

a. Integrate monitoring with other general management activities that occur on the property.

b. Consider monitoring the entire property on a regular basis. Methods will depend on the size and location of the property, as well as the scale, extent and type of NNIS present.

c. Periodically inspect high risk areas for introductions.

d. Organize monitoring/inventory work to begin in non-infested areas and work toward the infested areas.

e. Utilize any available history of the property's prior invasions.

f. Consider long term management when creating a monitoring plan.

g. Take surrounding properties into consideration.

h. Discuss the plan with neighboring property managers and consider cooperative projects with them.

i. If it is not possible to conduct follow-up monitoring (e.g., business hired for one job), then it becomes an opportunity to educate the customer on the need for monitoring and possible follow-up on their part.

**→BMP 9.2: Assess the extent of NNIS on and near the property by inventorying, locating and documenting infestations.**

> Knowing which NNIS are present and their locations, is the first piece of information needed to evaluate threats.

Considerations:

a. Inventory for NNIS at probable introduction sites such as access points (trails, roads, parking lots, rest stops, major ports of entry, etc.), new plantings, construction areas, other disturbed areas, area of dead/dying/stressed trees and other vegetation, greenways, drainage ways, corridors, adjacent properties and more.

b. Organize monitoring/inventory work to begin in non-infested areas and work towards the infested areas.

c. Keep assessments as simple as possible to meet NNIS management objectives.

d. Document NNIS in a manner consistent with established effective record-keeping practices.

e. Mapping is a very a useful tool for documenting and monitoring infestations.

f. When inventorying it may be useful to bring a GPS or compass, flagging ribbon, sample bags or plant press, map or air photo, pens, camera and a clipboard.

g. While assessing sites for NNIS, land managers should be alert for emerging NNIS threats such as the emerald ash borer.

h. Identify potential future invaders during inventorying or monitoring procedures.

i. Confer with forest health specialists or other resource managers to identify forest health threats or NNIS plant, insect or disease infestations of concern in the area.

j. Cooperate with partners, especially when dealing with NNIS on a broader geographical scale or when multi-agency issues are involved.

k. When planning for a specific management or maintenance activities: Identify activities that will be occurring on and near the property in the short and long term. Inventory for NNIS both within and around the activity area. Determine how those activities will affect and will be affected by NNIS on and near the property.

**→BMP 9.3: Monitor sites under your management following management/maintenance activities; determine necessary follow-up based on presence of NNIS. (See also 7.10.)**

Considerations:

a. Conduct periodic inspections of each site following management/maintenance activities.

b. Inspect on an annual basis, at a minimum, as long as there is an NNIS problem.

c. Consider monitoring the entire property on a regular basis. This depends on the size and location of the property, as well as the scale, extent and type of NNIS present.

d. Anticipate responses of NNIS to activities and check for new infestations, infections or the spread of existing populations during the appropriate life stage timing for the specific invasive in question.

e. Monitor sites not only for known NNIS, but also emerging NNIS threats such as the emerald ash borer.

f. Keep monitoring as simple as possible to meet NNIS management objectives; integrate with other activities.

g. Determine appropriate control measures to respond to new infestations or spreading populations; evaluate them for their efficiency and impact.

h. If it is not possible to conduct follow-up monitoring (e.g., business hired for one job), then it becomes an opportunity to educate the customer on the need for monitoring and possible follow-up on their part.

**→BMP 9.4: Keep records when inventorying and monitoring.**

Considerations:

a. Include information about the current infestation, as well as, areas on the fringe of the infestation, areas heavily used, disturbed areas and other areas you suspect may be invaded by NNIS.

b. Consider the use of mapping as a tool for recording and monitoring infestations.

c. Be consistent with your monitoring methods.

d. Be complete; they should be easily understood by another person.

e. Have them easily accessible for future reference.

f. See *Urban Forestry Appendix A, Monitoring,* for example recording sheets.

**→BMP 9.5: Report new infestations of known NNIS to the appropriate authority.**

Considerations:

a. Alert the property owners and others involved in its management.

**→BMP 9.6: As opportunities arise, interact with and engage researchers to further our understanding of NNIS. (See also BMP 3.9.)**

Our understanding of NNIS ecology and prevention is increasing but still insufficient to contain or control NNIS in many situations in which they occur. Our ability to predict what new species may become invasive and what landscape practices may provide habitat for these NNIS is even more limited. Research conducted by universities and institutions is one source for learning about NNIS. Researchers can also benefit by interacting with practitioners and discussing the emerging NNIS issues in the practice of urban forestry and landscaping.

Considerations:

a. Develop on-going communications and partnerships with area universities, colleges and institutions where the potential for research in matters of interest to urban forestry occur.

b. Consider the potential for cooperative research opportunities when undertaking new controls or practices for which little information is available.

c. Encourage research/testing of (new) urban landscape plants, either native or non-native, which exhibit tolerable levels of sterility and vegetative proliferation.

d. Researchers could be key partners in a monitoring program to help gauge which new plants, insects and diseases may become invasive and in which situations.

# Chapter 10. Education

The greatest instrument in the prevention and control of NNIS is education. It creates an awareness and understanding of NNIS issues. This is essential to the foundation of partnerships between property owners, urban forestry practitioners, local, state and federal governments, special interest groups and the public, all of whom have an investment and a role to play in the management of NNIS.

**BMP 10.1: Educate yourself about NNIS.**

**BMP 10.2: Educate employees and volunteers about NNIS.**

**BMP 10.3: Educate clients, customers and users about NNIS.**

**BMP 10.4: Educate public officials and other decision makers about NNIS.**

## →BMP 10.1: Educate yourself about NNIS.

Considerations:

a. Keep current with the changing information on NNIS.

b. Keep up to date with your professional accreditations and certifications.

c. See *Urban Forestry Appendix D, Resources,* Section 14 for a list of on-going educational opportunities.

d. Pass your knowledge on to others.

## →BMP 10.2: Educate employees and volunteers about NNIS.

Considerations:

a. Include information about identification, impacts, prevention and management in your organization's training programs and materials.

b. Instruct your employees and volunteers on the practical use of the *Urban Forestry Best Management Practices for Invasive Species* and evaluate their implementation.

c. Effectively seal (e.g., in plastic) any potential propagules, insects or diseases that you intend to use as educational "props."

d. Encourage employees to pursue or continue with professional accreditations and certifications.

e. Encourage employees to seek additional NNIS information. (See *Urban Forestry Appendix D, Resources,* Section 14 for a list of on-going educational opportunities.)

f. Encourage employees to pass their knowledge onto others.

**→BMP 10.3: Educate clients, customers and users about NNIS.**

Considerations:

a. Include information about identification, impacts, prevention and management in your organization's newsletters, marketing materials and face-to-face meetings.

b. Instruct clients, customers and users on the practical use of the urban forestry BMPs for NNIS.

c. Effectively seal (e.g., in plastic) any potential propagules, insects or diseases that you intend to use as educational "props."

d. Encourage clients, customers and users to seek additional NNIS information. (See Urban Forestry Appendix D, Resources, Section 14 for a list of on-going educational opportunities.)

e. Encourage clients, customers and users to pass their knowledge onto others.

f. Work with faculty and other educators to inform students, Master Gardeners and industry about the Urban Forestry Best Management Practices for NNIS.

**→BMP 10.4: Educate public officials and other decision makers about NNIS.**

Considerations:

a. Educate public officials and decision makers as to the role they play and the benefits to their constituents by preventing the introduction and spread of NNIS.

b. Include information about identification, impacts, prevention and management.

c. Coordinate education efforts with the municipal Weed Commissioner. (See Urban Forestry Appendix E, Federal and Wisconsin State Statutes and Administrative Rules Applicable to Invasive Plants and Pests.)

d. Effectively seal (e.g., in plastic) any potential propagules, insects or diseases that you intend to use as educational "props."

e. Encourage public officials and decision makers to seek additional NNIS information. (See Urban Forestry Appendix D, Resources, Section 14 for a list of on-going educational opportunities.)

f. Encourage municipalities to make NNIS information available to the public.

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# Appendices for Urban Forestry Best Management Practices

## *Urban Forestry Appendix A: Monitoring*

The following are examples of data sheets for inventorying, monitoring, and managing NNIS. The Midwest Invasive Plant Network keeps a list of data sheet examples at http://www.mipn.org/edrrDataForms.html. Urban forestry practitioners need to use the data sheet that works best for their situation.

## INVASIVE SPECIES INVENTORY FIELD REPORT FORM

Observation Date: _____

Name: _____ Association: _____

Address: _____ City: _____ State: _____ Zip: _____

Phone: _____ Email: _____

## Species Information - Name and Locations

Common Name: _____ Scientific (if known): _____

Locality Name ( lake or twnshp): _____ County: _____

Site address (if any): _____ City: _____ Zip: _____

Property Ownership (i.e, Private, county, state, federal, etc.): _____

**Provide one or more of the following location methods below:**

PLS: ¼ ¼ Sec _____ ¼ Sec _____ Sec _____ Twp _____ Range _____

GPS: X Coordinate (Lat./Easting): _____

Y Coordinate (Long./Northing): _____

**Number of individuals observed (Check one):** ☐ < 20 ☐ 20 - 99 ☐ 100 - 999 ☐ < 1000

**Distribution of infestation:** ☐ occurs singly ☐ scattered pockets ☐ continuous/extensive

**Size of infested area (acres):** ☐ < 1 ☐ 1 - 5 ☐ 5 - 10 ☐ 10 - 50 ☐ > 50

**Diagram:** Show roads, nearest intersections, distances, compass direction and rough outline in invasive species population.

(Attached diagram if filling out form digitally.)

**Verbal directions (if PLS/GPS information unavailable):**

**Mail form to:** Minnesota Department of Natural Resources
Division of Forestry
Attn: Invasive Species Specialist
500 Lafayette Rd
St. Paul, MN 55155-4025

**Email to:** susan.burks @ dnr.state.mn.us

For more information visit:
http://files.dnr.state.mn.us/assistance/backyard/treecare/forest_health/invasivereportform.pdf

# Setting Objectives for Invasive Species*

| | Weighted Score** |
|---|---|
| **Current Extent of the Species*** ** | |
| 1. Species present in early stage or emerging satellite populations | 5 |
| 2. Species present in large infestations and still expanding rapidly | 3 |
| 3. Species present in large infestations and no longer expanding | 1 |
| | Score : |
| **Current and Potential Impacts** | |
| 1. Species that alter ecosystem processes | 5 |
| 2. Species that out-compete native vegetation without disturbance, but not #1 | 3 |
| 3. Species that only out-compete with native vegetation following disturbance | 1 |
| | Score : |
| **Value of Habitats Affected** | |
| 1. Infestations occurring in high quality, high diversity or otherwise significant habitats | 5 |
| 2. Infestations occurring in already de-graded, low-diversity, or less significant sites | 2 |
| | Score : |
| **Feasibility of Control and Successful Outcomes** | |
| 1. Species likely to be controlled or eradicated with available methods and resources | 5 |
| 2. Species difficult to control or eradicate with available resources and methods | 3 |
| 3. Species unlikely to be controlled with available resources and methods | 1 |
| | Score : |

| | | |
|---|---|---|
| *Score - 15-20: Consider "Zero Tolerance" (Eradication) Objective* | ***ZT*** | **Total Score :** |
| *Score 9-14: Consider "Acceptable Threshold" Objective* | **AT** | |
| *Score 5-8: Consider "Slow the Spread" Objective* | **SS** | |

* Adapted from "Site Weed Management Plan Template" by Mandy Tu of The Nature Conservancy's Wildland Invasive Species Program. For the complete document see: http://tncweeds.ucdavis.edu/products/plans/WeedTemp.rtf

** Managers should select the condition that best describes their situation for each of the 4 criteria areas. The scoring ranges and associated objectives are recommended and managers may need to consider other information in setting objectives.

*** On larger properties consider creating multiple management units to reflect different conditions and levels of infestation.

## *Wisconsin:*

**Fort McCoy Wildlife Program**

**Treatment Action Data Sheet** **Grid #**_____

| | | Plant Phenology | | | | | | Chemical Action | | | | | | | | | | | | | Additives | | | | | | | | Base of Solution | | | | | Equipment | | | | | | Method | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Species Initials (See Back)*** | Date | Early Growth | Pre-flower | Peak Flower | Post-flower | Fall Flush | Dormant | Glyphosate** | 2-4,D LV4 | 2,4 – D Amine | Milestone | Transline | Tordon K | Plateau | Triclopyr 3SL | Triclopyr 4E | Habitat | Element 3A | Element 4 | Oust | Escort | Overdrive | L I 700 | Dye | Silkin | Liberate | Level 7 | Preference | Attach | Choice Weatherr | MSO | H2O | B.O. LT | B.O. EC | Dilient Blue | Dilient Blue XLT | Backpack | Wick | Truck Boom | Truck Gun | Polaris Boom | Polaris Hand Gu | Foliar | Basal Bark | Cut-stump | Total Amt. Sol. Used in **GAL.** | Total Amt. Herb. Used in **OZ** | Conc. Of Herb. (%) | Hours | # people | Total Hours | Initials* | Record # |
| SK | 6/18/07 | | x | | | | | | | | x | | | | | | | | | | | | | x | | x | | | | | | | | | | x | | | | | | | x | | | 10 | | 1/4 | 2 | 2 | 4 | JD | |
| SK | 6/19/07 | | x | | | | | | | | x | | | | | | | | | | | | | x | | x | | | | | | | | | | x | | | | | | | x | | | 2 | | 1/4 | 1 | 2 | 2 | JD | |
| SK | 6/20/07 | | x | | | | | | | | x | | | | | | | | | | | | | x | | x | | | | | | | | | | x | | | | | | | x | | | 12 | | 1/4 | 1 | 2 | 2 | JD | |
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**Under Comments, List:** date, type of glyphosate**, note on average patch desity (high, med., low), brief weather description (temp., precip., cloud cover, humidity, time of day and any other pertinent info.), Print or write neatly, be precise, but short. If Biological Control is implemented, mention specific species used.

| ***Initials-Name-State Cert. #** | **Comments:** |
|---|---|
| JD - John Doe - 012345 | 6-18-07 Coudy, mid-80's, wind 0-5mph |
| JS - Jane Smith - 012345 | 6-19-07 Spot sprayed, 90°, sunny, Site looks better than last year. |
| | 6-20-07 Spot sprayed, 90°, sunny, Revisit site in one week. |
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Species Initials***

| | | | |
|---|---|---|---|
| AO-Autumn Olive | CM-Common Mullen | HS- Honeysuckle | RC-Reed Canary Grass |
| BfT-Birdsfoot Trefoil | CoT-Common Teasel | JB-Jap. Barberry | SC-Sweet Clover |
| BL-Black Locust | CS-Cypress Spurge | JK-Jap. Knotweed | SJ-St. Johns Wort |
| BT-Bull Thistle | CT-Cutleaf Teasel | LS-Leafy Spurge | SK-Spotted Knapweed |
| CaT-Canada Thistle | CV- Cow/Crown Vetch | MFR-Multiflora Rose | SPS-Siberian Pea Shrub |
| CB-Common Buckthorn | GB-Glossy Bucktorn | MS-Musk Thistle | TA-Tansy |
| CE-Chinese Elm | GM-Garlic Mustard | PL- Purple Loosestrife | WP-Wild Parsnip |

For more information visit: http://www.mccoy.army.mil/

## *Urban Forestry Appendix B: Terrestrial Invasive Plants*

Each Eastern Region Forest should add relevant information here.

**WISCONSIN:**

There exists both formal and informal invasive plant lists for the state of Wisconsin and the surrounding region. Among these, no two lists are the same, in part because the agencies, organizations and groups who created them can have differing points of view about the invasiveness of some species. This is natural considering invasiveness varies due to location, habitat type, disturbance history, urban versus rural locations, proximity to propagules and many other factors. In short, what may be invasive in one environment may not be invasive in another.

Because no individual list will be able to meet the needs of every Urban Forestry practitioner in Wisconsin, we have put together a list of invasive plant lists pertinent to our region and have attempted to explain how they were compiled so that the user can decide for themselves which list best meets their needs.

Keep in mind that lists are continually being updated as new invasive plant species appear in Wisconsin and as additional research is being reported. It is important to remember that regardless if a particular species is included in a list, implementation of the BMPs should be effective at preventing or slowing the spread of any species.

**Lists:**

*Wisconsin Department of Natural Resources (WDNR)—Invasive Plant Species Proposed to be Regulated Under NR 40 and Plant Species Not Regulated by NR 40*
http://dnr.wi.gov/NNIS/classification/

The species lists, developed as part of the Wisconsin DNR's Proposed Invasive Species Identification, Classification and Control Rule – NR 40, were created with input from the DNR, the Wisconsin Council on Invasive Species and Species Assessment Groups (SAGs) comprised of experts in their respective fields and stake-holder groups. The SAGs reviewed literature summaries and made recommendations to the Council. The rule identifies NNIS in each specific category based on criteria and will place restrictions on those species that are classified as prohibited or restricted. Once formally adopted by the Wisconsin State Legislature, this will be the only invasive plant list that is regulated. This list is not definitive. Additional species are or will be under review, and the list will be periodically updated.

*Wisconsin Department of Natural Resources (WDNR)—Invasive Species Plants.*
http://dnr.wi.gov/NNIS/plants.asp

This is an informal list first created in 1992 by Wisconsin Department of Natural Resource staff with a great deal of input from land managers throughout the state. Species have been and continue to be added as they are brought to the attention of DNR staff. The list consists of species that appear to be anecdotally invasive, are widespread or are known to be significantly invasive outside of Wisconsin and have the potential to naturalize in our state. The list also includes native species with invasive tendencies.

*Invasive Plants Association of Wisconsin—IPAW Working List of the Invasive Plants of Wisconsin.*
http://www.ipaw.org/list/index.htm

The mission of IPAW, a private, nonprofit org is to advance understanding of invasive plants and encourage their control to promote stewardship of the natural resources of Wisconsin. In order to carry out their mission, members of IPAW created a working list of plants that are invasive in the natural plant communities and wild areas of Wisconsin. The list was created by a formal process that involved the collection of a wide variety of personal observations and experience of natural area and plant experts by survey. The survey was conducted in 2002 and the list was published in March 2003. It has not been updated since. The IPAW list does not include agricultural weeds; it focuses on plants that invade natural plant communities. It does not include plants that are native to Wisconsin. Non-native species that are not known to be currently invasive in Wisconsin, but are invasive in similar ecoregions and may have the potential to become invasive in our state, are presented separately in the "IPAW Working List of the Potentially Invasive Plants for Wisconsin". The IPAW list also does not take into consideration cultivar and varietal differences in potential invasiveness.

## *Urban Forestry Appendix C: Short List of Invasive Insects and Diseases*

Each Eastern Region Forest should add relevant information.

**WISCONSIN:**

The lists below are provided for educational purposes for use in conjunction with the BMPs. The lists represent insects and diseases, native or non-native, that are the most destructive or threatening to Wisconsin's urban forests. Species are listed in alphabetical order; they are not listed in order of priority. These species may already be present in our state or they have the potential to be here in the near future. The lists may be updated as new NNIS appear in or threaten Wisconsin.

Those species assessed by Species Assessment Groups are **in bold**. Species Assessment Groups, comprised of experts in their respective fields and stake-holder groups, were asked to review literature summaries and to make recommendations to the Wisconsin Council on Invasive Species as how to categorize species for WDNR's proposed Invasive Species Identification, Classification, and Control Rule (NR 40).

The lists are not comprehensive. See Urban Forestry *Appendix D, Resources*, Sections 3 and 4 for links to more information about the species listed and other invasive insect and disease species.

## Invasive Insects *Wisconsin:*

| Common Name | Scientific Name | Preferred Host Species |
|---|---|---|
| **European gypsy moth** | ***Lymantria dispar* (European race)** | *hardwoods; oaks preferred* |
| Japanese beetle | *Popillia japonica* | *many hosts* |
| **Emerald ash borer** | ***Agrilis planipennis*** | *all species of ash (Fraxinus spp.)* |
| **Asian longhorned beetle** | ***Anopliphora glabripennis*** | *hardwoods; maples preferred* |
| **Sirex woodwasp** | ***Sirex noctilio*** | *pines* |
| **Hemlock wooly adelgid** | ***Adelges tsugae*** | *Eastern and Carolina hemlock* |
| **Asian gypsy moth** | ***Lymantria dispar* (Asian race)** | *hardwoods & conifers* |
| | | |

## Invasive Diseases

| Disease Name | Scientific Name of Pathogen | Preferred Host Species |
|---|---|---|
| Diplodia shoot blight | *Diplodia pinea* | *pines; red, scots, jack & Austrian preferred* |
| Cytospora canker | *Cytospora kunzei var. piceae* | *Norway & Colorado blue spruce preferred* |
| Oak wilt | *Ceratocystis fagacearum* | *oaks; red/black family preferred* |
| **White pine blister rust** | ***Cronartium ribicola*** | *5-needled pines* |
| Dutch elm disease | *Ophiostoma ulmi, O. novo-ulmi* | *American elm most susceptible* |
| Fireblight | *Erwinia amylovora* | *rose, apple, pear, and other rosaceous plants* |
| **Sudden oak death** | ***Phytophthora ramorum*** | *many hosts* |
| **Butternut canker** | ***Sirococcus clavigignenti-juglandacearum*** | *butternut* |

**Species in bold** were assessed by Species Assessment Groups comprised of experts in their respective fields and stake-holder groups. The Species Assessment Groups were asked to review literature summaries and to make recommendations to the Wisconsin Council on Invasive Species as how to categorize species for the proposed Invasive Species Identification, Classification and Control Rule (NR 40). http://dnr.wi.gov/NNIS/classification/

## *Urban Forestry Appendix D: Resources*

1. Invasive Plants
2. Plants to Use as an Alternative to Invasives
3. Invasive Insects and Diseases
4. Invasive Insects and Diseases Lists
5. All Invasives
6. General Invasive Plant Management
7. Cooperative Weed Management Areas (CWMAs)
8. Biocontrol
9. Herbicide
10. Prescribed fire
11. Early Detection and Rapid Response
12. Prioritizing Management
13. General Sites of Interest
14. Educational Opportunities and Events

**1. NNIS Plants** (See also *All NNIS*)**:**

*Center for Invasive Plant Management (CIPM).* http://www.weedcenter.org
This web site provides information on invasive plant identification, biology, and impacts of NNIS. It also includes links to a resource guide, weed control methods, and invasive plant management online textbook.

*Great Lakes Indian Fish and Wildlife Commission (GLIFWC)—Exotic Plant Information Center.* http://www.glifwc.org/NNIS/ This site features a searchable database of NNIS accounts. It also provides distribution maps, educational materials, and a slide library.

*Invasive Plants Association of Wisconsin (IPAW).* http://www.ipaw.org
The mission of IPAW is to promote better stewardship of the natural resources of Wisconsin by advancing the understanding of invasive plants and encouraging the control of their spread. Their web site offers a photo gallery, NNIS list, educational resources, news and events, and more.

*Midwest Invasive Plant Network (MIPN).* http://www.mipn.org/
This organization's mission is to reduce the impact of invasive plant species in the Midwest. The web site provides information on prevention, early detection and rapid response, control and management, education, research, and more.

*Plant Conservation Alliance (PCA), Weeds Gone Wild, Alien Plant Invaders of Natural Areas.* http://www.nps.gov/plants/alien/ This web site provides a list of invasive plants in the US, background information on the threats and impacts of NNIS, fact sheets, and relevant links.

*The Nature Conservancy (TNC), Invasive Species Plant Summaries.* http://www.imapNNIS.org/GIST/ESA/index.html Elemental Stewardship Abstracts are no longer maintained by the Nature Conservancy but still provide good information on invasive plants.

*University of Wisconsin Extension—Weed Identification and Management.* http://weedid.wisc.edu This site houses an interactive weed identification database of 280 of the most common weeds/invasive plants in Wisconsin.

*University of Wisconsin-Green Bay Herbarium—Invasive Plants of Wisconsin.* http://www.uwgb.edu/biodiversity/herbarium/invasive_species/invasive_plants01.htm This site includes photos, description and distribution maps of invasive plants.

*University of Wisconsin Herbarium.* http://www.botany.wisc.edu/wisflora
The Herbarium's web site is fully searchable for Wisconsin's vascular plant species. It includes photos, habitat information, distribution maps, and herbarium specimen data.

*University of Wisconsin-Steven Point Freckmann Herbarium.* http://wisplants.uwsp.edu/VascularPlants.html This web site is searchable for Wisconsin's vascular plants species. It includes photos, habitat information, and distribution maps.

**2. Plants to Use as an Alternative to NNIS:**

*Alternative to Ash Trees: Commercially Available Species and Cultivars.* http://www.uwex.edu/ces/wihort/landscape/AshAlternatives.doc By Dr. Laura G. Jull, Dept. of Horticulture, University of Wisconsin-Madison

*Alternative to Ash Trees: Short List.* http://www.entomology.wisc.edu/emeraldashborer/Alternatives%20to%20Ash%20for%20Homeowners.pdf By Dr. Laura G. Jull, Dept. of Horticulture, University of Wisconsin-Madison

*Meijer & The Nature Conservancy's Recommended Non-Invasives List.* http://www.nature.org/wherewework/northamerica/states/michigan/files/meijer_plant_list.pdf

*Landscape Alternatives for Invasive Plants of the Midwest.* http://mipn.org/MIPN%20redraft2.pdf Lists the invasive and its alternatives

**3. NNIS Insects and Diseases** (See also *All Invasives*)**:**

*Department of Agriculture Trade and Consumer Protection (DATCP).* http://www.datcp.state.wi.us/core/insectspesticides/insectspesticides.jsp
DATCP is responsible for the prevention, introduction and spread of plant pests. This webpage provides information on specific pests, rules, firewood restrictions, and firewood dealer certification.

*Department of Agriculture Trade and Consumer Protection (DACTP)—Wisconsin Pest Bulletin.* http://pestbulletin.wi.gov/i ndex.jsp The most relevant links are: *Nursery and Forest*, *Exotic Pest of the Week*, and *DATCP Contacts*.

*Emerald Ash Borer: What you need to know.* http://www.emeraldashborer.info/ This web site is part of a multi-state effort to provide the latest information about EAB to the public.

*National Agricultural Pest Information System (NAPIS)—Pest Tracker.* http://ceris.purdue.edu/napis/
This web site has links to state information, pest information, survey maps and publications. Information

presented here is derived, in part, from the National Agricultural Pest Information System (NAPIS), an agricultural pest tracking and database sponsored by the US Department of Agriculture Animal and Plant Health Inspection Service (APHIS) and Plant Protection and Quarantine (PPQ) Cooperative Agricultural Pest Survey, (CAPS).

*The Exotic Forest Pest Information System for North America.* http://spfnic.fs.fed.us/exfor/index.cfm This web site contains a database of invasive insects, mites, and diseases with background information for each pest.

*U S Department of Agriculture (USDA) Animal Plant Health Inspection Service (APHIS).* http://www.aphis.usda.gov/plant_health/ APHIS safeguards agriculture and natural resources from the risks associated with the entry, establishment, or spread of animal and plant pests. The site has links to information on specific plant pests, pest detection and identification information, and plant protection and quarantine guides.

*US Department of Agriculture (USDA) Forest Service—North Central Research Station: Emerging Forest Insect Pests.*
http://www.ncrs.fs.fed.us/4501/focus/emerging_pests/ The North Central Research Station web site provides information on exotic forest insects, describes current research, and features publications and maps for a 20-state region spanning the Midwest and Northeast.

*Wisconsin Gypsy Moth.* http://www.gypsymoth.wi.gov/ The Wisconsin Gypsy Moth site has information on predicting defoliation, management options, identification, and life cycle and includes the phone number for the Gypsy Moth Information Line.

*Wisconsin's Emerald Ash Borer Resource.* http://emeraldashborer.wi.gov/ This site includes information on surveys, detection, and management, and includes an email address and phone number to report suspected infestations.

**4. NNIS Insects and Diseases Lists:**

*Wisconsin DNR Forest Health Protection Unit's Annual Report: Forest Health Conditions in Wisconsin, 2007.*
http://dnr.wi.gov/forestry/Fh/pdf/AnnualReport2007.pdf

*USDA Forest Service Invasive Species Program Web pages.*
http://www.fs.fed.us/NNISpecies/speciesprofiles/index.shtml

*USDA Forest Service North Central Research Station.*
http://www.ncrs.fs.fed.us/4501/focus/emerging_pests/

*The Nature Conservancy's Invasive Species Initiative Regional List of Pests, 2004 (scroll down to Midwest region, but note that this covers from MI to ND, south to TX).*http://www.invasive.org/gist/products/gallery/regionlist.html

**5. All NNIS:**

*National Invasive Species Council's Definition of Invasive Species.*
http://www.NNISpeciesinfo.gov/docs/council/isacdef.pdf

*National Invasive Species Management Plan.* http://www.NNISpeciesinfo.gov/council/nmp.shtml

*The Nature Conservancy (TNC), Global Invasive Species Team.* http://tncNNIS.ucdavis.edu This web site is no longer maintained by the Nature Conservancy but it is archived on various other web sites. It provides many resources designed to help conservationists deal most effectively with NNIS. It provides links to an introduction on NNIS management, planning and strategy, control methods, photo archive and more.

*USDA Forest Service Invasive Species Program.* http://www.fs.fed.us/NNISpecies This web site serves as a portal to Forest Service NNIS information and related management and research activities across the agency and with partners. The program's goal is to reduce, minimize, or eliminate the potential for introduction, establishment, spread, and impact of NNIS across all landscapes and ownerships.

*Wisconsin Council on Invasive Species.* http://dnr.wi.gov/NNIS/iscouncil.htm
This site includes a link to the comprehensive state management plan.

*Wisconsin Department of Natural Resources (WDNR).* http://dnr.wi.gov/NNIS
The Invasive Species webpage provides links to NNIS information including a photo gallery, complete plant and animal NNIS lists, and information on managing NNIS populations.

**6. General Invasive Plant Management:**

*Center for Invasive Plant Management (CIPM)—Weed Control Methods.*
http://www.weedcenter.org/management/control.html
The Weed Control Methods web page offers information and links on the following control techniques: biocontrol, grazing, herbicides, mechanical and prescribed burning.

*Department of Conservation and Natural Resources Invasive Exotic Plant Tutorial for Natural Land Managers. Invasive Exotic Plants in Pennsylvania List.*
http://www.dcnr.state.pa.us/forestry/invasivetutorial/List.htm
Although this site is for Pennsylvania most of the species featured are also invasive in Wisconsin. The site provides links to fact sheets and management and control recommendations.

*Garlic mustard (Alliaria petiolata)—Guide for identifying and controlling.*
http://www.for-wild.org/download/garlicmustard.pdf

*Illinois Nature Preserve Management Guidelines.* http://dnr.state.il.us/INPC/Management_guidelines.htm
The information presented gives guidance to landowners, managers, custodians and stewards of sites in the Illinois Nature Preserve Programs on control methods for common NNIS.

*Invasive Plants of the Upper Midwest* by Elizabeth J. Czarapata. This book is a comprehensive, fully-illustrated guide to the identification and control of invasive plant species.

*Plant Conservation Alliance—Alien Plant Invaders of Natural Areas.* http://www.nps.gov/plants/alien/factmain.htm This web site features illustrated, easy-to-read fact sheets on select invasive plants with native ranges; plant descriptions; ecological threats; US distributions and habitats; background of introductions; plant reproduction and dispersal; management approaches; alternative native plants; and other useful information.

*Shaw Nature Reserve Native Landscaping Manual—Chapter Three-Control and Identification of Invasive Species: A Management Guide for Missouri*. http://www.shawnature.org/nativeland/NativeLandscapingManual/ChapterThree.aspx This guide describes mechanical and chemical control methods and revegetation. It provides good illustrations of management.

*The Nature Conservancy (TNC)—Weed Control Methods Handbook: Tools and Techniques for Use in Natural Areas.* http://www.invasive.org/gist/handbook.html The handbook provides detailed information on the use of guide and mechanical techniques, grazing, prescribed fire, biocontrol, and herbicides for use in controlling NNIS in natural areas.

*USDA Forest Service Invasive Species Program—Control and Management.* http://www.fs.fed.us/NNISpecies/controlmgmt/index.shtml This page provides links for more information on research, management planning, forest service activities, and pest-specific control and management.

*US Forest Service—Dangerous Travelers: Controlling Invasive Plants along America's Roadsides (Video).* http://www.fs.fed.us/NNISpecies/prevention/dangeroustravelers.shtml The video outlines the best management practices that road crews should be following in their day-to-day operations. This is the first in a series on "Best Management Practices for Invasive Species Prevention." The video can also be ordered on DVD by contacting: USDA Forest Service; San Dimas Technology and Development Center; 444 East Bonita Avenue; San Dimas, CA 91773; (909) 599-1267

**7. Cooperative Weed Management Areas (CWMAs):**

A cooperative Weed Management Area is a partnership of federal, state and local government agencies; tribes; individuals; and other interested groups that manage invasive plants in a defined geographic area. CWMAs are local organizations that provide a mechanism for sharing invasive plant management resources across jurisdictional boundaries in order to achieve widespread invasive plant prevention and control. CWMAs operate under a formal agreement to ensure long-term, on-going resource-sharing and collaboration.

- *Midwest Invasive Plant Network* http://mipn.org/cwma.html
  A local Midwest resource for starting a CWMA.
- *Invasive Plant Association of Wisconsin* www.ipaw.org
  The most up-to-date list of CWMAs in Wisconsin.
- *Center for Invasive Plant Management* www.weedcenter.org
  Information and resources on how to start a CWMA.

**8. Biocontrol:**

*Invasive Plants of the Eastern U S—Biological Control of Invasive Plants in the Eastern United States. (USDA Forest Service Publication FHTET-2002-04, 413 p.)* http://www.invasive.org/eastern/biocontrol

This web site serves as a reference guide for field workers and land managers concerning the historical and current status of the biological control of select invasive plants in the eastern United States.

*Cornell University. Biological Control: A Guide to Natural Enemies in North America.* http://www.nysaes.cornell.edu/ent/biocontrol/ This web site provides photographs and descriptions of biocontrol agents of insect, disease and weed pests in North America.

**9. Herbicide:**

*Department of Agriculture Trade and Consumer Protection (DATCP)—Pesticide Database Searches.* http://www.kellysolutions.com/wi/ Use this site to search for registered pesticide products, the companies that sell and use pesticides, and the people that apply them.

*Herbicide safety information—Material Data Safety (MDS) sheets and product labels.* http://www.cdms.net/LabelsMsds/LMDefault.aspx?t=.

*The Nature Conservancy (TNC)—Safe Herbicide Handling in Natural Areas: A Guide for Land Stewards and Volunteer Stewards.* http://www.invasive.org/gist/products/library/herbsafe.pdf

*The Nature Conservancy (TNC)—Upkeep and Maintenance of Herbicide Equipment: A guide for natural area stewards.* http://www.invasive.org/gist/products/library/herbupkeep.pdf

**10. Prescribed fire:**

*California Invasive Plant Council—The Use of Fire as a Tool for Controlling Invasive Plants.* http://www.cal-ipc.org/ip/management/UseofFire.pdf
This document contains information on the following: planning and implementing prescribed burns, control of invasive plants with prescribed fire, using prescribed burning in integrated strategies, effects of fire on plant communities, effects of fire on chemical, physical, and biotic properties of soil.

*Center for Invasive Plant Management (CIPM)—Fire As a Tool For Controlling Nonnative Invasive Plants.* http://www.weedcenter.org/store/docs/burning_weeds.pdf This review focuses on the intentional use of fire, alone or integrated with other methods, to control exotic plants in North America.

*The Nature Conservancy (TNC)—Fire Management Manual.* http://www.tncfireguide.org/index.htm The guide serves as the Conservancy's guiding document on all aspects of wildland fire management.

*USDA Forest Service—Fire Effects Information System (FEIS).* http://www.fs.fed.us/database/feis/ FEIS features a searchable database that summarizes and synthesizes research about living organisms in the United States —their biology, ecology, and relationship to fire.

*Wisconsin Prescribed Fire Council.* http://www.prescribedfire.org/index.html The Wisconsin Prescribed Fire Council strives to make the use of prescribed fire in Wisconsin safer and more accepted for all practitioners. The site provides information and links on government relations, liability, training, weather, and fire implementation.

**11. Early Detection and Rapid Response:**

*iMapInvasives: Geotracking invasive exotic species.* http://imapNNIS.org/index.html
A consortium developed an on-line GIS-based NNIS mapping tool designed to aid in Early Detection and Rapid Response efforts. The site allows one to display maps and query by NNIS or contributing organization. Currently the site has only sample plant data for the state of New York. Long-term goals for the site include seeking participation of additional states and/or provinces.

*Midwest Invasive Plant Network (MIPN)—Early Detection and Rapid Response.*
http://www.mipn.org/detectionresponse.html

*National Biological Information Infrastructure (NBII). National Framework for Early Detection, Rapid Assessment, and Rapid Response to Invasive Species.*
http://NNISpecies.nbii.gov/portal/community/Communities/Ecological_Topics/Invasive_Species/Early_Detection,_Rapid_Response_(EDRR)/ This framework includes seven main components: 1) identification and validation, 2) reporting, 3) expert verification, 4) occurrence databases, 5) rapid assessment, 6) planning, 7) rapid response.

*The North American Weed Management Association.* http://www.nawma.org/ The North American Weed Association has developed a data collection standard for invasive plant monitoring in the western United States and it has been adopted by several federal agencies, including US Forest Service and the National Park Service. At the home page, scroll down to "Mapping Standards" link.

*USDA Forest Service. The Early Warning System for Forest Health Threats in the United States.*
http://www.fs.fed.us/foresthealth/publications/EWS_final_draft.pdf
This is a monitoring framework for early detection and response to environmental threats (e.g. insects, diseases, NNIS, and fire) to forest lands. The framework is based on the following steps: 1) identify potential threats, 2) detect actual threats, 3) assess impacts, and 4) respond.

*Wisconsin Department of Natural Resources/ University of Wisconsin-Madison Herbarium—Invasive Plants of the Future.* http://dnr.wi.gov/NNIS/futureplants/
This monitoring and early reporting project has three main goals: 1) identify and report populations of high-risk early-stage target weed species in Wisconsin; 2) eliminate or contain those populations before they spread; and 3) coordinate long-term monitoring of occurrence sites. All land managers are encouraged to participate in this program.

**12. Prioritizing Management:**

*NatureServe—An Invasive Species Assessment Protocol: Evaluating Non-Native Plants for Their Impacts on Biodiversity.*
http://www.natureserve.org/library/invasiveSpeciesAssessmentProtocol.pdf
The Invasive Species Assessment Protocol was developed as a tool for assessing, categorizing, and listing non-native invasive vascular plants according to their impact on biodiversity in a large area such as a nation, state or province, or ecological region. This protocol is designed to make the process of assessing and listing invasive plants objective and systematic.

*Animal and Plant Health Inspection Service (APHIS)—Weed-Initiated Pest Risk Guidelines for Qualitative Assessments.*
http://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/wra.pdf

This document provides a template for conducting pest risk analysis: initiating the process by identifying a pest that may qualify as a quarantined pest, and/or pathways that may allow introduction or spread of a quarantine pest; and assessing pest risk (determining which pests are quarantine pests, characterized in terms of likelihood of entry, establishment, spread, and economic importance.)

**13. General Sites of Interest:**

*American Nursery and Landscape Association.* *http://www.anla.org/* This website provides education, research, public relations, and representation services to members of the nursery and landscape industry.

*International Society of Arboriculture* http://www.isa-arbor.com/home.aspx This is a worldwide professional organization dedicated to fostering a greater appreciation for trees and to promoting research, technology, and the professional practice of arboriculture.

*Invaders of the Forest.* http://dnr.wi.gov/org/caer/ce/eek/teacher/invasiveplantguide.htm This is an educators' guide to invasive plants of Wisconsin forests. The guide provides classroom and field activities for formal and non-formal educators working with kindergarten through adult audiences. Lessons are correlated to Wisconsin's academic standards.

*Trees are Good. International Society of Arboriculture.* http://www.treesaregood.com/ This site helps to educate the general public about the importance and value of proper tree care.

*University of Wisconsin Extension.* http://www.uwex.edu/locations/ The site has links to the Master Gardener program, the Plant Disease Diagnostic Clinic, and urban horticulture topics. Extension has offices in every county in Wisconsin.

*University of Wisconsin Forestry Extension.* http://www.forest.wisc.edu/extension/index.html This site has publications, internet resources, and other materials related to forests, their management, and the wood products industry in Wisconsin. It includes a link to the popular *Forestry Facts* series.

U*niversity of Wisconsin Urban Horticulture.* http://wihort.uwex.edu/ This site houses the Wisconsin Garden Facts (X-file series), phenological information, Wisconsin horticultural updates and pest information including invasive plant publications.

*Wisconsin Arborist Association.* http://www.waa-isa.org/ This is a large organization of commercial, municipal, utility and academic arborists whose members serve Wisconsin by providing private and public arboriculture services and research. The WAA is a chapter of the International Society of Arboriculture which has representation in over 30 countries.

*Wisconsin Department of Natural Resources (WDNR). Urban Forestry Consultants and Certified Arborists.*
http://www.dnr.state.wi.us/forestry/UF/resources/consulth.htm This site links to lists of urban forestry consultants working in Wisconsin and also to the International Society of Arboriculture's (ISA's) certified arborist database and directory of certified arborists for hire in Wisconsin.

*Wisconsin Department of Natural Resources (WDNR). Urban and Community Forestry.* http://www.dnr.state.wi.us/forestry/uf/ The website includes information on the program, grants, news and events, the Wisconsin Urban Forestry Council, awareness and recognition programs, and additional resources.

**14. Educational Opportunities and Events:**

*International Society of Arboriculture*
http://www.isa-arbor.com/home.aspx

*Invasive Plant Association of Wisconsin*
http://www.ipaw.org/events.htm

*University of Wisconsin Extension*
http://www.uwex.edu/

*Wisconsin Arborist Association*
http://www.waa-isa.org/calendar_of_events.asp

*Wisconsin Council on Invasive Species*
http://NNISpecies.wi.gov/awareness/section.asp?linkid=1558&locid=63

*Wisconsin Department of Natural Resources - Urban Forestry*
http://www.dnr.state.wi.us/forestry/uf/news/

*Wisconsin Green Industry Federation*
http://www.wislf.org/

## *Urban Forestry Appendix E: Federal and State Statutes and Administrative Rules Applicable to NNIS Plants and Pests*

The links and statutes listed below are for the federal and statewide level. Local municipal and county ordinances should also be checked for laws applicable to invasive plants, pests and control treatments.

Each Eastern Region Forest should add relevant information.

**WISCONSIN:**

Reference the Wisconsin State Law Library for access to many of these county and municipal ordinances http://wilawlibrary.gov/ordinances.html.

**Municipal Government Authority:**

*Wisconsin Statutes*
The Updated Wisconsin Statutes and Annotations: http://www.legis.state.wi.us/rsb/stats.html
See left navigation bar to search for a specific Statute in the Infobase. Or go to a Statute Chapter:
http://www.legis.state.wi.us/rsb/Statutes.html

**27.09 – City forester, duties; tree planting**
**History:** 1991 a. 316.

**27.13 – Town and village parks**
**History:** Not listed. http://www.legis.state.wi.us/statutes/Stat0027.pdf

**66.0517 – Weed commissioner**
**History:** 1999 a. 150; 2003 a. 33.

**823.01 – Jurisdiction over nuisances**
**History:** 1973 c. 189; Sup. Ct. Order, 67 Wis. 2d 585, 762 (1975); Stats. 1975 s. 823.01.

*Wisconsin Constitution*
http://www.legis.state.wi.us/rsb/2wiscon.html

**Article XI, §3 Municipal home rule; debt limit; tax to pay debt. Section 3.**
**History:** *Nov. 1874, Nov. 1912, Nov. 1924, Nov. 1932, April 1951, April 1955, Nov. 1960, April 1961, April 1963, April 1966 and April 1981*.

**NNIS Plants:**

*Wisconsin Statutes*
The Updated Wisconsin Statutes and Annotations: http://www.legis.state.wi.us/rsb/stats.html
See left navigation bar to search for a specific Statute in the Infobase. Or go to a Statute Chapter:
http://www.legis.state.wi.us/rsb/Statutes.html

**15.34 Department of natural resources; creation.**
**15.347 Same; councils.**

**(18)** INVASIVE SPECIES COUNCIL
**History:** 1973 c.74; 1991 a.316; 2001 a.16.

**23.22 Invasive species.**
**Cross Reference:** See also ch. NR 198, Wis. adm. code.
**History:** 2001 a. 109 ss. 72t, 72xd; 2003 a. 33.

**23.235 Nuisance weeds.**
**History:** 1987 a. 41; 1999 a. 150 s. 616; Stats. 1999 s. 23.235; 2001 a. 16; 2001 109 ss. 72td to 72wj.

**26.02 Council on forestry.**
**History:** 2001 a. 109.

**28.04 Management of state forests.**
**History:** 1995 a. 257.
**Cross Reference:** See also ch. NR 44 and s. NR 1.24, Wis. adm. code.

**66.0407 Noxious weeds.**
**History:** 1975 c. 394 s. 12; 1975 c. 421; Stats. 1975 s. 66.96; 1983 a. 112, 189; 1989 a. 56 s. 258; 1991 a. 39, 316; 1997 a. 287; 1999 a. 150 ss. 617 to 619; Stats. 1999 s. 66.0407.

**94.38 Agricultural and vegetable seeds; definitions.**
**History:** 1975 c. 39, 308; 1983 a. 189; 1985 a. 138; 1993 a. 112.

**94.39 Seed labeling requirements.**
**History:** 1975 c. 39, 308; 1985 a. 138.

**94.41 Prohibitions.**
**History:** 1973 c. 194, 195; 1985 a. 138; 1993 a. 492.

**94.45 Powers and authority of the department** [Department of Agriculture].
**History:** 1975 c. 39, 308; 1983 a. 189 s. 329 (20).
**Cross Reference:** See also ch. ATCP 20, Wis. adm. code.

**94.46 Stop sale, penalties, enforcement**
**History:** 1985 a. 138.

*Administrative Code*

The Wisconsin Administrative Code and Register: http://www.legis.state.wi.us/rsb/code.htm
See left navigation bar to search for a specific Statute in the Infobase. Or go to a Code Chapter (look under "NR Natural Resources".) http://www.legis.state.wi.us/rsb/code/codtoc.html

**NR 150.025 Policy.**
**History:** Register, February, 1981, No. 302, eff. 3-1-81; renum. (2) (g) and (h) to be (2) (h) and (i), cr. (2) (g), Register, February, 1984, No. 338, eff. 3-1-84; am. (2) (e), Register, January, 1987, No. 373, eff. 2-1-87.

**NR 1.211 Cooperative forestry policy.**
**History:** Cr. Register, July, 1989, No. 403, eff. 8-1-89.

**NR 44.04 Master plan development, adoption and public involvement.**
**History:** Cr. Register, August, 1996, No. 488, eff. 9–1–96.

**NNIS Insects and Diseases:**

*Wisconsin Statutes*
The Updated Wisconsin Statutes and Annotations: **http://www.legis.state.wi.us/rsb/stats.html**
See left navigation bar to search for a specific Statute in the Infobase.
Or go to a Statute Chapter: http://www.legis.state.wi.us/rsb/Statutes.html

*Wisconsin Statutes that apply to the Department of Natural Resources (WDNR):*

**26.30 Forest insects and diseases; department jurisdiction; procedure.**
**History:** 1977 c. 29 s. 1650m (1); 1979 c. 32 s. 92 (9); 1979 c. 110 s. 60 (11); 1983 a. 189; 1985 a. 13; 1991 a. 316; 2003 a. 33, 57.
**Cross Reference:** See also s. NR 47.910, Wis. adm. code.

**45.04(1)(g) – Firewood restrictions on state property**
**History:** Cr. Register, December, 1983, No. 336, eff. 1−1−84; am. (2) (a) (intro.) and (c), cr. (3) (k), Register, December, 1987, No. 384, eff. 1−1−88; emerg. cr. (3) (l), eff. 4−1−88; emerg. cr. (3) (l), eff. 4−1−89; emerg. am. (3) (l), eff. 5−2−89; renum. (3) (h) to be (3) (h) 1. and cr. (3) (h) 2., Register, March, 1990, No. 411, eff. 4−1−90; am. (1) (c) and (2) (c), cr. (3) (l), Register, March, 1992, No. 435, eff. 4−1−92; r. and recr. (1) (a), (2) (a) and (3) (d), am. (1) (c), (3) (b) and (e), cr. (3) (m), Register, December, 1993, No. 456, eff. 1−1−94; cr. (1) (d), (2) (a) 3. and (b) 4., r. and recr. (2) (b) 3. and (3) (b), Register, November, 1995, No. 479, eff. 12−1−95; renum. (3) (k), (L) and (m) to be (3) (j), (k) and (L), Register, December, 1997, No. 504, eff. 1−1−98; am. (3) (g), cr. (3) (m), (n) and (o), Register, December, 1999, No. 528, eff. 1−1−00; CR 01−011: cr. (1) (e), (3) (p), (r) and (s) Register April 2002 No. 556, eff. 5−1−02; CR 03−035: cr. (1), (f), am. (2) (c), (3) (n) and (p), r. and recr. (3) (f) Register December 2003 No. 576, eff. 1−1−04; CR 04−092: am. (1) (c), cr. (3) (t) Register April 2005 No. 592, eff. 5−1−05; emerg. cr. (1) (g), eff. 4−1−06; CR 06−065: cr. (1) (g) Register November
2006 No. 611, eff. 12−1−06; CR 07−026: cr. (2) (a) 4., r. (3) (h) Register December 2007 No. 624, eff. 1−1−08; **CR 08−011: cr. (3) (u) Register September 2008 No. 633, eff. 2−1−09.**

*Wisconsin Statutes that apply to the Department of Agriculture, Trade and Consumer Protection (WDATCP):*

**21.17 – Emerald ash borer; import controls and quarantine**
**History:** CR 06−008: cr. Register October 2006 No. 610, eff. 11−1−06.

**94.01 Plant inspection and pest control authority.**
**History:** 1975 c. 394 s. 18; Stats. 1975 s. 94.01.
**Cross Reference:** See also ch. ATCP 21, Wis. adm. code.

**94.02 Abatement of pests.**
**History:** 1975 c. 394ss. 5, 19; 1975 c. 421; Stats. 1975 s. 94.02; 1977 c. 418; 1981 c.20.

**94.03 Shipment of pests and biological control agents; permits.**
**History:** 1975 c. 394 ss. 6, 17; 1983 a. 189 s. 329 (20).

**94.10 Nursery stock; inspection and licensing.**
**History:** 1975 c. 394 ss. 20, 22; 1975 c. 421; Stats. 1975 s. 94.10; 1983 a. 189; 1989 a. 31; 1993 a. 16; 1995 a. 27; 1999 a.9.

**94.685 Pesticides; licensing of dealers and distributors of restricted-use pesticides.**
**History:** 1987 a. 27; 1991 a. 269; 1993 a. 16, 490; 1997 a. 27.
**Cross Reference:** See also chs. ATCP29, 30, and 31 and ss. ATCP 160.19 and 160.21, Wis. adm. code.

**94.69 Pesticides; rules.**
**History:** 1975 c. 94s. 91 (10); 1977 c. 106; 1983 a. 410; 1997 a. 27, 237.
**Cross-reference:** See s. 94.709 for prohibition of use of DDT and exceptions to the prohibition.
**Cross Reference:** See also chs. ATCP 29, 30, and 31 and ss. ATCP 160.19 and 160.21, Wis. adm. code.

*Wisconsin Statutes that apply to both the Department of Agriculture, Trade and Consumer Protection (WDATCP) and the Department of Natural Resources (WDNR):*

**146.60 Notice of release of genetically engineered organisms into the environment.**
**History:** 1989 a. 15; 1993 a. 213; 1995 a. 27 s. 9126 (19); 1997 a. 283; 2001 a. 109.

*Administrative Code*
The Wisconsin Administrative Code and Register: http://www.legis.state.wi.us/rsb/code.htm
See left navigation bar to search for a specific Statute in the Infobase. Or go to a Code Chapter (look under "NR Natural Resources".) http://www.legis.state.wi.us/rsb/code/codtoc.html

**NR45.04(1)(g) – Firewood restrictions on state property**
**History:** Cr. Register, December, 1983, No. 336, eff. 1−1−84; am. (2) (a) (intro.) and (c), cr. (3) (k), Register, December, 1987, No. 384, eff. 1−1−88; emerg. cr. (3) (l), eff. 4−1−88; emerg. cr. (3) (l), eff. 4−1−89; emerg. am. (3) (l), eff. 5−2−89; renum. (3) (h) to be (3) (h) 1. and cr. (3) (h) 2., Register, March, 1990, No. 411, eff. 4−1−90; am. (1) (c) and (2) (c), cr. (3) (l), Register, March, 1992, No. 435, eff. 4−1−92; r. and recr. (1) (a), (2) (a) and (3) (d), am. (1) (c), (3) (b) and (e), cr. (3) (m), Register, December, 1993, No. 456, eff. 1−1−94; cr. (1) (d), (2) (a) 3. and (b) 4., r. and recr. (2) (b) 3. and (3) (b), Register, November, 1995, No. 479, eff. 12−1−95; renum. (3) (k), (L) and (m) to be (3) (j), (k) and (L), Register, December, 1997, No. 504, eff. 1−1−98; am. (3) (g), cr. (3) (m), (n) and (o), Register, December, 1999, No. 528, eff. 1−1−00; CR 01−011: cr. (1) (e), (3) (p), (r) and (s) Register April 2002 No. 556, eff. 5−1−02; CR 03−035: cr. (1), (f), am. (2) (c), (3) (n) and (p), r. and recr. (3) (f) Register December 2003 No. 576, eff. 1−1−04; CR 04−092: am. (1) (c), cr. (3) (t) Register April 2005 No. 592, eff. 5−1−05; emerg. cr. (1) (g), eff. 4−1−06; CR 06−065: cr. (1) (g) Register November
2006 No. 611, eff. 12−1−06; CR 07−026: cr. (2) (a) 4., r. (3) (h) Register December 2007 No. 624, eff. 1−1−08; **CR 08−011: cr. (3) (u) Register September 2008 No. 633, eff. 2−1−09.**

## Federal Laws and Regulations:

**PUBLIC LAW 106–224 114 STAT. 438-455 TITLE IV - Plant Protection Act**
http://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/PPAText.pdf

**7CFR 301.53 – 301.53-9 – EAB Regulations**
http://www.access.gpo.gov/nara/cfr/waisidx_05/7cfr301_05.html

**7CFR 319.40 – Logs, Lumber, and Other Unmanufactured Wood Articles Regulations**
http://www.access.gpo.gov/nara/cfr/waisidx_01/7cfr319_01.html

# Glossary

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| **4WD** | Four-wheel drive |
| **4x4** | Four-wheel drive vehicle |
| **Angler** | A person who fishes |
| **Aquatic invasives** | NNIS that is found in water. |
| **ATB** | All-terrain bicycle. See 'Mountain Bicycle.' |
| **ATV** | All-terrain vehicle |
| **Best Management Practices (BMPs)** | Practical and economically achievable practices for preventing or reducing the introduction and spread of NNIS**.** |
| **Biological Control** | The management of pests using other organisms, often natural predators. |
| **Chemical Control** | The application of a pesticide as the primary means of managing a pest. |
| **Containment** | Slowing the spread of an invasive species from a defined geographical area. |
| **Control** | To reduce the impact of a pest to a level necessary to meet site management goals. |
| **Cooperative Weed Management Area (CWMA)** | A formal partnership of federal, state and local government agencies; tribes; individuals; and other interested groups that share resources to manage invasive plants in a defined geographic area. |
| **Cultivar** | A cultivated variety of a plant. Cannot be reproduced without human assistance. Usually propagated asexually (cloned). Compare to variety. |
| **Cultural Control** | A planned series of treatments designed to change stand structure and composition to one that meets pest management goals. |

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| **Early Detection** | An integrated system of active or passive surveillance to find new populations of invasive species, as early as possible while their population is low, when eradication and control are still feasible and less costly. It may be targeted at: a) areas where introductions are likely, such as access points and travel corridors, b) areas with high ecological value where impacts are likely to be significant, and c) vulnerable habitats or recently disturbed areas. |
| **Ecosystem** | The complex of a community of organisms and its environment. |
| **Eradication** | Elimination of an NNIS from a specific country? or area. |
| **Established** | An introduced NNIS, present in a country or area, multiplying or expected to continue to occupy the area. (Isn't time a factor here?) |
| **Exotic** | From another country; not native to the place where found. |
| **Fire Break** | Naturally occurring or human-made barrier to the spread of fire. |
| **Geocaching** | An outdoor treasure-hunting game in which the participants use a Global Positioning System (GPS) receiver or other navigational techniques to hide and seek containers anywhere in the world. |
| **Impact** | The cumulative net effect of a pest population on any or all forest resources. |
| **Indigenous** | Native to a particular area not introduced. (see 'native') |
| **Infestation** | An established population of NNIS that is reproducing and spreading. |
| **Integrated Pest Management (IPM)** | To reduce the impact of destructive agents by the planned use of a variety of preventive, suppressive or regulatory tactics and strategies that are ecologically and economically efficient and socially acceptable. |
| **Introduction** | The intentional or unintentional escape, release, dissemination or placement of a species into an ecosystem as a result of human activity. |

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| **Invasive Disease** | Although diseases themselves are not technically invasive, the pathogens that cause plant diseases (including but not limited to fungi, bacteria, viruses and phytoplasmas) can be invasive when they infect a susceptible host and conditions are favorable for disease to develop. |
| **Inventory** | The collection of data about the number, condition and distribution of trees and other vegetation in order to manage the resource. |
| **Management** | The utilization of any procedure or combination of procedures designed to suppress or contain NNIS populations at a level to protect natural resources. |
| **Manual Control** | The deliberate management of pests using means such as hand-pulling, digging, flooding, mulching, burning, removal of alternate hosts, and manual destruction or removal of nests, egg masses or other life stages. |
| **Mechanical Control** | The deliberate management of pests by means such as hoeing, cutting, girdling, tilling, mowing, chopping, and constructing barriers using tools or machines. |
| **Microclimate** | The climate of small spaces, such as an inner city, a residential area or a mountain valley. Microclimate includes: sun/shade, wind, temperature and precipitation. |
| **Monitoring** | The periodic inspection of post-activity sites to detect new invasions and evaluate the success of pest management plans and control measures. |
| **Mountain Bicycle** | A mountain bike or mountain bicycle [abbreviated MTB or ATB (All Terrain Bicycle)] is a bicycle designed for off-road biking, either on dirt trails or other unpaved environments. |
| **MTB** | See ‘Mountain Bicycle.’ |
| **Mulch** | A natural or artificial layer of plant residue or other materials covering the land surface that conserves moisture, holds soil in place, aids in establishing plant cover, and minimizes temperature fluctuations. |
| **Mushing** | The use of one or more dogs to pull a sled on snow. |

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| **Native** | Present in a certain area from other than human causes or influences. (see indigenous) |
| **Native species** | With respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem. |
| **Non-native invasive species (NNIS)** | A species that is not native to the ecosystem under consideration whose introduction causes or is likely to cause economic or environmental harm or harm to human health |
| **OHV** | Off-highway vehicle |
| **Pathogen** | An agent that causes disease, especially a living microorganism such as a bacterium or fungus |
| **Pathway** | Any means that allows the entry or spread of an NNIS. |
| **Personal watercraft** | A motorized water vessel less than 15 feet in length designed to be operated by a person sitting, standing, or kneeling on it rather than within the confines of a hull. |
| **Pest** | Any living stage of an insect, mite, nematode, slug, snail, or other invertebrate animal injurious to plants, plant products, animals, and humans; any bacteria, fungi, other parasitic plants, or reproductive parts thereof, viruses, phytoplasmas, protozoans, or infectious substances which cause disease in or damage to plants or plant products; any host upon which a plant pest is dependent for the completion of all or a portion of its lifecycle. |
| **Prescribed burning** | Skillful application of fire to natural fuels that allows confinement of the fire to a predetermined area and at the same time produces certain planned benefits. |
| **Prevention** | The prescriptions or strategies used to discourage the presence or spread of pests. |
| **Propagule** | Any reproductive structure or part of an organism that can grow independently of its parent source. In plants, this may be a fruit, seed, bud, tuber, root, stem with rooting structures, or shoot. In insects, this may be an egg, larva, pupa or adult. In diseases, this may be a spore, mycelial fragment (similar to roots), or a fruiting body. |

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| **Provenance** | The geographic seed source (i.e., where the seed or seedling originated). Assures that the seed or seedling will be adaptable to the general climatic conditions of that geographic area. |
| **Rapid Response** | A systematic effort to contain, control, or eradicate invasive species while the infestation is still localized. It may be implemented in response to new introductions or to isolated infestations of a previously established species. Preliminary assessment and subsequent monitoring may be part of the response. It is most effective when based on a plan organized in advance so that the response is rapid and efficient. |
| **Recreationists** | Individuals who take part in outdoor recreational activities. |
| **Reforestation** | The reestablishment of forest cover either naturally (e.g., natural seeding, coppice, root suckers) or artificially (e.g., direct seeding or planting). |
| **Restoration** | The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. |
| **Revegetation** | The reestablishment and development of vegetation. |
| **Road bicycle** | A bicycle designed for use primarily on paved roads. |
| **RV** | Recreational vehicle |
| **Segway** | A self-balancing personal transportation device with two wheels; can operate in any level pedestrian environment. |
| **Skijor** | A winter sport where a person wearing skis is pulled over the snow by a dog or dogs. |
| **Soil seedbank** | The collective name for the store of unsprouted seeds in the soil. For example, although most seeds sprout in the first few years after they fall onto the soil, spotted knapweed seeds can last 10 years in the soil before they sprout. |
| **Species** | A group of organisms, all of which have a high degree of physical and genetic similarity, generally interbreed only among themselves and show persistent differences from members of allied groups of organisms. |
| **Survey** | A methodical procedure, conducted over a defined period of time, to determine the characteristics of an NNIS population, or to determine which species occur in an area. |
| **Terrestrial invasives** | NNIS that is found on land. |
| **Touring bicycle** | A bicycle designed to handle touring, distinctive in its sturdier wheels, wider tires, and in its ability to carry gear on racks. |

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| **Trailhead** | The point at which a path starts. Recreational trail users typically begin excursions at trailheads and may review kiosks with maps and other information on display, if available. |
| **Treatment** | Officially authorized procedure for killing or removing plant pests or rendering them infertile. |
| **Urban Forest** | All the trees, shrubs, groundcovers and associated vegetation in and around a city, village or town in association with the buildings, infrastructure, soil, water, air, topography, animals and people. |
| **Urban Forestry** | The art, science and technology of managing the urban forest landscape for the environmental, ecological, physiological, sociological, economic and aesthetic benefits trees, shrubs, groundcovers, and associated vegetation provide. |
| **UTV** | Utility terrain vehicle. |
| **Variety** | A naturally occurring subdivision of a species having a distinct difference and breeding true to that difference. Compare to cultivar. |
| **Vehicle access** | An entry point to a recreational trail or area for motorized vehicles. |
| **Weed Commissioner** | A position which a municipality or county may appoint as having responsibility over noxious weeds and other duties as assigned by the entity. |
| **Wildlife opening** | An opening in a forest that provides wildlife with a variety of food and cover sources that are close together and easily available. May be natural herbaceous or brushy cover, fire breaks, roads, utility rights-of-way, etc. |

## Glossary References

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# Appendix A: Brief Overview of Control Methods

**Manual control** techniques include activities such as hand-pulling, digging, flooding, mulching, burning, removal of alternate hosts, and manual destruction or removal of nests, egg masses or other life stages. These techniques work best on small populations or in areas where chemicals or motorized equipment cannot be used. Manual control efforts must be persistent and several treatments may be needed to reduce or eliminate the target population. If infestations are too pervasive, manual control may become labor intensive and thus not economically feasible.

**Mechanical control** techniques include hoeing, cutting, girdling, tilling, mowing, chopping and constructing barriers using tools or machines. These techniques are most useful in areas with large infestations where terrain does not create safety or equipment issues. Repeated mowing or cutting of invasive plants can weaken the population by depleting root reserves and preventing flowering; however, mechanical control is typically most effective when used in conjunction with herbicide treatments. If infestations are small, the cost of mechanical control is usually relatively low, and when combined with other treatments it can be very effective. However, cutting large populations of woody NNIS plants can become labor and resource intensive.

**Chemical control** refers to the use of pesticides, and for all practical purposes, some NNIS organisms cannot be controlled without the use of pesticides. There are many kinds of herbicides, insecticides, and fungicides, and not all of them will be appropriate for every situation. The choice of pesticide depends on the target population, stage of growth, the presence of desirable species that may be affected, the proximity of water resources and environmental conditions. Additionally, there may be some areas where chemical control is inappropriate, for example if rare species are present or if the area is near a densely populated area. Pesticides must always be applied in accordance with the label. Managers should possess the proper equipment and the knowledge to safely apply chemicals or contract a licensed applicator. Proper personal protection gear should be used, and materials to contain spills should be kept close by. Major NNIS plant infestations may require complete stand removal, using herbicides to remove the NNIS after harvest, and establishing a plantation of native tree species. Densely populated urban areas, adjacent property owners and local ordinances are just a few examples of things that can affect chemical control plans.

**Biological control** refers to the use of animals, fungi, or diseases to control invasive populations. Control organisms usually come from the native range of the target species, and require a period of study to ensure that they will remain specific to the target population, and will not harm native species, crops, or other ornamental species. Biological control typically does not eliminate the NNIS, and usually takes several years to show results. However, biological control has been effective for some species. An example is the *Galerucella* beetle, which has been used with some success to control the European perennial purple loosestrife (*Lythrum salicaria*), and Btk, *Entomophaga maimaiga* and the nuclear polyhedral virus for gypsy moth control.

**Cultural Control** is the manipulation of forest structure and composition, growing conditions, and tree health to control NNIS or the alteration of the stand so that effects will be limited if invasion occurs. Trees and other vegetation that are potentially susceptible host species can be reduced as a component of the forest, thus limiting population outbreaks of insects and disease-causing organisms. Alternately, species that are resistant to NNIS insects and diseases may be planted instead of nonresistant species. Other examples of cultural control activities include maintaining a level of canopy closure that impedes shade

intolerant NNIS, or developing advanced regeneration that can compete with NNIS plants before removing the overstory. For drastically disturbed sites, cultural control may include the replacement or restoration of the plant community through cultivation—cutting, tilling, re-seeding, fertilizing, and irrigating—to reduce the weed seed bank prior to planting desirable species and prevent or reduce future NNIS infestations.

### *Reference:*

(CNAP) Colorado Natural Areas Program. 2000. Creating an Integrated Weed Management Plan: A Handbook for Owners and Managers of Lands with Natural Values. Colorado Natural Areas Program, Colorado State Parks, Colorado Department of Natural Resources. Denver, CO.

# Appendix B. Regulations

Each Eastern Region Forest may add their state regulations, as appropriate here.

**Invasive Plant Statutes and Codes -- Wisconsin**

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Wisconsin Statutes http://www.legis.state.wi.us/rsb/stats.html
See left navigation area to search for a specific statute in the website's *Infobase* or go to a Statute Chapter.

**15.34 Department of natural resources; creation.**
**15.347 Same; councils.**
**(18)** INVASIVE SPECIES COUNCIL
**History:** 1973 c.74; 1991 a.316; 2001 a.16.

**23.22 Invasive species.**
**Cross Reference:** See also ch. NR 198, Wis. adm. code.
**History:** 2001 a. 109 ss. 72t, 72xd; 2003 a. 33.

**23.235 Nuisance weeds.**
**History:** 1987 a. 41; 1999 a. 150 s. 616; Stats. 1999 s. 23.235; 2001 a. 16; 2001 109 ss. 72td to 72wj.

**26.02 Council on forestry.**
**History:** 2001 a. 109.

**28.04 Management of state forests.**
**History:** 1995 a. 257.
**Cross Reference:** See also ch. NR 44 and s. NR 1.24, Wis. adm. code.

**66.0407 Noxious weeds.**
**History:** 1975 c. 394 s. 12; 1975 c. 421; Stats. 1975 s. 66.96; 1983 a. 112, 189; 1989 a. 56 s. 258; 1991 a. 39, 316; 1997 a. 287; 1999 a. 150 ss. 617 to 619; Stats. 1999 s. 66.0407.

**94.38 Agricultural and vegetable seeds; definitions.**
**History:** 1975 c. 39, 308; 1983 a. 189; 1985 a. 138; 1993 a. 112.

**94.39 Seed labeling requirements.**
**History:** 1975 c. 39, 308; 1985 a. 138.

**94.41 Prohibitions.**
**History:** 1973 c. 194, 195; 1985 a. 138; 1993 a. 492.

**94.45 Powers and authority of the department** [Department of Agriculture].
**History:** 1975 c. 39, 308; 1983 a. 189 s. 329 (20).
**Cross Reference:** See also ch. ATCP 20, Wis. adm. code.

Administrative Code http://www.legis.state.wi.us/rsb/code.htm
See left navigation area to search for a specific Statute in the website's *Infobase* or go to a Code Chapter (look under "NR Natural Resources".) http://www.legis.state.wi.us/rsb/code/codtoc.html

**NR 150.025 Policy.**
**History:** Register, February, 1981, No. 302, eff. 3-1-81; renum. (2) (g) and (h) to be (2) (h) and (i), cr. (2) (g), Register, February, 1984, No. 338, eff. 3-1-84; am. (2) (e), Register, January, 1987, No. 373, eff. 2-1-87.

**NR 1.211 Cooperative forestry policy.**
**History:** Cr. Register, July, 1989, No. 403, eff. 8-1-89.

**NR 44.04 Master plan development, adoption and public involvement.**
**History:** Cr. Register, August, 1996, No. 488, eff. 9–1–96.

**Insects and Diseases Statutes**

Wisconsin Statutes http://www.legis.state.wi.us/rsb/stats.html
See left navigation area to search for a specific Statute in the website's *Infobase* or go to a Statute Chapter: http://www.legis.state.wi.us/rsb/Statutes.html

*Wisconsin Statutes that apply to the Department of Natural Resources (WDNR):*

**26.30 Forest insects and diseases; department jurisdiction; procedure.**
**History:** 1977 c. 29 s. 1650m (1); 1979 c. 32 s. 92 (9); 1979 c. 110 s. 60 (11); 1983 a. 189; 1985 a. 13; 1991 a. 316; 2003 a. 33, 57.
**Cross Reference:** See also s. NR 47.910, Wis. adm. code.

*Wisconsin Statutes that apply to the Department of Agriculture, Trade and Consumer Protection (WDATCP):*

**94.01 Plant inspection and pest control authority.**
**History:** 1975 c. 394 s. 18; Stats. 1975 s. 94.01.
**Cross Reference:** See also ch. ATCP 21, Wis. adm. code.

**94.02 Abatement of pests.**
**History:** 1975 c. 394ss. 5, 19; 1975 c. 421; Stats. 1975 s. 94.02; 1977 c. 418; 1981 c.20.

**94.03 Shipment of pests and biological control agents; permits.**
**History:** 1975 c. 394 ss. 6, 17; 1983 a. 189 s. 329 (20).

**94.10 Nursery stock; inspection and licensing.**
**History:** 1975 c. 394 ss. 20, 22; 1975 c. 421; Stats. 1975 s. 94.10; 1983 a. 189; 1989 a. 31; 1993 a. 16; 1995 a. 27; 1999 a.9.

**94.685 Pesticides; licensing of dealers and distributors of restricted-use pesticides.**
**History:** 1987 a. 27; 1991 a. 269; 1993 a. 16, 490; 1997 a. 27.
**Cross Reference:** See also chs. ATCP29, 30, and 31 and ss. ATCP 160.19 and 160.21, Wis. adm. code.

**94.69 Pesticides; rules.**
**History:** 1975 c. 94s. 91 (10); 1977 c. 106; 1983 a. 410; 1997 a. 27, 237.
**Cross-reference:** See s. 94.709 for prohibition of use of DDT and exceptions to the prohibition.
**Cross Reference:** See also chs. ATCP 29, 30, and 31 and ss. ATCP 160.19 and 160.21, Wis. adm. code.

*Wisconsin Statutes that apply to both the Department of Agriculture, Trade and Consumer Protection (WDATCP) and the Department of Natural Resources (WDNR):*

**146.60 Notice of release of genetically engineered organisms into the environment.**
**History:** 1989 a. 15; 1993 a. 213; 1995 a. 27 s. 9126 (19); 1997 a. 283; 2001 a. 109.

# Appendix C: Resources

Each Eastern Region Forest may add NNIS resources as appropriate.

**NNIS –** *All NNIS, Wisconsin*

*Center for Invasive Plant Management (CIPM).* http://www.weedcenter.org
This web site provides information on invasive plant identification, biology, and impacts of NNIS. It also includes links to a resource guide, weed control methods, and invasive plant management online textbook.

*Great Lakes Indian Fish and Wildlife Commission (GLIFWC)—Exotic Plant Information Center.* http://www.glifwc.org/invasives/ This site features a searchable database of NNIS accounts. It also provides distribution maps, educational materials, and a slide library.

*Invasive Plants Association of Wisconsin (IPAW).* http://www.ipaw.org
The mission of IPAW is to promote better stewardship of the natural resources of Wisconsin by advancing the understanding of invasive plants and encouraging the control of their spread. Their web site offers a photo gallery, NNIS list, educational resources, news and events, and more.

*Midwest Invasive Plant Network (MIPN).* http://www.mipn.org/
This organization's mission is to reduce the impact of invasive plant species in the Midwest. The web site provides information on prevention, early detection and rapid response, control and management, education, research, and more.

*Plant Conservation Alliance (PCA), Weeds Gone Wild, Alien Plant Invaders of Natural Areas.* http://www.nps.gov/plants/alien/ This web site provides a list of invasive plants in the US, background information on the threats and impacts of NNIS, fact sheets, and relevant links.

*University of Wisconsin Herbarium.* http://www.botany.wisc.edu/wisflora
The Herbarium's web site is fully searchable for Wisconsin's vascular plant species. It includes photos, habitat information, distribution maps, and herbarium specimen data.

**NNIS Insects and Diseases**

*Department of Agriculture Trade and Consumer Protection (DATCP).*
http://www.datcp.state.wi.us/core/insectspesticides/insectspesticides.jsp
DATCP is responsible for the prevention, introduction and spread of plant pests. This webpage provides information on specific pests, rules, firewood restrictions, and firewood dealer certification.

*Department of Agriculture Trade and Consumer Protection (DACTP)—Wisconsin Pest Bulletin.* http://pestbulletin.wi.gov/index.jsp The most relevant links are: *Nursery and Forest*, *Exotic Pest of the Week*, and *DATCP Contacts*.

*Emerald Ash Borer: What you need to know.* http://www.emeraldashborer.info/ This web site is part of a multi-state effort to provide the latest information about EAB to the public.

*National Agricultural Pest Information System (NAPIS)—Pest Tracker.* http://ceris.purdue.edu/napis/ This web site has links to state information, pest information, survey maps and publications. Information presented here is derived, in part, from the National Agricultural Pest Information System (NAPIS), an agricultural pest tracking and database sponsored by the U.S. Department of Agriculture Animal and Plant Health Inspection Service (APHIS) and Plant Protection and Quarantine (PPQ) Cooperative Agricultural Pest Survey, (CAPS).

*The Exotic Forest Pest Information System for North America.* http://spfnic.fs.fed.us/exfor/index.cfm This web site contains a database of invasive insects, mites, and diseases with background information for each pest.

*U.S. Department of Agriculture (USDA) Animal Plant Health Inspection Service (APHIS).* http://www.aphis.usda.gov/plant_health/ APHIS safeguards agriculture and natural resources from the risks associated with the entry, establishment, or spread of animal and plant pests. The site has links to information on specific plant pests, pest detection and identification information, and plant protection and quarantine manuals.

*U.S. Department of Agriculture (USDA) Forest Service—North Central Research Station: Emerging Forest Insect Pests.*
http://www.ncrs.fs.fed.us/4501/focus/emerging_pests/ The North Central Research Station web site provides information on exotic forest insects, describes current research, and features publications and maps for a 20-state region spanning the Midwest and Northeast.

*Wisconsin Gypsy Moth.* http://www.gypsymoth.wi.gov/ The Wisconsin Gypsy Moth site has information on predicting defoliation, management options, identification, and life cycle and includes the phone number for the Gypsy Moth Information Line.

*Wisconsin's Emerald Ash Borer Resource.* http://emeraldashborer.wi.gov/ This site includes information on surveys, detection, and management, and includes an email address and phone number to report suspected infestations.

**All Non-native Invasive Species:**

*National Invasive Species Council's Definition of Invasive Species.*
http://www.invasivespeciesinfo.gov/docs/council/isacdef.pdf

*National Invasive Species Management Plan.* http://www.invasivespeciesinfo.gov/council/nmp.shtml

*The Nature Conservancy (TNC)—Global Invasive Species Initiative.* http://tncweeds.ucdavis.edu This web site provides many resources designed to help conservationists deal most effectively with NNIS. It provides links to an introduction on NNIS management, planning and strategy, control methods, and photo archive and more.

*USDA Forest Service Invasive Species Program.* http://www.fs.fed.us/invasivespecies This web site serves as a portal to Forest Service NNIS information and related management and research activities across the agency and with partners. The program's goal is to reduce, minimize, or eliminate the potential for introduction, establishment, spread, and impact of NNIS across all landscapes and ownerships.

**General Sites of Interest:**

Great Lakes Restoration Initiative Projects. GLRI Projects Funded by the USDA Forest Service. https://restore.glnpo.net/glas_pub/qadetailreport.htm?reportType=Organization&reportYear=All Years&subID=18

Non-Native Invasive Species Framework for Plants and Animals in the U.S. Forest Service, Eastern Region. *http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm91_054493.pdf*

U.S. Forest Service Eastern Region Native Plant Framework. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm91_054410.pdf

U.S. Forest Service Eastern Region (R9) Non-native Invasive Species Program. http://www.fs.usda.gov/main/r9/forest-grasslandhealth/invasivespecies

U.S. Forest Service Manual 2900, Invasive Species Management. http://www.fs.fed.us/im/directives/fsm/2900/wo_2900_zero_code.doc

U.S. Forest Service Non-native Invasive Species – Laws, Regulations and Policies. http://www.fs.usda.gov/detail/r9/forest-grasslandhealth/invasivespecies/?cid=fsm91_054666

**General Invasive Plant Management:**

*Center for Invasive Plant Management (CIPM)—Weed Control Methods.* http://www.weedcenter.org/management/control.htm
The Weed Control Methods web page offers information and links on the following control techniques: biocontrol, grazing, herbicides, mechanical and prescribed burning.

*Department of Conservation and Natural Resources Invasive Exotic Plant Tutorial for Natural Land Managers. Invasive Exotic Plants in Pennsylvania List.* http://www.dcnr.state.pa.us/forestry/invasivetutorial/List.htm
Although this site is for Pennsylvania most of the species featured are also invasive in Wisconsin. The site provides links to fact sheets and management and control recommendations.

*Garlic mustard (*Alliaria petiolata*)—Guide for identifying and controlling.* http://www.for-wild.org/download/garlicmustard.pdf

*Illinois Nature Preserve Management Guidelines.* http://dnr.state.il.us/INPC/Management_guidelines.htm The information presented gives guidance to landowners, managers, custodians and stewards of sites in the Illinois Nature Preserve Programs on control methods for common NNIS.

*Invasive Plants of the Upper Midwest* by Elizabeth J. Czarapata. This book is a comprehensive, fully-illustrated guide to the identification and control of invasive plant species. Available for purchase at www.ipaw.org.

*Plant Conservation Alliance—Alien Plant Invaders of Natural Areas.* http://www.nps.gov/plants/alien/factmain.htm This web site features illustrated, easy-to-read fact sheets on select invasive plants with native ranges; plant descriptions; ecological threats; US distributions and habitats; background of introductions; plant reproduction and dispersal; management approaches; alternative native plants; and other useful information.

*The Nature Conservancy (TNC)—Weed Control Methods Handbook: Tools and Techniques for Use in Natural Areas.* http://tncweeds.usdavis.edu/handbook.html
The handbook provides detailed information on the use of manual and mechanical techniques, grazing, prescribed fire, biocontrol, and herbicides for use in controlling NNIS in natural areas.

*USDA Forest Service Invasive Species Program—Control and Management.* http://www.fs.fed.us/invasivespecies/controlmgmt/index.shtml This page provides links for more information on research, management planning, forest service activities, and pest-specific control and management.

*USDA Forest Service—Dangerous Travelers: Controlling Invasive Plants along America's Roadsides (Video).* http://www.fs.fed.us/invasivespecies/ The video outlines the best management practices that road crews should be following in their day-to-day operations. This is the first in a series on "Best Management Practices for Invasive Species Prevention." The video can also be ordered on DVD by contacting: USDA Forest Service; San Dimas Technology and Development Center; 444 East Bonita Avenue; San Dimas, CA 91773; (909) 599-1267

*Wisconsin Department of Natural Resources (WDNR). Wisconsin Manual of Control Recommendations: Ecologically Invasive Plants.*
http://dnr.wi.gov/invasives/publications/manual/manual_toc.htm

**Biocontrol:**

Invasive Plants of the Eastern U S—Biological Control of Invasive Plants in the Eastern United States. (USDA Forest Service Publication FHTET-2002-04, 413 p.) http://wiki.bugwood.org/Archive:BCIPEUS This web site serves as a reference guide for field workers and land managers concerning the historical and current status of the biological control of select invasive plants in the eastern United States.

*Cornell University. Biological Control: A Guide to Natural Enemies in North America.* http://www.nysaes.cornell.edu/ent/biocontrol/ This web site provides photographs and descriptions of biocontrol agents of insect, disease and weed pests in North America.

**Grazing:**

*University of Idaho Rangeland Ecology and Management. Targeted Grazing: A Natural Approach to Vegetation Management and Landscape Enhancement.* http://www.cnr.uidaho.edu/rx-grazing/Handbook.htm The handbook outlines the basics of applying targeted grazing for vegetation management. This handbook includes 18 chapters and represents a compilation of the latest research on harnessing livestock to graze targeted vegetation in ways that improve the function and appearance of a wide variety of landscapes.

**Prescribed fire:**

*California Invasive Plant Council—The Use of Fire as a Tool for Controlling Invasive Plants.* http://www.cal-ipc.org/ip/management/UseofFire.pdf
This document contains information on the following: planning and implementing prescribed burns, control of invasive plants with prescribed fire, using prescribed burning in integrated strategies, effects of fire on plant communities, effects of fire on chemical, physical, and biotic properties of soil.

*Center for Invasive Plant Management (CIPM)—Fire As a Tool For Controlling Nonnative Invasive Plants.* http://www.weedcenter.org/management/burning_weeds.pdf
This review focuses on the intentional use of fire, alone or integrated with other methods, to control exotic plants in North America.

*The Nature Conservancy (TNC)—Fire Management Manual.* http://www.tncfiremanual.org/index.htm The manual serves as the Conservancy's guiding document on all aspects of wildland fire management.

*USDA Forest Service—Fire Effects Information System (FEIS).* (http://www.fs.fed.us/databas/feis/). FEIS features a searchable database that summarizes and synthesizes research about living organisms in the United States —their biology, ecology, and relationship to fire.

*Wisconsin Prescribed Fire Council.* http://www.prescribedfire.org/index.html The Wisconsin Prescribed Fire Council strives to make the use of prescribed fire in Wisconsin safer and more accepted for all practitioners. The site provides information and links on government relations, liability, training, weather, and fire implementation.

**Herbicide:**

*Department of Agriculture Trade and Consumer Protection (DATCP)—Pesticide Database Searches.* http://www.kellysolutions.com/wi/ Use this site to search for registered pesticide products, the companies that sell and use pesticides, and the people that apply them.

*Herbicide safety information—Material Data Safety (MDS) sheets and product labels.* http://www.cdms.net/LabelsMsds/LMDefault.aspx?t=.

*The Nature Conservancy (TNC)—Safe Herbicide Handling in Natural Areas: A Guide for Land Stewards and Volunteer Stewards.* http://tncweeds.ucdavis.edu/products/library/herbsafe.pdf

*The Nature Conservancy (TNC)—Upkeep and Maintenance of Herbicide Equipment: A guide for natural area stewards.* http://tncweeds.ucdavis.edu/products/library/herbupkeep.pdf

**Early Detection and Rapid Response:**

*iMapInvasives: Geotracking invasive exotic species.* http://imapinvasives.org/index.html
A consortium developed an on-line GIS-based NNIS mapping tool designed to aid in Early Detection and Rapid Response efforts. The site allows one to display maps and query by NNIS or contributing organization. Currently the site has only sample plant data for the state of New York. Long-term goals for the site include seeking participation of additional states and/or provinces.

*National Biological Information Infrastructure (NBII). National Framework for Early Detection, Rapid Assessment, and Rapid Response to Invasive Species.*
http://159.189.176.5/portal/community/Communities/Ecological_Topics/Invasive_Species/Early_Detection,_Rapid_Response_(EDRR)/ This framework includes seven main components: 1) identification and validation, 2) reporting, 3) expert verification, 4) occurrence databases, 5) rapid assessment, 6) planning, 7) rapid response.

*The Nature Conservancy (TNC)—Weed Information Management System (WIMS).*
http://tncweeds.ucdavis.edu/wims.html WIMS is a Microsoft Access-based relational database application that is designed to assist natural resource managers in managing their weed data.

*The North American Weed Management Association.* http://www.nawma.org/ The North American Weed Association has developed a data collection standard for invasive plant monitoring in the western United States and it has been adopted by several federal agencies, including US Forest Service and the National Park Service. At the home page, scroll down to "Mapping Standards" link.

*USDA Forest Service. The Early Warning System for Forest Health Threats in the United States.*
http://www.fs.fed.us/foresthealth/publications/EWS_final_draft.pdf
This is a monitoring framework for early detection and response to environmental threats (e.g., insects, diseases, NNIS, and fire) to forest lands. The framework is based on the following steps: 1) identify potential threats, 2) detect actual threats, 3) assess impacts, and 4) respond.

*Wisconsin Department of Natural Resources/ University of Wisconsin-Madison Herbarium—Invasive Plants of the Future.* http://dnr.wi.gov/invasives/futureplants/
This monitoring and early reporting project has three main goals: 1) identify and report populations of high-risk early-stage target weed species in Wisconsin; 2) eliminate or contain those populations before they spread; and 3) coordinate long-term monitoring of occurrence sites. All land managers are encouraged to participate in this program.

**Prioritizing Management:**

*NatureServe—An Invasive Species Assessment Protocol: Evaluating Non-Native Plants for Their Impacts on Biodiversity.*
http://www.natureserve.org/library/invasiveSpeciesAssessmentProtocol.pdf
The Invasive Species Assessment Protocol was developed as a tool for assessing, categorizing, and listing non-native invasive vascular plants according to their impact on biodiversity in a large area such as a nation, state or province, or ecological region. This protocol is designed to make the process of assessing and listing invasive plants objective and systematic.

*Animal and Plant Health Inspection Service (APHIS)—Weed-Initiated Pest Risk Guidelines for Qualitative Assessments.*
http://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/wra.pdf
This document provides a template for conducting pest risk analysis: initiating the process by identifying a pest that may qualify as a quarantined pest, and/or pathways that may allow introduction or spread of a quarantine pest; and assessing pest risk (determining which pests are quarantine pests, characterized in terms of likelihood of entry, establishment, spread, and economic importance.)

**Non-native Invasive Species Plant Lists:**

*Chequamegon-Nicolet National Forest, Invasive Plants of Immediate Concern.*
http://www.fs.fed.us/r9/cnnf/natres/nnis/species_list.html)

*Invasive Plant Association of Wisconsin, Working List of Invasive Plants in Natural Plant Communities and Wild Areas of the State.*
http://www.ipaw.org/list/list1.htm?n0

*USDA Forest Service, Invasive Plants Field and Reference Guide: An Ecological Perspective of Plant Invaders of Forests and Woodlands.*
http://www.na.fs.fed.us/pubs/misc/ip/ip_field_guide.pdf

*USDA PLANTS Database. Invasive and Noxious Weeds.* http://plants.usda.gov/java/noxiousDriver This database provides information about the vascular plants, mosses, liverworts, hornworts, and lichens of the US, including invasive plants. It includes species distribution, characteristics, species abstracts, images, references and links to more information.

*Wisconsin DNR, Program Feasibility Study: Invasive Plants in Forests*
*Plants Currently a Problem in Wisconsin's Forests (p.6-12).*
http://dnr.wi.gov/org/land/forestry/Publications/pdf/InvasivePlantStudy.pdf

*WDNR Target Invasive Plants of the Future.*
http://dnr.wi.gov/invasives/futureplants/target.htm

**Insects and Diseases Lists:**

*The Nature Conservancy's Invasive Species Initiative Regional List of Pests, 2004 (scroll down to Midwest region, but note that this covers from MI to ND, south to TX).*
http://tncweeds.ucdavis.edu/products/gallery/regionlist.html

*USDA Forest Service Invasive Species Program Web pages.*
http://www.fs.fed.us/invasivespecies/speciesprofiles/index.shtml

*USDA Forest Service North Central Research Station.*
http://www.ncrs.fs.fed.us/4501/focus/emerging_pests/

*Wisconsin DNR Forest Health Protection Unit's Annual Report: Forest Health Conditions in Wisconsin, 2005.*
http://dnr.wi.gov/org/land/forestry/fh/pdf/AnnualReport2005.pdf

# Appendix D: Financial Assistance for Controlling NNIS

**Non-native Invasive Plants:**

*Conservation Reserve Program (CRP)*
CRP is a federal program administered by the Farm Service Agency (FSA) with NRCS and DNR providing technical advice. It is an annual payment program based on bids submitted by the landowner, offering a 50 percent cost-share for establishing ground cover and agreeing not to farm the land. Cost sharing is available for plan preparation, tree planting, wildlife planting, grass establishment, erosion control structures, and stream buffers. For more information, go to: http://www.wi.nrcs.usda.gov/programs/crp.html.

*Conservation Technical Assistance (CTA)*
The CTA Program provides the technical capability, including direct conservation planning, design, and implementation assistance, that helps people plan and apply conservation on the land. This assistance is provided to individuals, groups, and communities who make natural resource management decisions on private, tribal, and other non-federal lands. NRCS, through the CTA Program, provides conservation technical assistance that addresses natural resource conservation issues at the local level that are of state and national concern. http://www.nrcs.usda.gov/programs/cta/

*Cooperative Forest Health Management Program*
This is a US Department of Agriculture grant and partnership program to fund weed management activities on state and private forest lands. Eligible entities include Cooperative Weed Management Areas, states, and non-profit organizations. This program requires a 50 percent match. For more information contact Rob Mangold at (703) 605-5340 or rmangold@fs.fed.us.

*Environmental Quality Incentives Program (EQIP)*
EQIP is a federal program administered by the NRCS, with DNR Forestry providing technical advice for forested lands. This program provides up to a 75 percent cost share, with 65 percent of funds allocated to priority areas and the remainder available statewide. Contracts are for five or ten years. Maximum cost shares set by the program are currently $10,000 annually and $50,000 per contract. Cost sharing is available for tree planting, ecosystem management including prescribed burning and brush management, erosion control, agricultural waste management, and stream buffers. For more information, go to: http://www.wi.nrcs.usda.gov/programs/eqip.html.

*Forest Land Enhancement Program (FLEP)*
FLEP was authorized by the 2002 Farm Bill, but was not re-funded in 2004, so funding under this program is not currently available. It replaced the Stewardship Incentives Program (SIP) and the Forestry Incentives Program (FIP). FLEP provided technical, educational, and cost share assistance to non-industrial private forest landowners. There is a possibility that it may be reauthorized in future Farm Bills.

*Landowner Incentive Program (LIP)*
LIP is funded by the U.S. Fish and Wildlife Service and administered by the Wisconsin DNR Bureau of Endangered Resources. The program helps private landowners by providing financial and technical assistance to manage and restore habitat for at-risk species on their land. At-risk species include rare and declining plants and animals in Wisconsin such as those that are listed as endangered or threatened, special concern or species of greatest conservation need. LIP provides up to 75 percent of the project cost for eligible projects. The maximum cost share is $25,000. Potential projects include conducting prescribed burns, planting native vegetation, and controlling invasive and woody species. For more information, go to: http://dnr.wi.gov/org/land/er/wlip/.

*National Fish & Wildlife Foundation Pulling Together Initiative (PTI)*
PTI applications are accepted from private non-profit (501) (c) organizations, local, county, and state government agencies, and from field staff of federal government agencies. Individuals, for-profit businesses, and USDA staff are not directly eligible to receive PTI grants, but are encouraged to work with eligible applicants to develop and submit applications to PTI. Proposals may be submitted that describe initiatives to prevent, manage, or eradicate invasive and noxious plants through a coordinated program of public/private partnerships; and that increase public awareness of the adverse impacts of invasive and noxious plants. For more information, see: http://www.nfwf.org.

*National Fish & Wildlife Foundation Upper Mississippi River Watershed Fund (UMRWF)*
UMRWF is a partnership between the USDA Forest Service and the National Fish and Wildlife Foundation that provides grants for forest stewardship and watershed restoration in the Upper Mississippi River drainage. Eligible applicants include non-profit 501 (c) organizations, local, and state units of government. In particular the UMRWF will support projects that address: conservation of priority forest areas, loss of migratory bird habitat, regeneration of bottom land hardwoods, enhancement of water quality and aquatic habitat, and outreach and education. For more information, see: http://www.nfwf.org.

*Partners for Fish and Wildlife (U.S. Fish & Wildlife Service)*
The Partners for Fish and Wildlife (PFW) program provides technical and financial assistance to private landowners who voluntarily restore wetlands and other fish and wildlife habitats on their lands. A dollar-for-dollar cost-share, although not a program requirement, is sought on a project-by-project basis. Up to 100-percent funding for habitat restoration projects is available through the Service and its partners. Landowners agree to maintain the restored habitats for no less than 10 years, but otherwise retain full control of their lands. For more information, go to: http://www.fws.gov/partners.

*State Wildlife Grant*
The State Wildlife Grants program is designed to assist states by providing federal funds for developing and implementing programs that benefit wildlife (including fish and invertebrates) and their habitats. This funding is intended to supplement, not duplicate existing fish and wildlife programs. Funding in the program is provided for species with the greatest conservation need, species indicative of the diversity and health of the state's wildlife, and low and declining populations as deemed appropriate by the state's fish and wildlife agencies. For more information, go to: http://dnr.wi.gov/org/land/er/swg/.

*Urban Forestry Grant Program*
This is a state program administered by the WDNR Division of Forestry - Urban Forestry. It is a 50-50 cost-share program providing grants that range from $1,000 to $25,000. Grant recipients are reimbursed upon project completion. Eligible applicants may be a city, village, town, county, tribal government, or a 501(c)(3) nonprofit organization. Projects may include, but are not limited to, development of: urban forestry plans, tree inventories, vegetation ordinances, tree boards, staff training and public awareness programs. Funds may be available for tree planting, maintenance, or removal. However, priority is given to projects focusing on long term urban forestry management. The application deadline varies each year

but is generally around the beginning of October. Projects begin at the start of the calendar year and must be completed by the end of that year. For more information go to:
http://www.dnr.state.wi.us/forestry/UF/grants/

*For Urban Natural Areas*
There are additional grant opportunities that may be applicable for certain large urban natural areas and other similar environments. See the Forestry Track's Financial Assistance Appendix to view these grants.
http://council.wisconsinforestry.org/NNIS/forestry.php

*Wildlife Habitat Incentives Program (WHIP)*
WHIP is a federal program administered by the NRCS, with NRCS and DNR Fisheries and Wildlife providing technical advice. WHIP provides 75 percent cost share for items proposed in a five or ten year contract. The maximum cost share per year is $10,000. Cost sharing is available for wildlife planting, grass establishment, fencing, prescribed burning, farmstead shelterbelts, and wildlife practices that include nesting habitat, vegetation management, tree and shrub planting, creation of openings, and wildlife corridors. For more information, go to: http://www.wi.nrcs.usda.gov/programs/whip.html.

*Wisconsin Forest Landowner Grant Program (WFLGP)*
WFLGP is a state program administered by the WDNR Division of Forestry. It provides $1,250,000 annually for stewardship practices on private lands. A wide array of practices are eligible for cost sharing including management plan development, wetland restoration, tree planting, forest improvement, and prairie restoration. Up to 50 percent of the eligible costs can be refunded to the landowner upon completion of the work. The maximum cost share amount is currently set at $10,000 per year. Landowner Grant applications are accepted continuously but processed only four times a year—February 1, May 1, August 1 and November 1. Applications are funded on the basis of priority. Plan development, afforestation, reforestation and timber stand improvement are top priorities while the remaining practices are secondary. For more information, go to: http://dnr.wi.gov/forestry/private/financial/#costshare.

*More information*
Grants are sometimes available for special purposes or community projects. See the following websites for current announcements or opportunities.

- Midwest Invasive Plants Association - http://www.mipn.org/grants.html
- Invasive Plants Association of Wisconsin - http://www.ipaw.org/funding/index.htm
- National Urban and Community Forestry Advisory Council - http://www.treelink.org/nucfac/
- Wisconsin's Certified Community Foundations - http://www.wisconsingives.org/
- USDA grant and partnership programs that could be used to fund NNIS related projects - http://www.NNISpeciesinfo.gov/docs/toolkit/usdagrants2009.pdf
- Grants Information Collection - UW Madison - http://grants.library.wisc.edu
- Wisconsin Dept. of Commerce - http://www.commerce.state.wi.us/
- All federal grants - http://www.grants.gov/

**Insects and Diseases:**

*Gypsy Moth Suppression Program*
The DNR facilitates an aerial spray program to suppress gypsy moth outbreaks which is offered to landowners in WI through counties. Because this is a state organized program, the DNR can apply for federal cost sharing available for management of outbreaks of this invasive pest. Depending on

availability of federal funds, the reimbursement may be up to 50% of the cost of the spray and its associated administrative work. The DNR passes through the federal cost share to the counties to offset their costs and for distribution to the communities and/or individuals who paid for the treatment. http://dnr.wi.gov/org/caer/cfa/lr/gypsy/moth.html

*United States Department of Agriculture Forest Service Wood Education and Resource Center (WERC)*
The Wood Education and Resource Center (WERC) funds projects that create opportunities for sustained forest products production for primary and secondary hardwood industries located in the eastern hardwood forest region. Examples of proposals that would be given priority include: Develop technology and markets to address emergency issues including: 1) Phytosanitation of wood packaging materials, firewood and similar products to eliminate these pathways for the transport of insect and disease pests, and 2) development of markets for and utilization of unpredicted increases in volume of urban and rural wood due to incidents like new pest introductions (e.g., EAB). http://www.na.fs.fed.us/werc/grants.shtm