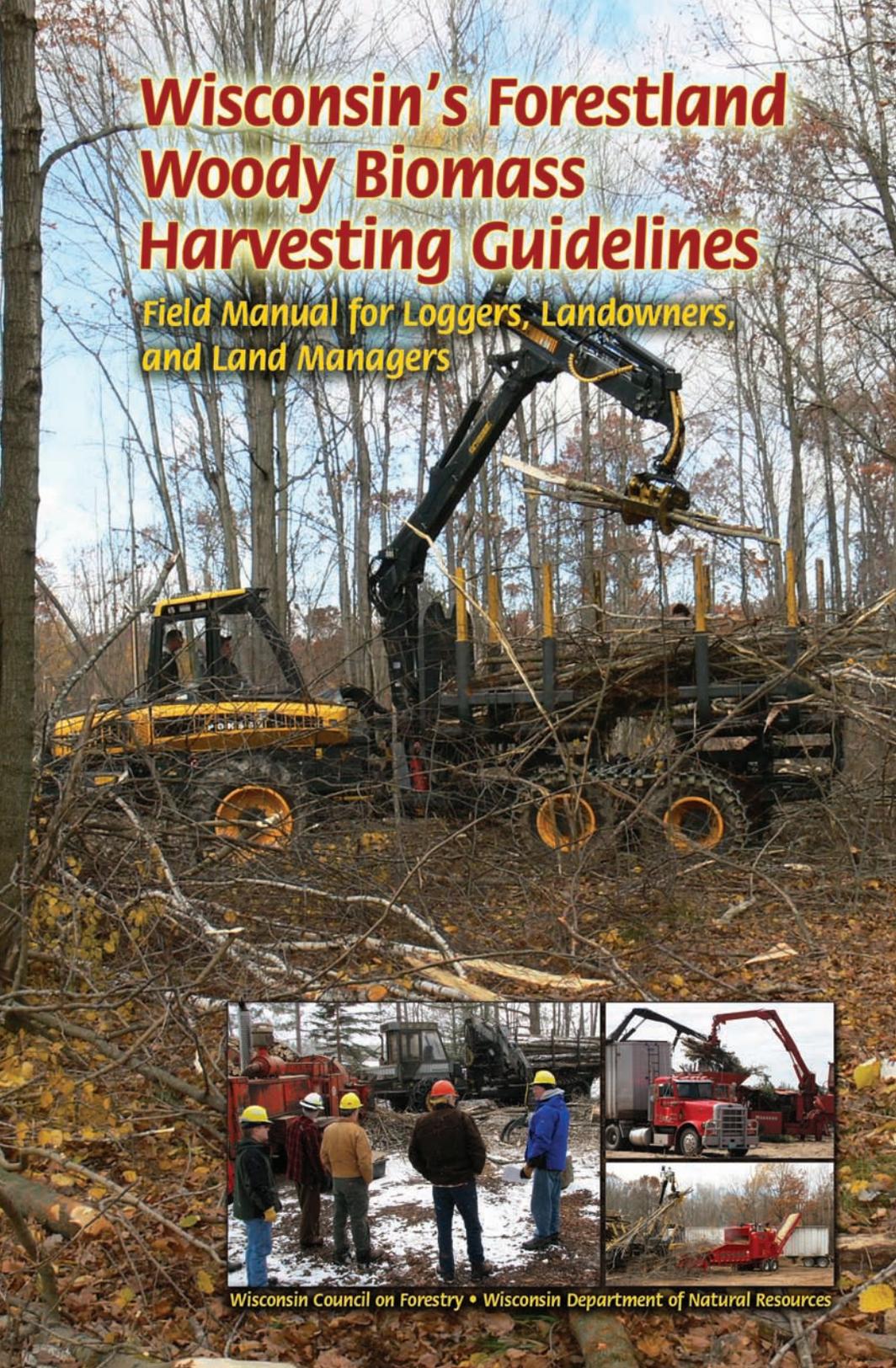


Wisconsin's Forestland Woody Biomass Harvesting Guidelines

Field Manual for Loggers, Landowners,
and Land Managers



Wisconsin Council on Forestry • Wisconsin Department of Natural Resources



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Carmen Wagner, WI DNR

Foreword

Dear Reader,

This field manual was developed by Wisconsin's forestry community in recognition of an emerging interest in wood-based bio-energy. Woody biomass offers Wisconsin woodland owners and timber producers a potential new market for a previously underutilized product – small diameter trees and the branches, tops and limbs of harvested trees.

Harvesting woody biomass typically removes more woody material from forests than traditional harvest methods. The emergence of this new market has raised concerns about sustainability including the potential loss of soil nutrients, reduced wildlife habitat, and compaction of forest soils. The Wisconsin Council on Forestry recognized the need for harvesting guidelines to ensure that woody biomass harvest does not compromise the long-term productivity of Wisconsin's forestland and that woody biomass is a sustainable, reliable forest product for landowners and timber producers. The Council requested the assistance of the WI DNR - Division of Forestry to lead the effort to develop forestland woody biomass harvesting guidelines (BHG).

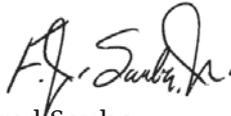
These guidelines are the result of a cooperative effort between the Council on Forestry, Wisconsin DNR, a stakeholder advisory committee, and a panel of expert reviewers to evaluate potential impacts of woody biomass harvests. While acknowledging the need for additional research addressing the relationships between woody material, soil nutrients, wildlife habitat, biodiversity and other components of sustainable forest management, the Council on Forestry approved these guidelines and believes they offer reasonable management practices based on the best science currently available.

These guidelines will be revisited in 2012 or sooner depending on availability of new information. It is hoped that new information will allow the forestry community to further evaluate the sustainability and operability of woody biomass harvests. As with any guidance, we expect there will be opportunities for improvement as we begin application of the BHGs and as new information comes to light as a result of research.

We hope you find this manual helpful, and appreciate your commitment to protect and sustainably manage Wisconsin's forests.



Paul DeLong
Chief State Forester
Wisconsin DNR



Fred Souba
Chairman
Wisconsin Council on Forestry



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Preface

Wisconsin's Forestland Woody Biomass Harvesting Guidelines provide guidance to forest resource managers, loggers, equipment operators, contractors, and landowners on the sustainable harvest of woody biomass from forested areas within the context of generally accepted forestry practices. The guidelines are intended to facilitate operational analysis and informed decision-making regarding the harvest of woody biomass from forestland. Recommendations are based on the best available information regarding harvesting effects on forest ecosystems.

The guidelines were drafted at the request of the Wisconsin Council on Forestry by a technical team comprised of WI DNR staff using best available information. Draft guidelines underwent technical review by a select group of experts, and a stakeholder review by an Advisory Committee selected by the Wisconsin Council on Forestry. After review and approval by the Advisory Committee, the guidelines were presented to the Wisconsin Council on Forestry, and the Council elected to solicit public input prior to final approval. The technical team and the Advisory Committee revised the guidelines in light of comments received. The final draft was approved by the Council on Forestry at their December 16, 2008 meeting. The guidelines are scheduled for review and revision in 2012.

The Forestland Woody Biomass Harvesting Guidelines are divided into two categories: general and site specific. General guidelines are designed to be applicable to and should be implemented on any site where fine woody material will be harvested. Site specific guidelines address specific conditions which are not present at all sites, and should be implemented only on sites exhibiting the conditions referenced in the guideline.

Expert reviewers, Advisory Committee members and others who contributed to the development of this manual are listed in Appendix C.

Chapter 1

Introduction

Wood-based bio-energy could benefit Wisconsin's economy by creating additional markets for forest products, creating jobs and reducing reliance on fossil fuels. However, concerns have been raised about the sustainability and environmental impacts of increased removal of woody biomass from Wisconsin's forests. Several factors, including Governor Jim Doyle's clean energy initiative, a projected increase in demand for woody biomass, a Corrective Action Request regarding certified forests, and concern about the impacts of increased removal of woody material from forests led the Wisconsin Council on Forestry to sponsor the development of woody biomass harvesting guidelines for Wisconsin. These guidelines are designed to ensure that woody biomass is a sustainable forest product and that increased extraction does not compromise the long-term productivity of Wisconsin's forestland.



Emnice Padley, WI DNR

Figure 1-1. Down coarse woody debris provides important habitat for a variety of wildlife.

Traditional timber harvests have generally removed wood or biomass greater than four inches in diameter for use in forest products. In non-traditional “biomass harvests” the entire aboveground portion of a tree may be removed, including trunk, branches, bark, and leaves or needles, typically for use as bio-energy. In addition, biomass harvests may include the removal of small-diameter trees and shrubs. The harvest of fine woody material from forests results in increased removals from a site, and therefore a higher level of nutrient export and other impacts. It is important to note that the guidelines apply to any sale of fine woody material regardless of whether the product is used for energy production.

Wisconsin’s Forestland Woody Biomass Harvesting Guidelines focus on the sustainable harvest of woody biomass from forested areas within the context of generally accepted forestry practices. The guidelines provide considerations and recommendations applicable to stand and site-level management based on best available information. The guidelines, when applied in concert with other forest management guidelines (Forest Management Guidelines (FMGs), Best Management Practices (BMPs) for Water Quality, and Silviculture Handbook), address



Joe Kovach, WI DNR

Figure 1-2. Woody biomass harvests often require additional equipment and processing.



Figure 1-3. Old stumps provide important habitat for fungi and other microorganisms that help break down wood and replenish soil nutrients.

potential impacts of increased biomass harvesting on biodiversity conservation, soil nutrient depletion, physical properties of soil, and water quality. The objective is to provide guidance to forest resource managers, loggers, equipment operators, contractors, and landowners in Wisconsin, and to facilitate operational analysis and informed decision-making regarding the harvest of woody biomass from forestland. Implementation of the Forestland Woody Biomass Harvesting Guidelines is voluntary.

Wisconsin's Forestland Woody Biomass Harvesting Guidelines were developed to limit the impacts of harvesting of woody biomass on: a) biodiversity conservation, b) soil nutrient depletion, c) physical properties of soil, and d) water quality. The scope of the Guidelines was limited in order to target the most significant ecological issues. Woody biomass harvests are not common in Wisconsin's forests and there is a lack of research information about some aspects of potential impacts. Once research begins, it will take several years of data collection to understand the results. In the



Dick Rossmann, MN DNR

Figure 1-4. Fine woody material is redistributed over a timber sale on a whole tree harvest.

future other issues may also be addressed, including: woody biomass resource availability; economics and energy balances for harvesting, transporting, and processing woody biomass for energy; potential effects on carbon storage and climate change; short rotation intensive culture of woody biomass plantations; landscape planning and management; and monitoring strategies. These topics could not be covered with adequate detail under the timeline set by the Council on Forestry for the development of the initial guidelines. In addition, some topics are already addressed by Wisconsin's existing framework of regulations and guidelines for forest management and do not need to be reiterated in the biomass harvesting guidelines.

Wisconsin's Forestland Woody Biomass Harvesting Guidelines

General Guidelines

These guidelines are generally applicable to any site. It is recommended that these guidelines be implemented in addition to any applicable silvicultural guidelines, forest management guidelines (FMGs) and best management practices (BMPs). The Guidelines may be modified for specific site conditions, for specific operational issues or to meet specific management objectives. Examples of where a modification may be warranted include site preparation to facilitate tree regeneration, control of invasive or exotic species, fuel reduction treatments, barrens/savanna restoration or prescribed fire.

1.A Retain and limit disturbance to down coarse woody debris (CWD) already present, except on skid trails and landings.

✓ **Exception:** For complete salvage operations, follow Guidelines 2.B.

2.A Retain down fine woody debris (FWD) on site following harvest.

- 🌿 Retain down FWD already present (before cutting), except on skid trails and landings, to the extent feasible.
- 🌿 Retain FWD resulting from incidental breakage of tops and limbs in the general harvest area.
- 🌿 Retain and scatter tops and limbs (<4" diameter) from 10% of trees in the general harvest area (e.g. one average-sized tree out every 10 trees harvested).
- 🌿 Fine woody debris (FWD) on site following harvest is a combination of pre-existing down FWD, along with wood that was cut or broken during harvest operations and left on the ground.



R. A. Kleppin

Fisher

Considerations:

- ✓ Some forests lack woody debris because of past management; consider retaining additional amounts of FWD and/or CWD in these areas.
- ✓ If possible, leave most of the FWD well-distributed throughout the site to maintain nutrient cycles. Retaining some small slash piles may benefit some animals and plants.

3.A ➡ **Do not remove the forest litter layer, stumps, and/or root systems.**

Reminder: For tree and snag retention guidelines, refer to WI DNR Silviculture Handbook, Chapter 24.



Eunice Padley, WI DNR



Eunice Padley, WI DNR

Examples of snag trees.

Site Specific Guidelines

Site specific guidelines apply only to sites with the specific conditions described in the Guideline; they are not generally applicable to all sites. It is recommended that these Guidelines be implemented in addition to any applicable silvicultural guidelines, forest management guidelines (FMGs) and best management practices (BMPs). The Guidelines may be modified for specific site conditions, for specific operational issues, or to meet specific management objectives. Examples of where a modification may be warranted include site preparation to facilitate tree regeneration, control of invasive or exotic species, fuel reduction treatments, barrens/savanna restoration, or prescribed fire.

1.B Protect and sustainably manage species of greatest conservation need and sensitive ecosystems.

-  Do not harvest fine woody material from sites where Federal or State Endangered or Threatened Species are known to exist or are discovered during operations.
 -  **Exception:** If harvests of fine woody material have been demonstrated to maintain or improve habitat for the species present, then follow appropriate management guidelines to sustain the occurrence or condition. Limit, to the extent possible, the establishment of landings and roads in these areas.
-  Before harvesting fine woody material, determine the presence (and location) of and potential impacts on:
 - State Special Concern Species and Species of Greatest Conservation Need (those not listed as Federal or State Endangered or Threatened)
 - Element Occurrences (EO) of Wisconsin Natural Heritage Inventory (WNHI) Community Types
 - Designated High Conservation Value Forests (HCVF)

- Communities demonstrating exceptional composition or structure, and sensitive sites (those not listed as WNHI EO or HCVF), including: Relict forests, old-growth forests, old forests, large bogs, vernal pools, seeps, cliffs, rock outcrops, ravines, and caves
- Follow management strategies to protect and conserve species of greatest conservation need and sensitive ecosystems. Limit, to the extent possible, the establishment of landings and roads in these areas.

 Consult specialists, management guides, and databases to assess occurrence, habitat requirements, community characteristics, potential impacts of proposed management activities, and management alternatives and recommendations.

- ✓ Specialists are those who have in-depth knowledge regarding conservation and management of the species or ecosystem of concern, and may include wildlife biologist, conservation biologist, community ecologist, and forest ecologist.

2.B  ***For complete salvage operations, following severe disturbance (e.g. crown fire or complete blowdown), implemented on areas >10 acres under one ownership, that include the harvest of fine woody material:***

 Retain at least 5% of area in unsalvaged (no harvest) patches at least 0.1 acres in size. These should include large diameter reserve trees, mast trees, cavity trees, snags, and down coarse woody debris if present.

Exceptions:

- ✓ Retention is deemed a threat to human health and safety
- ✓ Retention would interfere with effective sanitation methods to control pathogen outbreaks

3.B ➡ **Do not harvest fine woody material on shallow soils where bedrock is within 20 inches of the surface.**

🌿 Areas with shallow soils are identified by using soil survey maps produced by the Natural Resources Conservation Service (NRCS). A list of soil map units appears in Appendix D. See the Web Soil Survey for soil maps: <http://websoilsurvey.nrcs.usda.gov/app/>

4.B ➡ **Do not harvest fine woody material on dry nutrient-poor sandy soils.**

🌿 Dry nutrient-poor sandy soils are components of soil map units that meet certain criteria, such as low clay content. See Appendix D for a complete list of criteria.

🌿 Areas with dry nutrient-poor sandy soils are identified by using soil survey maps produced by the Natural Resources Conservation Service (NRCS). A list of soil map units appears in Appendix D. See the Web Soil Survey for soil maps: <http://websoilsurvey.nrcs.usda.gov/app/>

✓ **Exception:** Jack pine stands may be harvested for woody biomass at rotations of 40 years or longer.

5.B ➡ **Do not harvest fine woody material on soils classified as dysic Histosols. These are wetland soils with at least 16 inches of organic material that are nutrient-poor with a low pH.**

🌿 Areas with dysic Histosols are identified by using soil survey maps produced by the Natural Resources Conservation Service (NRCS). A list of soil map units appears in Appendix D. See the Web Soil Survey for soil maps: <http://websoilsurvey.nrcs.usda.gov/app/>



Carmen Wagner, WI DNR

Figure 2-1. Pre-existing coarse woody debris should be retained on site, except as noted in Guideline 1.A.

Chapter 2

Background and Implementation Notes on General Guidelines

Guideline 1.A ■■■▶ **Retain and limit disturbance to down coarse woody debris (CWD) already present, except on skid trails and landings.**

Exception: For complete salvage operations, follow Guidelines 2.B.

Background and Implementation Notes

The goal of Guideline 1.A is to protect down woody material on the forest floor – stumps, logs, and branches – to address site nutrient, wildlife habitat and biodiversity concerns. Specifically, coarse woody debris (CWD) is dead woody material found on the forest floor and in waterways that is at least 4 inches in diameter inside the bark at the small end of the piece of wood (Figure 2-2). If the woody material is less than 4 inches in diameter, then it is fine woody debris (FWD) and is discussed in Guideline 2.A.

Biomass harvests should not include pre-existing CWD. That material is to be left on site. Care should be taken to avoid running over CWD with equipment. Route skid trails around large relic pieces of CWD (Figure 2-1) as much as possible.

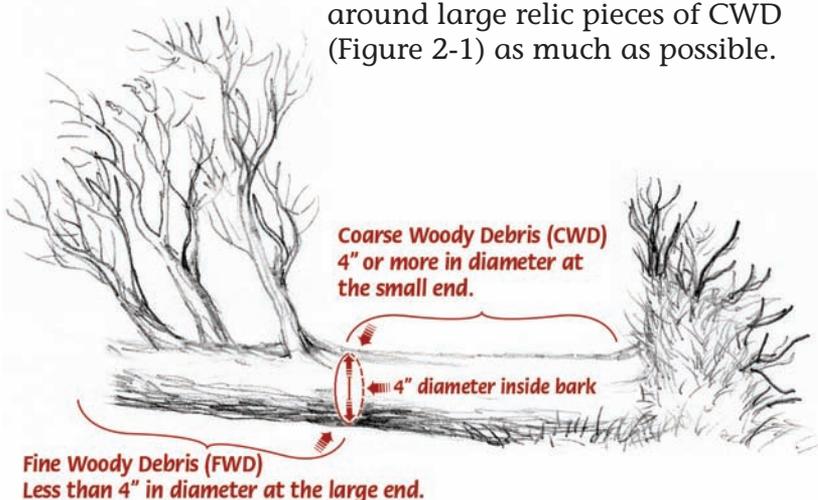


Figure 2-2. Generalized illustration of coarse and fine woody debris.

In some instances, it may be necessary to move CWD to accommodate traffic or to establish fire breaks (Figure 2-3), but the CWD should be retained in the woodland.

Guideline 2.A ■■■▶ **Retain down fine woody debris (FWD) on site following harvest.**

- ❧ Retain down FWD already on present (before cutting), except on skid trails and landings, to the extent feasible.
- ❧ Retain FWD resulting from incidental breakage of tops and limbs in the general harvest area.
- ❧ Retain and scatter tops and limbs (<4" diameter) from 10% of trees in the general harvest area (e.g. one average-sized tree out every 10 trees harvested).
- ❧ Fine woody debris (FWD) on site following harvest is a combination of pre-existing down FWD, along with wood that was cut or broken during harvest operations and left on the ground.



Kirby Demousek

Figure 2-3. Coarse woody debris was mostly removed from this 100 foot wide firebreak in Bayfield County. This firebreak includes a 16 foot roadbed from which nearly all woody material was cleared.



Joe Kovach, WI DNR

Figure 2-4. The tops and limbs of 9 out every 10 trees can be collected for biomass.

Considerations:

- ✓ Some forests lack woody debris because of past management; consider retaining additional amounts of FWD and/or CWD in these areas.
- ✓ If possible, leave most of the FWD well-distributed throughout the site to maintain nutrient cycles. Retaining some small slash piles may benefit some animals and plants.

Background and Implementation Notes

This guideline is intended to retain some fine woody debris (FWD) on a site to address nutrient, wildlife habitat, and biodiversity concerns. Fine woody debris consists of dead pieces of wood, such as tops, branches and twigs, found on the forest floor or in lakes and streams. Fine woody debris is material that has a diameter of less than 4 inches inside the bark at the large end of the piece of wood (Figure 2-2).

Any FWD on the site prior to harvest should remain on the property and is not to be collected. Some FWD may be moved or run over on skid trails and landings. In addition, FWD may also be used on top of roads and skid



Carmen Wagner, WI DNR

Figure 2-5. Woody material left on the forest floor after harvest includes incidental breakage and non-merchantable stems and branches. These residues provide habitat for some wildlife species, contribute to nutrient cycling, and help retain elements of biological diversity

trails to support equipment and prevent rutting. It is not necessary to redistribute FWD that is used in such a way.

During the harvest, any FWD that results from incidental breakage of tops and limbs should remain in the general harvest area. It is not to be collected as part of the harvest. Generally 10-15% of the tops and limbs will break during a harvest depending on the tree species, type of equipment and season of harvest.

In addition to the incidental breakage, 10% of the tops and limbs (<4 inches in diameter) are to be retained in the general harvest area. If a cut-to-length system is being used, the tops and branches of one average-sized tree of every 10 trees should be left on the site. Tops and limbs from the remaining nine trees can be collected for biomass (Figure 2-4). If a whole-tree skidding operation



Dick Rossman, MN DNR

Figure 2-6. Tops and limbs are being redistributed onto this site by a grapple skidder

is occurring, then the tops and limbs of one out every 10 trees needs to be hauled back into the general harvest area and evenly scattered over the site (Figure 2-6).

The ultimate goal is to have 5 or more oven dry tons per acre of FWD on site following the harvest. Following these guidelines should achieve that standard on most average sites. If a site lacks woody debris, consider retaining more FWD and/or CWD than is recommended by Guidelines 1.A and 2.A (Figure 2-7).



Kristin Shy, WI DNR

Figure 2-7. Consider retaining additional woody debris when harvesting in forests that have little dead wood on the forest floor.

Guideline 3.A ■■■▶ **Do not remove the forest litter layer, stumps, and/or root systems.**

Background and Implementation Notes

The forest floor is a layer made up of organic materials, including leaves, needles, bark and wood, that lies above the mineral soil. The organic material exists in various stages of decomposition. Numerous insects, microbes and fungi feed on the litter and play an important role in nutrient cycling.

Retaining the forest litter layer, stumps and root systems on a site will help protect nutrient levels and prevent soil erosion. Soil moisture is conserved by the protective layer, providing better growing conditions for tree seedlings and other plants. The forest floor also provides important habitat features for wildlife (Figure 2-8).

In some instances it may be necessary to move stumps and root systems during site preparation, but the material should still be retained on the site so that nutrients contained in that material are not lost.



Eumice Paraley, WI DNR

Figure 2-8. Retaining the forest litter layer helps maintain site nutrients and moisture.



Paul Pingrey, WI DNR



Eunice Padley, WI DNR

Figure 2-9. Stumps of newly harvested trees, as well as old stumps, like these two in a pine plantation, should be retained on site. They may be moved if necessary for site preparation operations.

Reminder: For tree and snag retention guidelines, refer to WI DNR Silviculture Handbook, Chapter 24.

The importance of retaining leaf trees, snags, coarse woody debris and slash, conifers, and mast trees for wildlife as part of sustainable forestry operations is discussed in more detail in Wisconsin's FMGs. The WI DNR Silviculture Handbook contains specific recommendations and quantitative guidelines for the retention of reserve trees, wildlife trees, and snags, and offers management considerations pertaining to wildlife and biodiversity.



Paul White

Figure 2-10. Snags (dead trees) provide perching, nesting, and foraging sites for birds and other wildlife.



Eunice Padley, WI DNR

Figure 2-11. WI DNR's Silviculture Handbook, Chapter 24, provides recommendations on the retention of reserve trees, wildlife trees, and snags.

Large trees provide habitat used by many animals and some plants. They provide nesting sites and high exposed perches for birds, such as hawks, bald eagle, osprey, herons, flycatchers, ravens, and turkey vultures (Figure 2-12).



Steve Meyer

Figure 2-12. Large trees provide nesting sites for many species of birds, especially raptors.

Trees and shrubs also provide food and shelter for many animal species. Retaining a variety of trees and shrubs that produce mast (nuts and berries) can provide an abundant and diverse source of food. Mast producing species include oak, dogwoods, and juneberries. Conifers are especially important in providing thermal cover and roosting areas during harsh Wisconsin winters. Ruffed grouse, turkey, and many resident birds and mammals utilize conifers for shelter.

Cavity trees are partially hollow living trees used by many wildlife species (Figure 2-13). Cavity trees provide wildlife with sites to den, nest, rear young, feed, store food, and escape from predators and inclement weather. Although both large and small cavity trees provide useful habitat, large diameter cavity trees are particularly important. In general, the larger the cavity tree, the better for wildlife habitat. A large cavity tree can host Pileated Woodpecker, American marten, fisher, raccoon, porcupine, and even bear.



Steve Meyer

Figure 2-13. Cavity trees are partially hollow living trees. Wildlife species such as the Pileated Woodpecker use these trees for food, shelter, and nesting

Chapter 3

Background and Implementation Notes on Site Specific Guidelines

Guideline 1.B ■■■▶ **Protect and sustainably manage species of greatest conservation need and sensitive ecosystems.**

🌿 Do not harvest fine woody material from sites where Federal or State Endangered or Threatened Species are known to exist or are discovered during operations.



Figure 3-1. Four-toed salamanders lay their eggs in the dense moss along the edge of woodland ponds.

Matthew Ignoffo

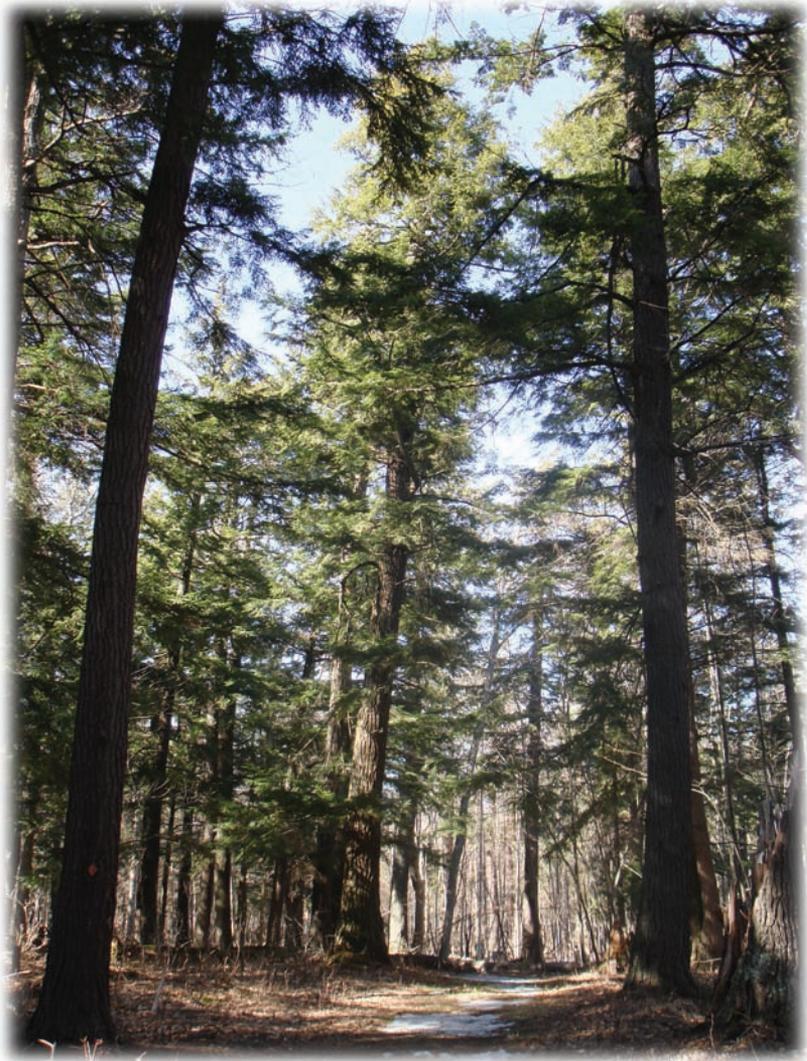
✓ **Exception:** If harvests of fine woody material have been demonstrated to maintain or improve habitat for the species present, then follow appropriate management guidelines to sustain the occurrence or condition. Limit, to the extent possible, the establishment of landings and roads in these areas.

🌿 Before harvesting fine woody material, determine the presence (and location) of and potential impacts on:

- State Special Concern Species and Species of Greatest Conservation Need (those not listed as Federal or State Endangered or Threatened)
- Element Occurrences (EO) of Wisconsin Natural Heritage Inventory (WNHI) Community Types
- Designated High Conservation Value Forests (HCVF)

- Communities demonstrating exceptional composition or structure, and sensitive sites (those not listed as WNHI EO or HCVF), including:

Relict forests, old-growth forests, old forests, large bogs, vernal pools, seeps, cliffs, rock outcrops, ravines, and caves



Erinice Padley, WI DNR

Figure 3-2. Old-growth forests such as this hemlock site are scarce in Wisconsin, and potential impacts of biomass harvesting should be carefully evaluated. Old-growth sites will often have been previously identified as Element Occurrences of Wisconsin Natural Heritage Inventory Community Types, or as Designated High Conservation Value Forests.

Follow management strategies to protect and conserve species of greatest conservation need and sensitive ecosystems. Limit, to the extent possible, the establishment of landings and roads in these areas.

 Consult specialists, management guides, and databases to assess occurrence, habitat requirements, community characteristics, potential impacts of proposed management activities, and management alternatives and recommendations.

✓ Specialists are those who have in-depth knowledge regarding conservation and management of the species or ecosystem of concern, and may include wildlife biologist, conservation biologist, community ecologist, and forest ecologist.

Background and Implementation Notes

Guideline 1.B specifies that fine woody material may not be harvested from sites where Endangered or Threatened Species (ETS) occur, unless there is evidence that the harvest would be beneficial for the species (examples include barrens and prairie restoration projects).

The sites where biomass is being harvested should be screened for documented occurrences of ETS. The Wisconsin Natural Heritage Inventory (NHI) database is the most comprehensive database on the occurrences of rare species and natural communities available for the state. Wisconsin DNR staff and other authorized users can access the database using the “NHI Portal.” Contact the Wisconsin DNR Bureau of Endangered Resources regarding data access. Generalized data are also currently available on the Wisconsin DNR Web site (<http://dnr.wi.gov/org/land/er/nhi/countyMaps/>). Other data sources may exist for your area, but no rare species database can be considered complete. Assessing an area for potential rare species habitat is an important component of rare species screening.

Other guidance in 1.B concerns identifying management strategies to protect and conserve sensitive species and sites. Guidance for a variety of species can be found at <http://dnr.wi.gov/org/land/er/biodiversity.htm>. A source for bird species guidance is <http://www.wisconsinbirds.org/plan/species/>.



Carmen Wagner, WI DNR



Erinice Parafley, WI DNR



Steve Meyer



Lana Hays



Michelle Woodford



E. Jurdzewicz

Figure 3-3. Examples of sensitive species and sites include: Ephemeral Pond, Braun's holly fern, Pileated Woodpecker, Black-throated Green Warbler, American Marten, Moist Cliff.



Sarah Herrick, WI DNR

Example of a Forested Seep.

Information for managing sensitive sites is contained in a number of sources, including the WI DNR's Wildlife Action Plan, Ecological Landscapes Handbook, Silviculture Handbook, and Old Growth Handbook. Many properties have management plans that also contain guidance for sensitive sites, including High Conservation Value Forests. See Appendix A for additional resources.

Developing site-level management strategies for rare species or High Conservation Value Forests can involve many factors, including site characteristics such as the context of the area within the surrounding landscape. If management strategies cannot be found from existing sources, or if it is unclear how they apply to a particular species or site, a specialist should be consulted. Specialists are on the staff of public agencies such as WI DNR and USFS as well as county governments; there are other specialists who work as private consultants.

Guideline 2.B ■■■▶ **For complete salvage operations, following severe disturbance (e.g. crown fire or complete blowdown), implemented on areas >10 acres under one ownership, that include the harvest of fine woody material:**

- ✻ Retain at least 5% of area in unsalvaged (no harvest) patches at least 0.1 acres in size. These should include large diameter reserve trees, mast trees, cavity trees, snags, and down coarse woody debris if present.

Exceptions:

- ✓ Retention is deemed a threat to human health and safety
- ✓ Retention would interfere with effective sanitation methods to control pathogen outbreaks



Figure 3-4. This photo shows a portion of the damage wreaked by a tornado that crossed northeastern Wisconsin in 2007. On large ownerships where salvage sales are taking place, 5% of the area should remain unsalvaged.

USFS



Kyoko Scantlon, WI DNR

Figure 3-5. Where a sanitation harvest is being conducted to stop or reduce the spread of insects or disease, there is an exception to the requirement to retain unsalvaged areas.

Background and Implementation Notes

Guideline 2.B specifies that some woody material be left on site to provide soil nutrients, wildlife habitat, and address other biological diversity concerns. Note that the woody material should be retained in patches at least a tenth of an acre in size.

Ownerships of 10 acres or smaller are not required to retain woody material on site in salvage operations. This provision is intended to address operational difficulties of implementing retention on small ownerships; however, retaining woody material is still a good idea regardless of parcel size, and landowners may choose to do this where it is operationally feasible.

An exception to Guideline 2.B was designed to allow for removal of woody material that presents a threat to human health and safety during a salvage operation. It is the responsibility of the operator to make a reasonable determination as to whether such a threat exists.

Another exception to Guideline 2.B allows for removal of woody material that is contributing to insect or disease outbreaks (i.e. sanitation harvest).

Guideline 3.B ■■■▶ **Do not harvest fine woody material on shallow soils where bedrock is within 20 inches of the surface.**

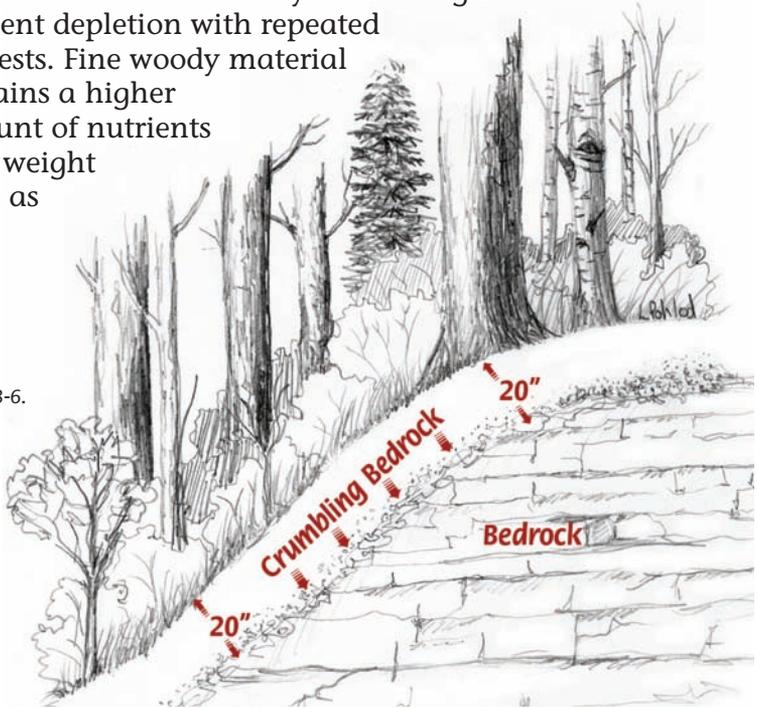
🌿 Areas with shallow soils are identified by using soil survey maps produced by the Natural Resources Conservation Service (NRCS). A list of soil map units appears in Appendix D. See the Web Soil Survey for soil maps: <http://websoilsurvey.nrcs.usda.gov/app/>

Background and Implementation Notes

Guideline 3.B restricts the harvest of fine woody material on shallow soils where bedrock occurs at a depth of 20 inches or less from the soil surface.

The nutrient content of a soil without bedrock is typically calculated based on nutrients in the upper 40 inches. A shallow soil with bedrock at 20 inches has about half the nutrient supply of a deep soil. Soils that lack a good supply of nutrients are more likely to show signs of nutrient depletion with repeated harvests. Fine woody material contains a higher amount of nutrients on a weight basis as

Figure 3-6.



Guideline 3.B limits harvest of fine woody material where soil depth is less than 20 inches. Depth to bedrock is measured from the top of the mineral soil down to solid bedrock.

compared with a tree's bole and large branches. Retaining fine woody material keeps a portion of tree nutrients on site and helps maintain productivity.



Eunice Padley, WI DNR

Appendix D gives a list of soil map units that are shallow to bedrock.

Figure 3-7. Parts of southwestern Wisconsin have thick layers of limestone or dolomite bedrock near the surface.

Depth to bedrock is measured vertically (perpendicular to the land's surface). Measurement begins at the top of a layer of decomposed material or mineral soil, but does not include fresh, undecomposed leaf litter or twigs lying on the forest floor.

Bedrock is considered solid material, so the depth to bedrock includes particles that may be flaking or crumbling from the rock's surface (Figure 3-6). Depth to bedrock is often variable, so a number of observations are taken (for example, with auger borings or shovel holes) and the typical or most common depth is chosen to represent the site.



Andy Clark, WI DNR

Figure 3-8 . Sites with bedrock outcroppings at the surface are considered shallow to bedrock. Sites with surface rocks and boulders may or may not have shallow bedrock.

Guideline 4.B **Do not harvest fine woody material on dry nutrient-poor sandy soils.**

🌿 Dry nutrient-poor sandy soils are components of soil map units that meet certain criteria, such as low clay content. See Appendix D for a complete list of criteria.

🌿 Areas with dry nutrient-poor sandy soils are identified by using soil survey maps produced by the Natural Resources Conservation Service (NRCS). A list of soil map units appears in Appendix D. See the Web Soil Survey for soil maps: <http://websoilsurvey.nrcs.usda.gov/app/>



Carmen Wagner, WI DNR

Figure 3-9. Soils on dry nutrient-poor sandy sites are almost entirely made up of clean quartz sand grains.

✓ **Exception:** Jack pine stands may be harvested for woody biomass at rotations of 40 years or longer.



Dave Schulz, WI DNR

Figure 3-10. Dry nutrient-poor sandy sites typically occur on relatively flat outwash sand plains where there are few nutrients in the soil. The area in this photo, on the Brule River State Forest, was struck by a severe hailstorm in August, 2000. At the time the photo was taken, it had been site-prepped for replanting

Background and Implementation Notes

Guideline 4.B restricts the harvest of fine woody material, except for jack pine, on dry nutrient-poor sandy soils. These are soils that meet the specific criteria listed in Appendix D. The criteria were designed to identify soils with low clay content, low capacity to hold nutrients, low pH, and drainage classes that indicate dry conditions.

Dry nutrient-poor sandy soils are restricted from harvest of fine woody materials because they lack soil nutrients. These soils were formed in glacial outwash, where water movement washed away most of the nutrients and left soils that are predominantly made up of sterile quartz sand. A Lake States soils dataset was analyzed to find the range of nutrient supply for calcium (Ca), a soil nutrient of concern for potential depletion. Most soils in our region have ample Ca supplies, but there are some soils that have less than 1000 lbs/acre of available Ca. Calculations indicate that a whole-tree harvest in aspen on a 40-year rotation could represent a loss of more than 400 lbs/acre Ca. This is because Ca inputs from atmospheric deposition and mineral weathering do not make up for the amount removed in whole-tree harvesting. Soils with these extremely low levels of nutrients are of concern because two or three aspen whole-tree harvests could theoretically remove all the available Ca from the site. Potassium and magnesium are also of concern, and although their supply in soil was not analyzed separately, their levels are generally correlated with Ca.

Guideline 4.B was developed to address concerns for nutrient depletion on soils with 1000 lbs/acre Ca or less. Soils that lack a good supply of nutrients are more likely to show signs of nutrient depletion with repeated whole-tree harvests. Fine woody material contains a higher amount of nutrients on a weight basis as compared with a tree's bole and large branches. Retaining fine woody material keeps a portion of tree nutrients on site and helps maintain productivity.



Paul Pingrey, WI DNR

Figure 3-11. Harvesting fine woody material from jack pine stands is an exception to Guideline 4.B because jack pine accumulates less nutrients in comparison to other tree species. In this photo, a jack pine stand is being harvested using a tub grinder.

Aspen is a particularly nutrient-demanding species that accumulates a lot of Ca in bark and twigs. Jack pine is much less nutrient-demanding. A Minnesota study found that there were 765 lbs/acre Ca in above ground parts of aspen and only 181 lbs/acre Ca in jack pine. This is why Guideline 4.B does not limit harvest of fine woody material from jack pine stands. A stand is considered jack pine if more than 50% of the basal area is pine, and jack pine has the highest basal area among the pine species.

Criteria shown in Appendix D were used in a query of the Natural Resources Conservation Service (NRCS) database to identify soil map units that are dry nutrient-poor sands. A list of soil map units by county was developed and appears in Appendix D. The list is subject to periodic changes as NRCS updates older soil mapping in some Wisconsin counties.

Guideline 5.B ||||➔ **Do not harvest fine woody material on soils classified as dysic Histosols. These are wetland soils with at least 16 inches of organic material that are nutrient-poor with a low pH.**

🌿 Areas with dysic Histosols are identified by using soil survey maps produced by the Natural Resources Conservation Service (NRCS). A list of soil map units appears in Appendix D. See the Web Soil Survey for soil maps: <http://websoilsurvey.nrcs.usda.gov/app/>

Background and Implementation Notes

Guideline 5.B restricts the harvest of fine woody material on dysic Histosols. These are soils that form in acidic wetlands, where organic matter accumulates faster than it decomposes and eventually builds up into a thick layer.

Dysic Histosols are of concern for potential nutrient depletion because their only nutrient inputs are from runoff and atmospheric deposition. The upper portions of these organic soils, which are the parts that support vegetative growth, are isolated from mineral soil and do not receive nutrient inputs from mineral weathering. Because of this potential for depletion, harvest of fine woody material is restricted. Fine woody material contains a higher amount of nutrients on a weight basis as compared with a tree's bole and large branches. Retaining fine woody material keeps a portion of tree nutrients on site and helps maintain productivity.



Andy Clark, WI DNR

Figure 3-12. Typical appearance of vegetation growing on a dysic Histosol. Most dysic Histosols are not productive enough to support large volumes of biomass.



Eunice Padley, WI DNR

Figure 3-13. A dysic Histosol is an organic soil formed in wetlands. The soil is made up of partly decomposed vegetation and is very dark colored and spongy.

Chapter 4

Application and Modification of Guidelines

The general guidelines found in Chapter 2 are generally applicable to any site. The site specific guidelines described in Chapter 3 apply only to those sites with the specific conditions described in the guideline; they are not generally applicable to all sites.

It is recommended that these guidelines be implemented in addition to any applicable silvicultural guidelines, forest management guidelines (FMGs) and best management practices (BMPs) (Figure 4-1). The Guidelines may be modified for specific site conditions, for specific operational issues or to meet specific management objectives. Examples of where a modification may be warranted include site preparation to facilitate tree regeneration (Figure 4-2), control of invasive or exotic species (Figure 4-3), fuel reduction treatments, barrens/savanna restoration or prescribed fire (Figure 4-4).



Carmen Wagner WI DNR

Figure 4-1. The biomass harvesting guidelines should be used in addition to any other applicable guidelines, such as BMPs for water quality when a harvest is adjacent to a lake or stream.



Paul Pingrey, WI DNR

Figure 4-2. During site preparation operations, CWD may be moved around a site.



Tim Beyer, WI DNR

Figure 4-3. During efforts to control buckthorn, honeysuckle and other invasive trees and shrubs, all woody material from the invasive species may need to be removed.

Figure 4-4. When using prescribed fires to restore prairie or savannas, CWD may be moved out of the burn area.



Brian Dhuey, WI DNR



Brian Dhuey, WI DNR

Appendix A: Resources

General Information

- 🌿 Wisconsin Council on Forestry Biomass Page - <http://council.wisconsinforestry.org/biomass/>
- 🌿 WI DNR Division of Forestry - <http://dnr.wi.gov/forestry/>
- 🌿 WI DNR Foresters - <http://dnr.wi.gov/forestry/ftax/County.asp>
- 🌿 Wisconsin County Forest Administrators - <http://www.wisconsincountyforests.com/wcfa-adm.htm>
- 🌿 Managed Forest Law - <http://dnr.wi.gov/forestry/feeds/faqsFull.asp?s1=ForestTax&s2=MFL&inc=ftax>
- 🌿 WI DNR Invasive Species - <http://dnr.wi.gov/invasives/>
- 🌿 Consulting Foresters - <http://www.wi-consultingforesters.com/>

Endangered Resources/Sensitive Species

- 🌿 WI DNR Endangered Resources - <http://dnr.wi.gov/org/land/er/>
- 🌿 WNHI Database Portal - http://dnr.wi.gov/org/land/er/nhi_portal/.
- 🌿 Threatened and Endangered Species in Forests of Wisconsin - <http://dnr.wi.gov/forestry/publications/endangered/toc.htm>
- 🌿 Animals, Plants and Natural Communities - <http://dnr.wi.gov/org/land/er/biodiversity/>
- 🌿 Bird Species Guidance - <http://www.wisconsinbirds.org/plan/species/>
- 🌿 Karner Blue Butterfly Habitat Conservation Plan - <http://dnr.wi.gov/forestry/karner/>

Handbooks and Other Guidance

- 🌿 Silviculture Handbook - <http://dnr.wi.gov/forestry/Publications/Handbooks/24315/>
- 🌿 Ecological Landscapes Handbook - <http://dnr.wi.gov/landscapes/>
- 🌿 Water Quality BMPs - <http://dnr.wi.gov/forestry/Usesof/bmp/>
- 🌿 Old Growth Handbook – available upon request.
- 🌿 WI DNR Biodiversity Report - http://dnr.wi.gov/org/es/science/publications/rs915_95.htm
- 🌿 Wisconsin's Forest Management Guidelines - <http://dnr.wi.gov/forestry/publications/Guidelines>

Land Management Planning

- 🌿 WI DNR Land Legacy Report - http://dnr.wi.gov/master_planning/land_legacy/.
- 🌿 TNC's Ecoregional plans: The Superior Mixed Forest Ecoregional Plan, and the Prairie-Forest Border Ecoregional Plan - <http://conserveonline.org/>
- 🌿 WI DNR Basin Reports - <http://dnr.wi.gov/org/gmu/stateofbasin.html>
- 🌿 Wisconsin Regional Planning Commissions - <http://commerce.wi.gov/BD/BD-RPC-map.html>
- 🌿 Wisconsin Association of Resource Conservation & Development (RC&D) - <http://wisrcd.org/>

Wildlife

- ❧ WI DNR Wildlife Action Plan - <http://dnr.wi.gov/org/land/er/WWAP/>
- ❧ Breeding Bird Atlas - <http://www.uwgb.edu/birds/wbba/>
- ❧ Wisconsin Bird Conservation Initiative website - <http://www.wisconsinbirds.org/>
- ❧ Important Bird Areas - <http://www.wisconsinbirds.org/iba/>





Cate Harrington

Soils and Mapping

- 🌿 Web Soil Survey - <http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>
- 🌿 Landtype Associations, and other terrestrial ecological units mapped at broader spatial scales - <http://dnr.wi.gov/landscapes/maps.asp>.

Other Biomass Harvesting Guidelines

- 🌿 Minnesota - <http://www.frc.state.mn.us/FMgdline/BHGC.html>
- 🌿 Missouri - <http://mdc4.mdc.mo.gov/Documents/18043.pdf>
- 🌿 Pennsylvania - http://www.dcnr.state.pa.us/PA_Biomass_guidance_final.pdf
- 🌿 Maine - <http://www.maine.gov/doc/mfs/>

Appendix B: Glossary

Biological Diversity (biodiversity): The spectrum of life forms and ecological processes that support and sustain them. Biological diversity occurs at four interacting levels: genetic, species, community, and ecosystem.

Coarse (down) Woody Debris (CWD): Dead woody material, greater than or equal to 4 inches diameter inside bark at the small end, on the ground in forest stands or in water.

Community: An assemblage of plants and animals living together and occupying a given area.

Dysic Histosols: Histosols are soils made up of organic material that accumulates in wetlands where restricted drainage slows decomposition. 'Dysic' is a reaction class, indicating that these Histosols have a pH of 4.5 or less, characteristic of acidic peatland bogs.

Element Occurrence (EO): An area of land and/or water in which an element (a natural community, a rare plant population, a rare animal population, or other feature tracked by the Natural Heritage Inventory program) is, or was, present. For natural community elements, the EO may represent a stand or patch of a natural community, or a cluster of stands or patches of a natural community. Because they are defined on the basis of biological information, EOs can cross jurisdictional boundaries.

Endangered Species: (Wisconsin): Any species whose continued existence as a viable component of Wisconsin's wild animals or wild plants is determined by the Department to be in jeopardy on the basis of scientific evidence. These species are protected by state law (see State Statute 29.604 and Administrative Rule NR27). There are additional species that receive protection under the federal Endangered Species Act that are not listed as endangered or threatened by the state of Wisconsin.

Federally listed Species: Species federally-listed as endangered or threatened (legally protected) and those proposed for federal listing or candidates for federal listing, or their proposed or designated critical habitats. Impacts to federally-listed species are subject to requirements of the U.S. Endangered Species Act.

Fine (down) Woody Debris: Dead woody material, less than 4 inches diameter inside bark at the large end, on the ground in forest stands or in water.

Fine Woody Material: Woody material, living or dead, less than 4 inches diameter inside bark at the large end; including fine woody debris and portions of standing living and dead shrubs and trees.

Forest: An ecosystem characterized by a more or less dense and extensive tree cover, often consisting of stands varying in characteristics such as species composition, structure, age class, and associated processes. Typically, tree cover will exceed 50% crown cover, except following a severe disturbance and during stand (re)establishment. Productive forest stands are capable of growing wood volume at an average rate of at least 20 cubic feet per acre per year.

Forest Litter Layer: A layer that lies above the mineral soil, made up of organic debris including leaves, needles, bark, and wood, in different stages of decomposition, with a variety of insects, microbes, and fungi that feed on the litter.

Habitat: The place (environment) where an animal, plant, or population naturally or normally lives and develops.

High Conservation Value Forest (HCVF): A term used by Forest Certification organizations. These areas possess exceptional ecological qualities and have been specifically designated as HCVF in property management plans. For some ownerships, such as Wisconsin State Forests, HCVF may be referred to using a different designation (e.g. State Natural Area or Native Community Management Area), but a crosswalk has been provided for use by certification organizations.

Old Forest: Forests which are older than the typical managed forest (beyond traditional rotation age), but are not biologically old. They are beyond economic maturity, but are not senescent.

Old-Growth Forest: Forests which are relatively old and relatively undisturbed by humans. The forest is biologically old, containing some trees which are nearing or beyond their average expected lifespan. The original even-aged overstory, established following a catastrophic disturbance, is becoming senescent, is senescing, or has senesced.



Eunice Padley, WI DNR

Relict Forest: Forests which appear never to have been manipulated, exploited, or severely disturbed by humans of European origin; in Wisconsin, the stand and site should show no evidence of significant human disturbance since about 1800 AD.

Reserve Tree (standard, legacy tree, green tree retention): Living trees, >5 inches dbh (diameter breast height - diameter at 4.5' above the ground), retained after the regeneration period under even-aged or two-aged silvicultural systems.

Salvage Cutting: The removal of dead trees or trees damaged or dying because of injurious agents other than competition, to recover economic value that would otherwise be lost. Note: complete salvage refers to salvage operations following extensive stand injury that requires subsequent reforestation, whereas partial salvage follows light to moderate disturbance events that do not result in stand regeneration.

Slash: The residue left on the ground after logging or accumulating as a result of storm, fire, girdling, or delimiting.

Snag: Standing dead tree.

Special Concern Species (Wisconsin): Any species with some problem of abundance or distribution suspected but not proved. The main purpose of this category is to focus attention on certain species before they become endangered or threatened. The Wisconsin Natural Heritage Inventory program maintains a list of species currently tracked by the WI DNR. Some species listed as Special Concern are federally-listed and thereby protected under the U.S. Endangered Species Act. In addition, several other state and federal laws may apply to some of these species (see <http://dnr.wi.gov/org/land/er/laws/> for more information).

Species of Greatest Conservation Need (Wisconsin): Animal species identified as at risk or declining in the Wisconsin Wildlife Action Plan. They include threatened and endangered species, as well as many other species whose populations are of concern. Designation of a species as SGCN does not, alone, offer legal protection; however, many of the SGCN are either state or federally-listed. In addition, several other state and federal laws may apply to some of these species (see <http://dnr.wi.gov/org/land/er/laws/> for more information).

Sustainable Forest Management (sustainable forestry):

1) WI DNR: The practice of managing dynamic forest ecosystems to provide ecological, economic, social, and cultural benefits for present and future generations.

2) SAF – UN: The practice of meeting the forest resource needs and values of the present without compromising the similar capability of future generations.

3) SAF – EU: The stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality, and potential to fulfill, now and in the future, relevant ecological, economic, and social functions at local, national, and global levels, and that does not cause damage to other ecosystems.

Threatened Species (Wisconsin): Any species which appears likely, within the foreseeable future, on the basis of scientific evidence, to become endangered. These species are protected by state law (see Statute 29.604 and Administrative Rule NR27). There are additional species that receive protection under the federal Endangered Species Act that are not listed as endangered or threatened by the state of Wisconsin.

Whole-tree Harvesting: Cutting and removing an entire upper portion of a tree consisting of trunk, branches, and leaves or needles.

Wildlife: All non-domesticated animal life.

Woody Biomass: Wood materials, such as wood, bark, sawdust, timber slash, and mill scraps. (Note: The woody biomass harvesting guidelines refer to woody biomass that comes directly from forestland harvest, i.e. wood and bark. This definition is for the purpose of this document and is not meant to supplant or conflict with the definition of sustainable woody biomass approved by the WI Council on Forestry.)



Eunice Padley, WI DNR

Appendix C – Contributors

Wisconsin’s Forestland Woody Biomass Harvesting Guidelines were developed with the help of four groups:

-  A stakeholder Advisory Committee – representatives from affected stakeholder groups, including industry, government, landowners, conservation organizations, and non-profit groups appointed by the Council on Forestry
-  A soils sub-committee convened at the request of the Advisory Committee to address soil nutrient issues.
-  Expert reviewers who reviewed the technical and scientific aspects of the guidelines
-  BHG Field Manual reviewers

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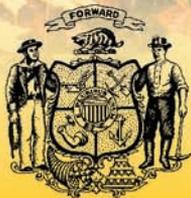
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