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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Foreword

Dear Reader,

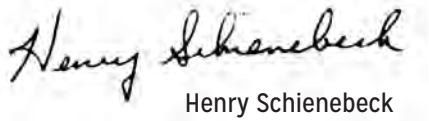
Welcome to the second edition of Wisconsin's Forestland Woody Biomass Harvesting Guidelines Field Manual. In 2009, when the biomass harvesting guidelines were developed, the Wisconsin Council on Forestry requested the guidelines be reviewed in three years to assess any new information that became available regarding the sustainability of biomass harvests and the operability of the guidelines. As planned, the biomass harvesting guidelines were recently revised based on new research and operational experiences. Those revisions have been incorporated into this Field Manual. In addition, please note that the guidelines have been reconfigured to better meet implementation needs.

The biomass harvesting guidelines are designed to provide guidance to forest resource managers, loggers, equipment operators, contractors, and landowners in Wisconsin regarding the sustainable harvest of woody biomass from Wisconsin's forests. However, the guidelines do not lessen the need for technical skill, sound silvicultural judgment, and informed decision-making when selecting proper management practices to achieve resource management objectives. The biomass harvesting guidelines may be modified for specific site conditions, for specific operational issues or to meet specific management objectives.

The revised guidelines are the result of a cooperative effort between the Council on Forestry, Wisconsin DNR, and many other partners who worked together to assess new research and to share their experiences implementing the guidelines. While there is still uncertainty in our understanding of the relationships between woody material, soil nutrients, wildlife habitat, biodiversity and other components of sustainable forest management, the Council on Forestry approved the guideline revisions and believes they offer reasonable management practices based on the best science currently available. As with any guidance, we expect that there will be further opportunities for improvement and refinement as more research becomes available and more practitioners implement the guidelines.

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

Paul Delong
Chief State Forester
Wisconsin DNR



Henry Schienebeck
Chairman
Wisconsin Council on Forestry

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Carmen Hardin, WDNR

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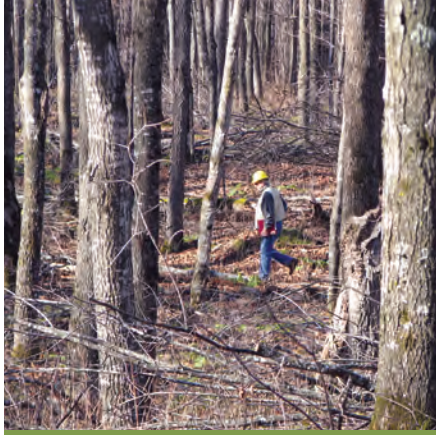
Preface

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 initially drafted in 2008 at the request of the Wisconsin Council on Forestry by a technical team comprised of WDNR staff using best available information. Draft guidelines underwent technical review by a select group of experts, and a stakeholder review by Advisory Committee members who were selected by the Wisconsin Council on Forestry. In 2013, the guidelines were reviewed and revised by the Advisory Committee with the assistance of DNR staff and other experts with research or implementation experience related to the guidelines. The Advisory Committee recommended some revisions to the guidelines; those revisions were accepted by the Council on Forestry in September 2013.

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

Down coarse woody debris provides important habitat for a variety of wildlife. *Eunice Padley, WDNR*



Paul Pingrey, WDNR

Old stumps provide important habitat for fungi and other microorganisms that help break down wood and replenish soil nutrients. *Eunice Padley, WDNR*

Joe Kovach, WDNR

Chapter 1

Introduction

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, and provide considerations and recommendations applicable to stand-level and site-level management based on best available information. These guidelines, when applied in concert with other forest management guidelines (Wisconsin Forest Management Guidelines (FMGs), Wisconsin Forestry's Best Management Practices (BMPs) and the WDNR Silviculture Handbook), are designed to address 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 informed decision-making regarding the harvest of woody biomass from Wisconsin's forests.

Traditional timber harvests generally remove woody material greater than four inches in diameter from the bole of a tree for use in forest products, while the smaller material is left on site. In "biomass harvests," the entire aboveground portion of a tree may be removed, including trunk, branches, bark, and leaves or needles. The harvest of fine woody material from forests results in increased removals from a site and a higher level of nutrient export. While bio-energy is the typical use for this material, it is important to note the guidelines apply to any harvest of fine woody material (< 4" diameter) regardless of the product's end purpose.

Wisconsin's Forestland Woody Biomass Harvesting Guidelines (BHGs) were developed to decrease the impacts of woody biomass harvesting on: a) biodiversity, b) soil nutrient depletion, c) the physical properties of soil, and d) water quality. The scope of these biomass harvesting guidelines was limited in order to target only the most significant ecological issues. The biomass harvesting guidelines may be modified for specific site conditions, for specific operational issues or to meet specific management objectives. The guidelines do not lessen the need for technical skill, sound silvicultural judgment, and informed decision-making when selecting proper management practices to achieve integrated resource management objectives. Chapter 4 of this manual addresses some of the more common modifications that may be encountered when balancing management objectives.

History of Wisconsin's Forestland Biomass Harvesting Guidelines

In 2008, several factors, including Former 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 initial development of woody biomass harvesting guidelines for Wisconsin. The guidelines were designed by an Advisory Committee of affected stakeholders, including representatives from industry, government, landowners, tribal interests, conservation organizations, and non-profit groups. The goal of guideline development was to ensure woody biomass was a sustainable forest product and increased extraction would not compromise the long-term productivity of Wisconsin's forestland.

In December 2008, the Wisconsin Council on Forestry accepted Wisconsin's Forestland Woody Biomass Harvesting Guidelines. When accepting the guidelines, the Council on Forestry also made a commitment to review the guidelines in 2012, as the results of additional research projects became available and as information concerning the implementation of the guidelines was evaluated. In September 2012, the Council

Woody biomass harvests often require additional equipment and processing. *Joe Kovach, WDNR*

Carmen Hardin, WDNR

sponsored an effort to review the guidelines for the harvest of woody biomass on Wisconsin's forestlands. The guideline review process builds on the work completed in the initial development of the guidelines, incorporates new research and addresses implementation, operational, and economic concerns. During the review, the Stakeholder Advisory Committee was assisted by three subcommittees (Appendix C) that reviewed the guidelines and made recommendations to the Advisory Committee. The Implementation, Operability, and Economics Subcommittee addressed operational and economic aspects of the guidelines and their implementation. The Forest Ecology Subcommittee addressed ecological concerns and made recommendations based on the latest research, and the Soils Subcommittee reviewed the restricted soils criteria and the listed soil series. Subcommittees forwarded recommendations to the Advisory Committee for consideration. The Advisory Committee agreed on revisions to Wisconsin's Forestland Woody Biomass Harvesting Guidelines, which were accepted by the Council on Forestry in September 2013.

Chapter 2

Wisconsin's Forestland Woody Biomass Harvesting Guidelines

Guidelines 1, 2, and 3 apply only to sites with the specific soil conditions described below. These are not generally applicable to all sites, but only to sites with poor soil nutrient conditions. Guidelines 4, 5, and 6 are generally applicable to any site. Reminders A, B, and C refer users to existing guidance on issues that apply to all timber harvests, including biomass harvests. It is recommended that the Biomass Harvesting Guidelines (BHGs) be implemented in addition to any applicable silvicultural guidelines, forest management guidelines (FMGs) and best management practices (BMPs). For detailed information on the background and implementation of the Biomass Harvesting Guidelines see Chapter 3 of this field manual.

These Biomass Harvesting 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. For more examples and a more detailed look at guideline modifications see Chapter 4 of this field manual.

Guideline 1 *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 that are considered to meet these criteria appears in Appendix D. See the Web Soil Survey for soil maps: **http://websoilsurvey.nrcs.usda.gov/app/**.

Exceptions:

- Jack pine stands may be harvested for woody biomass at rotations of 40 years or longer.
- Red pine stands may be harvested for woody biomass at rotations of 40 years or longer.
- Biomass harvesting in jack pine and red pine can include intermediate treatments as long as the final rotation age is at least 40 years.

A typical dry nutrient-poor sandy soil. *Carmen Hardin, WDNR*

The biomass harvesting guidelines may be modified for specific site conditions, for specific operational issues or to meet specific management objectives, including site preparation, restoration goals, invasive species control, and fuel reduction, among others.. *Dave Schulz, WDNR*

Guideline 2 *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 that are considered to meet these criteria appears in Appendix D. See the Web Soil Survey for soil maps: **http://websoilsurvey.nrcs.usda.gov/app/**.

Guideline 3 *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 that are considered to meet these criteria appears in Appendix D. See the Web Soil Survey for soil maps: **http://websoilsurvey.nrcs.usda.gov/app/**

Guideline 4 *Retain down coarse woody debris (CWD) already present. Minimize disturbance, including crushing, fragmenting, and displacing existing down CWD except on roads, skid trails, and landings.*

Guideline 5 *The goal is to retain at least 5 oven-dry tons per acre of fine woody debris (FWD; < 4" in diameter) on site following harvest. This can be achieved by:*

- Retaining down FWD already present (before cutting) except on roads, skid trails, and landings, to the extent feasible.
- Retaining FWD resulting from incidental breakage of tops and limbs in the general harvest area, to the extent feasible.
- Retaining and scattering additional tops and limbs in the general harvest area, if needed.

Considerations:

- In aspen stands, retaining FWD already present and created through incidental breakage is usually sufficient to achieve at least 5 oven-dry tons per acre of FWD.
- In non-aspen systems, retain at least 10% FWD in harvested tops and limbs (e.g. 1 in 10 tops or equivalent volume), or the equivalent volume in other FWD material, in addition to FWD already present and incidental breakage, to achieve at least 5 oven-dry tons per acre of FWD.
- The average stand in Wisconsin has approximately 3 oven-dry tons per acre of FWD already present. Generally, there should be approximately twice as much FWD post-harvest to achieve at least 5 oven-dry tons per acre of down FWD.
- Consider retaining additional amounts of FWD and/or Coarse Woody Debris (> 4" in diameter) at sites having minimal woody debris prior to a harvest.
- 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.
- If possible, maintain FWD from a diverse mix of species to enhance soil nutrients and preserve ecosystem functions.

Guideline 6 *Do not remove the forest litter layer, stumps, and/or root systems.*

Important Reminders:

Reminder A Stand-level tree and snag retention is important to accomplish sustainable forest management goals. For tree and snag retention guidelines, refer to WDNR Silviculture Handbook, Chapter 24.

Reminder B Salvage operations sometimes include biomass harvesting, especially after severe disturbances. For additional salvage operation guidelines, refer to WDNR Silviculture Handbook, Chapter 23.

Reminder C Always consider Federal and State Endangered and Threatened Species, State Special Concern Species, Species of Greatest Conservation Need, and sensitive natural communities prior to forest management operations. The Wisconsin Natural Heritage Inventory database is the most comprehensive source of documented locations for these elements, and species guidance documents and specialists in WDNR's Bureau of Natural Heritage Conservation can provide avoidance strategies or management options.

Carmen Hardin, *WDNR*

Carmen Hardin, WDNR

Chapter 3

Guideline Rationale and Implementation Notes

Guidelines 1, 2, and 3 apply only to sites with the specific soil conditions described below. These are not generally applicable to all sites, but only to sites with poor soil nutrient conditions. Guidelines 4, 5, and 6 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 operations, control of invasive or exotic species, fuel reduction treatments, barrens/savanna restoration or prescribed fire (see Chapter 4).

Guideline 1 *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 2. See the Web Soil Survey for soil maps: **http://websoilsurvey.nrcs.usda.gov/app/**

Exceptions:

- Jack pine stands may be harvested for woody biomass at rotations of 40 years or longer.
- Red pine stands may be harvested for woody biomass at rotations of 40 years or longer.
- Biomass harvesting in jack pine and red pine can include intermediate treatments as long as the final rotation age is at least 40 years.

Guideline 1 restricts the harvest of fine woody material, except for jack pine and red pine, on dry nutrient-poor sandy soils. Soils meeting the specific criteria are listed in Appendix D. Dry nutrient-poor sandy soils are 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 and because they have high leaching rates, which add to increased nutrient loss. To illustrate the concern of biomass harvest on these nutrient poor soils, a Lake States soils dataset was analyzed to find the range of nutrient supply for calcium (Ca), one of the soil nutrients 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 multiple aspen whole-tree harvests could significantly alter the long-term productivity of a forest stand. It is important to note that Ca is only one of many nutrients that have a potential to be limited. Potassium and magnesium are other nutrients that are susceptible to depletion when whole-tree harvesting on these nutrient-poor sandy soils.

Harvesting fine woody material from jack pine stands is an exception to Guideline 1 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. *Paul Pingrey, WDNR*

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. *Dave Schulz, WDNR*

Guideline 1 was developed to address these concerns about nutrient depletion on soils that lack the necessary characteristics to sustainably supply nutrients to the forest system. 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.

Whole-tree harvests of species other than red or jack pine on these sensitive sandy soils will produce a decreasing amount of necessary soil nutrients with each whole-tree harvest. Aspen is a particularly nutrient-demanding species that accumulates a lot of Ca in bark and twigs. In contrast, jack and red pine contain much less nutrients in the needles, twigs and bark. 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 1 does not limit harvest of fine woody material from jack and red pine stands. A stand is considered jack pine or red pine if more than 50% of the basal area is represented by one or both of these species.

The restricted soils list in Appendix D was created by reviewing analytical data provided by the Natural Resources Conservation Service (NRCS) database to identify soil map units meeting the criteria of a nutrient poor soil. 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.

Shallow soils with rock outcroppings. *Eunice Padley, WDNR*

Parts of southwestern Wisconsin have thick layers of limestone or dolomite bedrock near the surface. *Eunice Padley, WDNR*

Typical appearance of vegetation growing on a dysic Histosol. Most dysic Histosols are not productive enough to support large volumes of biomass. *Andy Clark, WDNR*

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. *Eunice Padley, WDNR*

Guideline 2 *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/**

Guideline 2 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 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.

Depth to bedrock should be 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 leaf litter or twigs lying on the forest floor.

Bedrock is considered solid material, and the measured depth to bedrock does not include particles that may be flaking or crumbling from the rock's surface.

If the depth to bedrock is variable, the typical or most common depth should be chosen to represent the site.

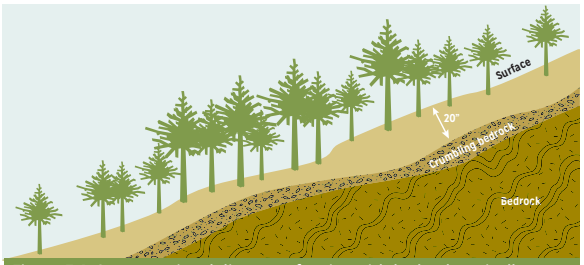


Figure 3–1. Cross sectional diagram of a site with bedrock typically found at 20 inch depths or less.

Guideline 3 *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 NRCS Web Soil Survey for soil maps: **http://websoilsurvey.nrcs.usda.gov/app/**

Guideline 3 restricts the harvest of fine woody material on soils classified as 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 parts that support vegetative growth, are isolated from mineral soil and do not receive nutrient inputs from mineral weathering. Due to the potential for depletion, harvest of fine woody material is restricted. Fine woody material contains a higher amount of nutrients on a weight basis when 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.

Identifying sites limited under Guidelines 1, 2, and 3.

When a harvest of fine woody material is being considered, users can first check the Forest Habitat Type Group to screen for sites that may be dry nutrient-poor sands limited by Guideline 1. If the site's Forest Habitat Type Group is one of the following, see a soil map to determine whether the site is actually considered a dry nutrient-poor sandy soil:

- ❑ Southern Dry
- ❑ Northern Very Dry-to-Dry
- ❑ Northern Dry-to-Dry Mesic

On other habitat type groups, harvests of fine woody material are not limited by Guideline 1.

For sites with soils that may be considered to be dry nutrient-poor sands, dysic Histosols, or shallow to bedrock, users will need to cross-reference a soil survey map with the list of soil map units that appears in Appendix D.

For many counties, printed copies of Soil Survey Reports are available, and many users are familiar with them. The NRCS Web Soil Survey is another way to access soil survey maps, using the following procedure.

1. Go to **http://websoilsurvey.nrcs.usda.gov/app/**
2. Click on the large green "Start WSS" button at the top of the page:

3. Using zoom and pan tools on the "Area of Interest Interactive Map", navigate to an area that includes your site. Alternatively, use the ..... menu on the left side of the screen to locate an area such as a county, or Town-Range-Section.

4. After locating the general area, use the "Area of Interest" (AOI) buttons at the top of the interactive map to define a specific area of interest up to 10,000 acres in size.

5. Click the "Soil Map" tab at the top of the screen to view the soil map for your AOI.
6. Determine where on the map your site is located. Make a note of the map unit codes for your site. (A map unit key on the left side of the screen will provide more information, if needed, about the soils displayed on the map.)

7. For a printed copy of your results, click the "Printable Version" button on the right side of the screen.

Soils affected by the biomass harvesting guidelines are found in Appendix D.

The soils list in Appendix D identifies specific soil map units, limiting components of the soil map unit, reasons for the limitation, and the percent of the map unit that is limiting. Some soil map units, such as Boone sand, are comprised of only one soil component. Boone is the limiting component because it is a dry nutrient-poor sand. Applying biomass harvesting guidelines to a timber sale on Boone sand is fairly straight-forward; 100% of the map unit is Boone sand and the guidelines would apply equally over the entire site. However, in many soils, one may find inclusions of different soils that can make up as much as 25% of the soil map unit. Fine woody material may be harvested on a soil inclusion if there is evidence that it is a suitable soil. Biomass harvests should be avoided on obviously unsuitable sites, such as small inclusions of dysic histosols. Other soil map units are complexes which consist of two or more dissimilar components. The soils are mapped together because they cannot be mapped separately at a scale of 1:24,000. An example of a soil complex is Sarona-Vilas complex. It is on the list of soils limited by the biomass harvesting guidelines because Vilas is a dry nutrient-poor sand. However, Vilas only comprises 30% to 40% of the map unit, depending on a site's topography. This means that for the Sarona-Vilas map unit, 60% to 70% of the map unit (Sarona) can support a biomass harvest, while the remainder (Vilas) cannot. Applying the biomass harvesting guidelines to a timber sale involving complexes can require more work. There are several ways to approach a biomass harvest on a soil complex.

Option 1—Forego Biomass Harvest

On some sites, it may simply be most efficient to forego harvest of fine woody material on the entire soil map unit. This may be the best approach if the soils are similar in appearance as it may be difficult to identify which soil is limited and which is not. This may also be the best approach if the complex includes wetlands or other sensitive features that would be difficult to avoid operationally. It is important to remember that these sites can still support a traditional bolewood harvest.

Option 2—Identify Suitable Soils

If the soils in the complex can be readily identified in the field, it may be feasible to harvest biomass on portions of the timber sale. Identify by mapping, with flagging, or by other methods, parts of the soil map unit that are suitable for harvest of fine woody material, and proceed with the harvest on those portions of the map unit.

Option 3—Evaluate the Site

Another option is to evaluate the site and determine whether or not the site is suitable for a biomass harvest by considering soils, vegetation, timber type, site index, and a number of other site characteristics. The utility of this approach depends on how much of the soil map unit is limited. This method relies on best professional judgment, familiarity with the site, surrounding soils, and forest characteristics. It is important to document rationale for the decision so someone else reviewing the documentation could reach the

Pre-existing coarse woody debris should be retained on site, except as noted in Guideline 4. *Carmen Hardin, WDNR*

Fine woody material is redistributed over a timber sale on a whole tree harvest. *Dick Rossman, WDNR*

Carmen Hardin, WDNR

Eunice Padley, WDNR

same logical conclusion. Note: When evaluating a site in terms of a soil complex, the percentage of a soil map unit that is limiting (see Appendix D for percentages by specific soil complex) refers to the percentage of biomass restricted soils within the entire map unit and not to the percentage of biomass restricted soils within a sale area or an Area of Interested as generated on the NRCS Web Soil Survey. Resource managers will need to evaluate their specific sale area to determine which portions are appropriate for a biomass harvest.

If 81% to 100% of a soil map unit is limiting, the site is unlikely to support a biomass harvest. With this high of a percentage of a limiting soil, it is difficult to justify the additional investment in time and evaluation to identify portions of a site that can support a biomass harvest. However, it may still be appropriate to modify the guidelines based on specific site conditions, operational issues, or management objectives. For example, Vilas loamy sand can be 90% to 95% limiting because Vilas is a dry nutrient-poor sandy soil. There may be inclusions of other soils that account for 5% to 10% of the map unit that may support a biomass harvest; however, it may be very difficult and labor intensive to identify any small areas that contain a suitably rich soil.

If 51% to 80% of a soil map unit is limiting, conduct a field site visit and evaluate the site to determine whether or not a biomass harvest is appropriate on the entire site or portions of the site. The goal of the site visit and evaluation is to look at a number of site characteristics to determine if the site is appropriate for a biomass harvest. In this case, the soils may not be readily discernible, but other site factors may indicate the fertility of the site. Factors to consider include composition of soil, site index, timber type, habitat type, management objectives, land type associations (LTAs), glacial landforms, and other available site characteristics. This method relies on best professional judgment and familiarity with the area, soils, and forest stands.

As an example, consider the Haustrup-Lundeen-Rock outcrop complex. Haustrup and Rock outcrop comprise 80% of the map unit and limit biomass harvests because the soils are shallow to bedrock. The rock outcrops should be easy to identify and exclude from the biomass harvest. Distinguishing between the Haustrup and Lundeen may be more difficult, but not impossible. Lundeen is a deeper soil than Haustrup and may be slightly more productive. Compare the stand in question to other stands growing on Haustrup and Lundeen—which one is the stand more similar to? Look at the composition of the soil (in this case, primarily depth to bedrock), site index, timber type, and other important factors to see if there is strong correlation with one soil type or the other. If the site appears to be more closely related to Lundeen, then it would be a suitable site to conduct a biomass harvest. If the site appears to more similar to Haustrup or if it is not possible to make a distinction, then this would not be a suitable site for a biomass harvest.

If 26% to 50% of a soil map unit is limiting, conduct a field site visit to determine whether or not a biomass harvest is appropriate on the entire site or portions of the site. The goal of the site visit is to determine whether or not the site is appropriate for a biomass harvest. Within the harvest boundary and within the soil map unit, are there any discernible patterns in vegetation or indicators of a richer site? How much of the soil map unit is covered by the harvest area? This determination is again based on best professional judgment. The level of investigation required in this situation is not as rigorous as above because there is a smaller likelihood of encountering a limiting soil. For example, the Keweenaw, stony-Rubicon complex is limited by Rubicon, a dry nutrient-poor sand which covers 30% of the map unit. If the proposed harvest covers 15% of the map unit and 30% of the map unit is limited, then there is a good chance that the Rubicon soil may be avoided. Visit the site and compare the proposed harvest area to the surrounding areas and other sites that are on Rubicon. Does the site appear to be an acceptable site for a biomass harvest? Are there any indicators the site may be on a poorer soil?

If 0% to 25% of a soil map unit is limiting, then the soil map unit was not included on The soils list in Appendix D, and the site is suitable for a biomass harvest. As described above, biomass harvests should be avoided on obviously unsuitable sites, such as small inclusions of dysic histosols.

Gerald Emmerich

Eunice Padley, WDNR

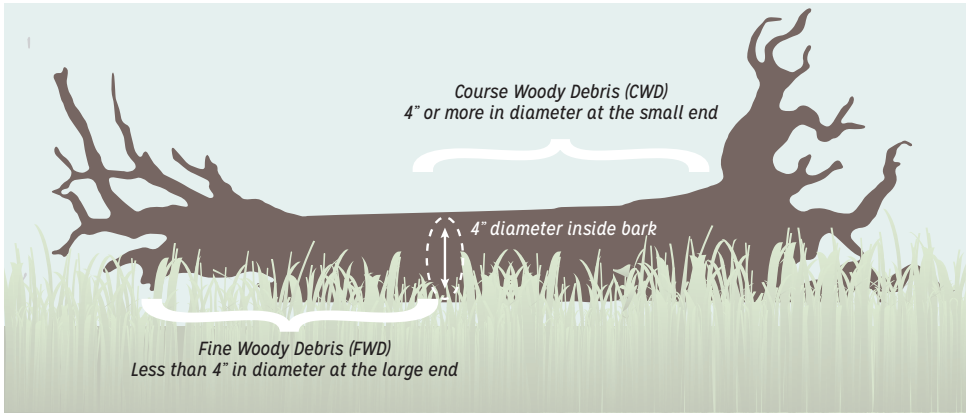
In aspen stands, FWD already present along with incidental breakage usually meets or exceeds 5 oven-dry tons per acre. *Eunice Padley, WDNR*

Scott Mulcahy

Guideline 4 *Retain down coarse woody debris (CWD) already present. Minimize disturbance, including crushing, fragmenting, and displacing existing down CWD except on roads, skid trails, and landings.*

The goal of Guideline 4 is to protect down coarse 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 3-2). If the woody material is less than 4 inches in diameter, then it is fine woody debris (FWD)—which is discussed in Guideline 5.

Biomass harvests should not remove pre-existing CWD and this material should be left on site and kept intact as possible to benefit wildlife habitat and other biodiversity. Care should be taken to avoid running over CWD with equipment. Route skid trails around large relic pieces of CWD, as much as possible. In some instances, it may be necessary to move CWD to accommodate traffic, but the CWD should be retained in the woodland.



Guideline 5 *The goal is to retain at least 5 oven-dry tons per acre of fine woody debris (FWD; < 4" in diameter) on site following harvest. This can be achieved by:*

- Retain down FWD already present (before cutting) except on roads, skid trails, and landings, to the extent feasible.
- Retain FWD resulting from incidental breakage of tops and limbs in the general harvest area, to the extent feasible.
- Retain and scatter additional tops and limbs in the general harvest area, if needed.

Considerations:

- In aspen stands, retaining FWD already present and created through incidental breakage is usually sufficient to achieve at least 5 oven-dry tons per acre of FWD.
- In non-aspen systems, retain at least 10% FWD in harvested tops and limbs (e.g. 1 in 10 tops or equivalent volume), or the equivalent volume in other FWD material, in addition to FWD already present and incidental breakage, to achieve at least 5 oven-dry tons per acre of FWD.
- The average stand in Wisconsin has approximately 3 oven-dry tons per acre of FWD already present. Generally, there should be approximately twice as much FWD post-harvest to achieve at least 5 oven-dry tons per acre of down FWD.
- Consider retaining additional amounts of FWD and/or Coarse Woody Debris (> 4") at sites that have minimal woody debris prior to a harvest.
- 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.

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. *Carmen Hardin, WDNR*

The Companion Guide to Assessing Fine Woody Debris was developed as a tool to help practitioners determine how much fine woody debris is present on a site. *Dustin Bronson, WDNR*

Eunice Padley, WDNR

Stumps of newly harvested trees, as well as old stumps, should be retained on site. They may be moved if necessary for site preparation operations. *Paul Pingrey, WDNR*

- If possible, maintain FWD from a diverse mix of species to enhance soil nutrients and preserve ecosystem functions.

This guideline is intended to retain fine woody debris (FWD) addressing site 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 3-2).

Any FWD on the site prior to harvest should be retained. 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 trails to support equipment and prevent rutting. It is not necessary to redistribute FWD that is used in this way.

In scientific studies based in Wisconsin and Minnesota, it was shown that incidental breakage alone generally produced the necessary 5 oven-dry tons per acre for aspen dominated forests, thereby eliminating the need to purposely leave additional FWD. However, for other species that produce less incidental breakage, especially conifers, it is generally necessary to leave 10% FWD in harvested tops and limbs, in addition to any incidental breakage. Examples of how this can be accomplished in a harvest operation include: leaving one average-size tree crown out of every ten trees harvested; cutting and leaving the equivalent volume in small, non-merchantable trees (<4" diameter); or harvesting to a 1" or 2" top and to leave the equivalent volume in limbs.

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 goal on most sites. If a site has minimal woody debris, consider retaining more FWD and/or CWD than is required.

Guideline 6 *Do not remove the forest litter layer, stumps, and/or root systems.*

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.

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 ensuring nutrients contained in that material are not lost.

Important Reminders for Maintaining Site Productivity:

Reminder A Stand-level tree and snag retention is important to accomplish sustainable forest management goals. For tree and snag retention guidelines, refer to WDNR Silviculture Handbook, Chapter 24.

The importance of retaining leave trees, snags, coarse woody debris, conifers, and mast trees for wildlife as part of sustainable forestry operations is discussed in more detail in the Wisconsin Forest Management Guidelines (FMGs). The WDNR 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.

Eunice Padley, WDNR

Steve Meyer

Steve Meyer

R.A. Kleppin

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.

Cavity trees are partially hollow living trees used by many wildlife species. 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.

Paul White

Eunice Padley, WDNR

WDNR

Dave Schulz, WDNR

This photo shows portions of the damage wreaked by a tornado that crossed northeastern Wisconsin in 2007. *USFS*

Reminder B Salvage operations sometimes include biomass harvesting, especially after severe disturbances. For additional salvage operation guidelines, refer to WDNR Silviculture Handbook, Chapter 23.

After a salvage operation it is important some woody material be left on site to provide soil nutrients, wildlife habitat, and address other biological diversity concerns. Large diameter decaying trees, snags, and course woody debris provide critical habitat for many organisms. Consider retaining unsalvaged patches at least a tenth of an acre in size to provide these habitat structures. The extent and distribution of unsalvaged patches may need to be modified if retention would interfere with effective sanitation and control of insect and disease outbreaks.

Kyoko Scanlon, WDNR

Reminder C Always consider Federal and State Endangered and Threatened Species, State Special Concern Species, Species of Greatest Conservation Need, and sensitive natural communities prior to forest management operations. The Wisconsin Natural Heritage Inventory database is the most comprehensive source of documented locations for these elements, and species guidance documents and specialists in WDNR's Bureau of Natural Heritage Conservation can provide avoidance strategies or management options.

Before harvesting fine woody material, determine the presence (and location) of and potential impacts on Federal and State Endangered and Threatened Species, State Special Concern Species, Species of Greatest Conservation Need, and sensitive natural communities and follow all applicable laws and guidelines established to protect these species and ecosystems. 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 Natural Heritage Conservation regarding data access. Generalized data are also currently available on the Wisconsin DNR Web site: **http://dnr.wi.gov/topic/NHI/CountyData.html**. Other data sources may exist for your area, although no rare species database can be considered complete.

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/**.

Useful information for managing sensitive sites is contained in a number of resources, including the WDNR'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 and sensitive sites 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 those who have in-depth knowledge regarding conservation and management of the species or ecosystems of concern, and may include wildlife biologists, conservation biologists, community ecologists, and forest ecologists. Many specialists are on staff with public agencies, such as WDNR.

Carmen Hardin, WDNR

Lana Hays

Biomass harvesting may be justified on shallow or dry nutrient-poor sandy soils for the purpose of barrens or savanna restoration. *Eunice Padley, WDNR*

During site preparation operations, CWD may be moved around a site. *Paul Pingrey, WDNR*

E. Judziewwicz

Steve Meyer

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

Eunice Padley, WDNR

Four-toed Salamander. *Mathew Ignoffo*

Joe Kovach, WDNR

Chapter 4

Modification of Guidelines

The biomass harvesting guidelines may be modified for specific site conditions, for specific operational issues or to meet specific management objectives. The guidelines do not lessen the need for technical skill, sound silvicultural judgment, and informed decision-making when selecting proper management practices to achieve integrated resource management objectives. Chapter 4 addresses some of the more common modifications that may be encountered when balancing management objectives. Modifications to generally accepted forestry practices and guidelines should always be documented in the management record. It is recommended the biomass harvesting guidelines be implemented in addition to any applicable silvicultural guidelines, forest management guidelines (FMGs) and best management practices (BMPs).

Reasons for Modifying the Guidelines

Site Preparation

Site preparation practices include any number of hand, mechanical, chemical, or burning treatments designed to create proper conditions for seed germination and/or seedling development of desired species. The biomass harvesting guidelines may be modified to accomplish some site preparation objectives. For example, coarse woody debris may be moved around the site when using scarification equipment (see anchor chain figure). Disturbance can often be balanced by avoiding scarification and protecting CWD on a portion of the site. In certain situations, the biomass harvest itself may be used to accomplish site preparation objectives by removing woody material that would otherwise interfere with other management on the site (e.g., removing slash to facilitate tree planting operations) and therefore can be a tool to improve results and reduce costs.

Biomass harvesting is a useful tool for restoring barrens or savanna communities and can facilitate further management with prescribed fire. In addition, when using prescribed fires to restore these communities, CWD may be moved out of the burn area. *Brian Dhuey, WDNR*

During efforts to control buckthorn, honeysuckle and other invasive trees and shrubs, all woody material from the invasive species may need to be removed. *Tim Beyer, WDNR*

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. *Carmen Hardin, WDNR*

Barrens or Savanna Restoration

Fire was once an important disturbance factor in many Wisconsin natural communities. Oak and pine barrens/savanna often developed more open forest conditions due to frequent fires and supported unique plant and wildlife communities. Biomass harvesting has been a useful tool to restore some of these communities to a more open condition and facilitate further management with prescribed fire. Barrens and savannas often occur on the same shallow and dry nutrient-poor sandy soils restricted from biomass harvesting. Biomass harvesting may be justified on these sites when conducting barrens and savanna restoration. Long-term impacts to the nutrient cycle will be limited in barrens/savanna restoration since the sites will typically not be harvested repeatedly. Reasons for Modifying the Guidelines

Invasive Species Control

Invasive plant species, such as buckthorn and honeysuckle, can dominate forest stands and interfere with natural regeneration. Biomass harvesting may be used as a tool on these sites to remove woody invasive species, facilitate chemical and/or prescribed burning treatments, and improve natural tree regeneration.

Fuel Reduction Treatments

Mechanical fuel reduction treatments can be effective at reducing wildfire intensity and therefore fire risk in critical areas, such as near housing developments. Dry nutrient-poor sandy soils are common in the fire prone landscapes of central and northwestern Wisconsin, but biomass harvesting may be justified on these soils to reduce fire risk in these critical areas by removing woody fuels, such as small trees, shrubs, and slash.

Landscape Management

The biomass harvesting guidelines are designed to protect stand-level productivity and sustainability by maintaining soil nutrients, wildlife habitat, and ecosystem functions. Land managers who implement these guidelines have wondered if landscape-level objectives can be considered when modifying the guidelines. For example, can biomass harvesting be used as a tool to diversify the forest age structure on a large property, even though many of the property's soil types restrict biomass removals? There is not a one-size-fits-all answer to this question. Multiple factors need to be considered to determine the best way to balance stand-level sustainability with landscape-level goals. Is the ownership large enough to minimize successive biomass rotations? Is there a long-term strategy and management commitment to mitigate impacts to soil nutrients and ecosystem functions? Modifications to biomass harvesting guidelines may be justified in the context of an overall landscape management strategy, as long as steps are also taken to protect stand-level productivity and sustainability.

Red and Jack Pine Conversions

Guideline 1 restricts biomass harvests on dry nutrient-poor sandy soils, with the exception of red pine stands and jack pine stands harvested on rotations of 40 years or longer. Jack and red pine are much less nutrient demanding species and therefore fine woody material can be removed from these stands without compromising long-term soil productivity. A common question is whether or not other forest cover types can be sustainably harvested for biomass on these sandy soils if the objective is immediate conversion to jack or red pine. The initial conversion process will likely remove greater amounts of nutrients from the site since these other species contain more nutrients within their bark and limbs, but that impact will be lessened as the stand is converted to and maintained in jack or red pine. This modification should also consider the ecological impacts of converting to pine at the expense of other forest types.

Before. *Craig Golembiewski*

After . *Craig Golembiewski*

Before. *Robert Hanson, WDNR*

After. *Robert Hanson, WDNR*

CASE STUDY

Douglas County Forest

The Douglas County Forest encompasses 278,000 acres in northwest Wisconsin, including many acres of forest located on dry nutrient-poor sandy soils. Many of these outwash sands are part of the Pine-Oak Barren natural community, a designated Conservation Opportunity Area (COA) in Wisconsin's Wildlife Action Plan. In 2010, Douglas County Forestry Department established a timber sale on an 80-acre mixed stand of scrub oak and jack pine within the COA, with the long-term management goal of restoring a greater component of jack pine to the barrens. The limited amount of natural jack pine within the current stand meant that site preparation followed by tree planting or direct seeding would be required to accomplish stand objectives. The predominant soil map unit was Rubicon Sand, a dry nutrient-poor sandy soil restricted by the biomass harvesting guidelines. The forester prescribed whole tree harvesting, as a tool to remove woody material that would interfere with follow-up mechanical site preparation and planting to jack pine. Biomass harvesting in this case helped manage for a less nutrient demanding species (i.e., jack pine) and decrease long-term nutrient impacts to the site, as well as meet landscape barrens restoration goals.

CASE STUDY

Crex Meadows Wildlife Area, Burnett County

The Crex Meadows Wildlife Area is a 30,000 acre property in western Burnett County owned and managed by the Wisconsin DNR. The property includes wetlands, savannas, barrens and forests located on outwash sandy soils. Crex Meadows is part of the larger Pine-Oak Barrens natural community in the Northwest Sands Ecological Landscape. Historically, wildfires maintained this semi-open landscape and its unique plant communities. In 2013, Wisconsin DNR established a 200-acre timber sale in mixed scrub oak and jack pine stands in order to begin restoring the barrens and savanna conditions. The predominant soil map unit was Grayling Sand, a dry nutrient-poor sandy soil restricted by the biomass harvesting guidelines. Whole-tree biomass harvesting was prescribed in this case to lower fuel loads and to facilitate follow-up prescribed burning needed to restore and maintain barrens and savanna conditions.

R.A. Kleppin


Paul Pingrey, WDNR

Appendix A

Resources

General Information

- Wisconsin Council on Forestry Biomass Page—**http://council.wisconsinforestry.org/biomass/**
- WDNR Division of Forestry—**http://dnr.wi.gov/topic/forestry.html**
- WDNR Foresters—**http://dnr.wi.gov/topic/ForestLandowners/assist.html**
- Wisconsin County Forest Administrators—**http://www.wisconsincountyforests.com/administrators/administrators-contact/**
- Managed Forest Law—**http://dnr.wi.gov/topic/ForestLandowners/mfl.asp?s1=Forest ax&s2=M-FL-Enrollment**
- WDNR Invasive Species—**http://dnr.wi.gov/topic/Invasives/**
- Consulting Foresters—**http://www.wi-consultingforesters.com/**

Endangered Resources/Sensitive Species

- WDNR Natural Heritage Conservation—**http://dnr.wi.gov/topic/endangeredresources/**
- Wisconsin's Natural Heritage Inventory—**http://dnr.wi.gov/topic/NHI/**
- Animals, Plants and Natural Communities—**http://dnr.wi.gov/topic/EndangeredResources/biodiversity.html**
- Bird Species Guidance—**http://www.wisconsinbirds.org/plan/species/**
- Karner Blue Butterfly Habitat Conservation Plan—**http://dnr.wi.gov/topic/forestplanning/karner.html**

Handbooks and Other Guidance

- Silviculture Handbook—**http://dnr.wi.gov/topic/ForestManagement/silviculture.html**
- Ecological Landscapes Handbook—**http://dnr.wi.gov/topic/landscapes/**
- Water Quality BMPs—**http://dnr.wi.gov/topic/forestmanagement/bmp.html**
- Old Growth Handbook—available upon request.
- WDNR Biodiversity Report—**http://www.dnr.state.wi.us/org/es/science/publications/rs915_95.htm**
- Wisconsin's Forest Management Guidelines **http://dnr.wi.gov/topic/ForestManagement/guidelines.html**

Land Management Planning

- WDNR Land Legacy Report—**http://dnr.wi.gov/topic/lands/landlegacy/**
- TNC's Ecoregional plans: The Superior Mixed Forest Ecoregional Plan, and the Prairie-Forest Border Ecoregional Plan—**http://conserveonline.org/**
- WDNR Basin Reports—**http://dnr.wi.gov/water/basin/**
- Wisconsin Regional Planning Commissions—**http://www.awrpc.org/**
- Wisconsin Association of Resource Conservation & Development (RC&D)—**http://wisrcd.weebly.com/**

Wildlife

- WDNR Wildlife Action Plan—**http://dnr.wi.gov/topic/wildlifehabitat/actionplan.html**
- Breeding Bird Atlas site—**http://www.uwgb.edu/birds/wbba/**
- Wisconsin Bird Conservation Initiative website—**http://www.wisconsinbirds.org/**
- Important Bird Areas—**http://www.wisconsinbirds.org/iba/**

Soils/mapping

- Websoil 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/topic/landscapes/**

Other Biomass Harvesting Guidelines

- Indiana—**http://www.in.gov/dnr/forestry/files/fo-BiomassGuide.pd**
- Maine—**http://www.maine.gov/dacf/mfs/archive/pubs/biomass_retention_guidelines.html**
- Maryland—**http://www.pinchot.org/gp/Maryland_Biomass**
- Michigan—**http://www.michigan.gov/documents/dnr/WGBH_321271_7.pdf**
- Minnesota—**http://mn.gov/frc/documents/council/site-level/MFRC_brushland_BHG_2007-12-01.pdf**
- Missouri—**http://mdc.mo.gov/sites/default/files/resources/2010/09/woody_biomass_ha vesting_bmp_book.pdf**
- Pennsylvania—**http://www.dcnr.state.pa.us/PA_Biomass_guidance_final.pd**

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.

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.

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 delimbing.

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 WDNR. 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 (WDNR 2006). 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) WDNR: 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.***

Appendix C

Contributors

2013 Guideline Revision

Wisconsin's Forestland Woody Biomass Harvesting Guidelines were revised in 2013 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
- The Implementation, Operability, and Economics Subcommittee addressed operational and economic aspects of the guidelines and their implementation.
- The Forest Ecology Subcommittee addressed ecological concerns and new research.
- A Soils Subcommittee convened at the request of the Advisory Committee to review restricted soil criteria and soil series.

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2008 Guideline Development

Wisconsin's Forestland Woody Biomass Harvesting Guidelines were developed in 2008 with the help of four groups:

- Expert reviewers who reviewed the technical and scientific aspects of the guidelines
- 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.
- BHG Field Manual reviewers

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Marshall Pecore	Menominee Tribal Enterprises
Jesse Turk	Natural Resources Conservation Service
Mark Fries	NewPage Corporation
Gary Wyckoff	Plum Creek Timber
Matt Dallman	The Nature Conservancy
Geoff Chandler	USDA Forest Service
David Mladenoff	UW–Dept of Forest Ecology
Neal Paisley	WDNR–Wildlife Management
Don Peterson	Wisconsin Consulting Foresters Association
Jane Severt	Wisconsin County Forest Association
Jeff Barkley	WDNR–Division of Forestry
Earl Gustafson	Wisconsin Paper Council
Ed Moberg	Wisconsin Woodland Owners Association

Soils Sub-committee

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Jesse Turk	Natural Resources Conservation Service
Dave Hoppe	USDA–Forest Service, CNNF
Sarah Mase	USDA–Forest Service, Ottawa NF
Connor Fristoe	Plum Creek
Mike Demchik	UW–Stevens Point
Jay Gallagher	WDNR–Division of Forestry
Andy Stoltman	WDNR–Division of Forestry
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Carmen Wagner	WDNR–Division of Forestry
Eunice Padley	WDNR–Division of Forestry

Expert Review

Keith McCaffery	WDNR–Retired
Bob Howe	UW–Green Bay
Bob Hay	WDNR–Bureau of Endangered Resources
Drew Feldkirchner	WDNR–Bureau of Endangered Resources
Mike Demchik	UW–Stevens Point
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Steve Bertjens	Southwest Badger RC&D
Jane Cummings-Carlson	WDNR–Forest Health
Jim McLaughlin	Ontario Forest Research Institute
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Jim Bockheim	UW–Madison
Don Waller	UW–Madison
Craig Lorimer	UW–Madison
Martin Jurgensen	Michigan Technological University
Jolene Ackerman	WDNR–Fire Management
WDNR Silviculture Team	
WDNR Public Lands Team	
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BHG Field Manual Reviewers

Jeff Barkley	WDNR–Division of Forestry
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Carol Nielsen	WDNR–Division of Forestry
Jane Severt	Wisconsin County Forest Association
Ed Moberg	Wisconsin Woodland Owners Association
Matt Dallman	The Nature Conservancy

Appendix D

List of Soil Map Units Limited by Biomass Harvesting Guidelines—September 10, 2012

Note: This list will be updated periodically to reflect new information from soil survey updates being conducted in Wisconsin by the Natural Resources Conservation Service.

Soil map units were removed from the list if 25% or less of the soil map unit is limiting.

County	Map unit name	Map unit symbol	Limited component(s)	Reason for limitation	Percent of map unit
Adams	Boone sand, 2 to 6% slopes	BnB	Boone	Dry Nutrient-Poor Sand	100%
	Boone sand, 6 to 12% slopes	BnC	Boone	Dry Nutrient-Poor Sand	100%
	Boone sand, 12 to 25% slopes	BnD	Boone	Dry Nutrient-Poor Sand	100%
	Boone-Rock outcrop complex, 25 to 45% slopes	BpF	Boone, Rock Outcrop	Dry Nutrient-Poor Sand, Shallow Bedrock	100%
	Plainfield sand, 0 to 2% slopes	PfA	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield sand, 2 to 6% slopes	PfB	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield sand, 6 to 12% slopes	PfC	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield sand, 12 to 35% slopes	PfD	Plainfield	Dry Nutrient-Poor Sand	100%
Ashland	Amasa-Karlin complex, esker, 2 to 18% slopes	5146C	Karlin	Dry Nutrient-Poor Sand	40%
	Dawson, Greenwood, and Loxley soils, 0 to 1% slopes	5140A	Dawson, Greenwood, Loxley	Dysic Histosol	95%
	Deerton-Brownstone complex, 0 to 6% slopes, very stony	3608B	Deerton, Brownstone	Dry Nutrient-Poor Sand	90%
	Deerton-Brownstone complex, 6 to 15% slopes, very stony	3608C	Deerton, Brownstone	Dry Nutrient-Poor Sand	90%
	Dishno-Gogebic-Peshekee-Rock outcrop complex, 18 to 35% slopes, very stony	5369D	Peshekee, Rock Outcrop	Shallow Bedrock	30%
	Haplosaprists, Peats and Mucks, 0 to 1% slopes	9155A	Loxley, Beseman	Dysic Histosol	40%
	Keweenaw, stony-Rubicon complex, 0 to 6% slopes	874B	Rubicon	Dry Nutrient-Poor Sand	30%
	Keweenaw, stony-Rubicon complex, 6 to 15% slopes	874C	Rubicon	Dry Nutrient-Poor Sand	30%
	Keweenaw-Sayner-Vilas complex, 2 to 6% slopes, stony	69B	Sayner, Vilas	Dry Nutrient-Poor Sand	50%
	Keweenaw-Sayner-Vilas complex, 6 to 15% slopes, stony	69C	Sayner, Vilas	Dry Nutrient-Poor Sand	50%
	Keweenaw-Sayner-Vilas complex, 15 to 45% slopes, stony	69E	Sayner, Vilas	Dry Nutrient-Poor Sand	50%

County	Map unit name	Map unit symbol	Limited component(s)	Reason for limitation	Percent of map unit
Ashland	Loxley and Beseman soils, 0 to 1% slopes	414A	Loxley, Beseman	Dysic Histosol	85%
	Loxley, Beseman, and Dawson soils, 0 to 1% slopes	3403A	Loxley, Beseman, Dawson	Dysic Histosol	98%
	Michigamme-Schweitzer-Peshekee-Rock outcrop complex, 35 to 55% slopes, very stony	5369E	Peshekee, Rock Outcrop	Shallow Bedrock	35%
	Michigamme-Schweitzer-Peshekee-Rock outcrop complex, 55 to 75% slopes, very stony	5369F	Peshekee, Rock Outcrop	Shallow Bedrock	35%
	Pelissier gravelly sandy loam, 6 to 15% slopes	571C	Pelissier	Dry Nutrient-Poor Sand	80%
	Pelissier gravelly sandy loam, 15 to 45% slopes	571E	Pelissier	Dry Nutrient-Poor Sand	80%
	Redrim very cobbly sand, 0 to 6% slopes, very stony	603B	Redrim	Dry Nutrient-Poor Sand, Shallow Bedrock	85%
	Rock outcrop-Ishpeming complex, 0 to 15% slopes	925C	Rock Outcrop	Shallow Bedrock	50%
	Rousseau loamy fine sand, 0 to 6% slopes	339B	Rousseau	Dry Nutrient-Poor Sand	85%
	Rousseau loamy fine sand, 6 to 15% slopes	339C	Rousseau	Dry Nutrient-Poor Sand	90%
	Rousseau loamy fine sand, 15 to 30% slopes	339D	Rousseau	Dry Nutrient-Poor Sand	90%
	Rubicon-Sayner complex, 6 to 15% slopes	475C	Rubicon, Sayner	Dry Nutrient-Poor Sand	90%
	Sayner-Lindquist complex, 0 to 6% slopes	9012B	Sayner	Dry Nutrient-Poor Sand	60%
	Sayner-Lindquist complex, 6 to 15% slopes	9012C	Sayner	Dry Nutrient-Poor Sand	60%
	Sayner-Lindquist complex, 15 to 30% slopes	9012D	Sayner	Dry Nutrient-Poor Sand	60%
	Sayner-Pence-Vilas complex, 0 to 6% slopes	974B	Sayner, Vilas	Dry Nutrient-Poor Sand	60%
	Sayner-Pence-Vilas complex, 6 to 15% slopes	974C	Sayner, Vilas	Dry Nutrient-Poor Sand	60%
	Sayner-Pence-Vilas complex, 15 to 30% slopes	974D	Sayner, Vilas	Dry Nutrient-Poor Sand	65%
	Vilas loamy sand, 0 to 6% slopes	74B	Vilas	Dry Nutrient-Poor Sand	90%
	Vilas loamy sand, 6 to 15% slopes	74C	Vilas	Dry Nutrient-Poor Sand	95%
	Vilas-Lindquist complex, 0 to 6% slopes	594B	Vilas	Dry Nutrient-Poor Sand	50%
	Vilas-Lindquist complex, 6 to 15% slopes	594C	Vilas	Dry Nutrient-Poor Sand	50%
	Vilas-Lindquist complex, 15 to 30% slopes	594D	Vilas	Dry Nutrient-Poor Sand	50%

County	Map unit name	Map unit symbol	Limited component(s)	Reason for limitation	Percent of map unit
Barron	Beseman peat, 0 to 1% slopes	Be	Beseman	Dysic Histosol	100%
	Greenwood peat, 0 to 1% slopes	Gr	Greenwood	Dysic Histosol	100%
	Haugen-Greenwood complex, 0 to 15% slopes	HgC	Greenwood	Dysic Histosol	30%
	Hayriver-Twinmound complex, 20 to 50% slopes	HzF	Twinmound	Dry Nutrient-Poor Sand	40%
	Menahga loamy sand, 0 to 2% slopes	MnA	Menahga	Dry Nutrient-Poor Sand	100%
	Menahga loamy sand, 2 to 6% slopes	MnB	Menahga	Dry Nutrient-Poor Sand	100%
	Menahga loamy sand, 6 to 12% slopes	MnC	Menahga	Dry Nutrient-Poor Sand	100%
	Menahga loamy sand, 12 to 25% slopes	MnD	Menahga	Dry Nutrient-Poor Sand	100%
Bayfield	Deerton-Brownstone complex, 0 to 6% slopes	3608B	Deerton, Brownstone	Dry Nutrient-Poor Sand	90%
	Deerton-Brownstone complex, 6 to 15% slopes	3608C	Deerton, Brownstone	Dry Nutrient-Poor Sand	90%
	Haplosaprists, Peats and Mucks, 0 to 1% slopes	9155A	Loxley, Beseman	Dysic Histosol	40%
	Keweenaw, stony-Rubicon complex, 0 to 6% slopes	874B	Rubicon	Dry Nutrient-Poor Sand	30%
	Keweenaw, stony-Rubicon complex, 6 to 15% slopes	874C	Rubicon	Dry Nutrient-Poor Sand	30%
	Keweenaw, stony-Rubicon complex, 15 to 30% slopes	874D	Rubicon	Dry Nutrient-Poor Sand	30%
	Keweenaw, stony-Rubicon complex, 20 to 45% slopes	874E	Rubicon	Dry Nutrient-Poor Sand	30%
	Keweenaw, stony-Vilas-Cathro complex, 0 to 15% slopes	884C	Vilas	Dry Nutrient-Poor Sand	30%
	Keweenaw, stony-Vilas-Cathro complex, 0 to 55% slopes	884E	Vilas	Dry Nutrient-Poor Sand	30%
	Keweenaw-Sayner-Vilas complex, 2 to 6% slopes	69B	Sayner, Vilas	Dry Nutrient-Poor Sand	50%
	Keweenaw-Sayner-Vilas complex, 6 to 15% slopes	69C	Sayner, Vilas	Dry Nutrient-Poor Sand	50%
	Keweenaw-Sayner-Vilas complex, 15 to 45% slopes	69E	Sayner, Vilas	Dry Nutrient-Poor Sand	50%
	Loxley mucky peat, 0 to 1% slopes	406A	Loxley	Dysic Histosol	90%
	Loxley, Beseman, and Dawson soils, 0 to 1% slopes	3403A	Loxley, Beseman, Dawson	Dysic Histosol	98%
	Pelissier gravelly sandy loam, 15 to 45% slopes	571E	Pelissier	Dry Nutrient-Poor Sand	80%
	Redrim very cobbly sand, 0 to 6% slopes, very stony	603B	Redrim	Dry Nutrient-Poor Sand, Shallow Bedrock	85%

County	Map unit name	Map unit symbol	Limited component(s)	Reason for limitation	Percent of map unit
Bayfield	Rock outcrop-Frogcreek-Metonga complex, 2 to 45% slopes, very stony	524E	Rock Outcrop	Shallow Bedrock	30%
	Rousseau loamy fine sand, 0 to 6% slopes	339B	Rousseau	Dry Nutrient-Poor Sand	85%
	Rousseau loamy fine sand, 6 to 15% slopes	339C	Rousseau	Dry Nutrient-Poor Sand	90%
	Rousseau loamy fine sand, 15 to 30% slopes	339D	Rousseau	Dry Nutrient-Poor Sand	90%
	Rubicon sand, 0 to 6% slopes	174B	Rubicon	Dry Nutrient-Poor Sand	85%
	Rubicon sand, 6 to 15% slopes	174C	Rubicon	Dry Nutrient-Poor Sand	90%
	Rubicon sand, 15 to 30% slopes	174D	Rubicon	Dry Nutrient-Poor Sand	90%
	Rubicon sand, 30%to 60% slopes	174F	Rubicon	Dry Nutrient-Poor Sand	90%
	Rubicon sand, eskers, 20 to 45% slopes	9064E	Rubicon	Dry Nutrient-Poor Sand	90%
	Rubicon-Sayner complex, 0 to 6% slopes	475B	Rubicon, Sayner	Dry Nutrient-Poor Sand	85%
	Rubicon-Sayner complex, 6 to 15% slopes	475C	Rubicon, Sayner	Dry Nutrient-Poor Sand	90%
	Rubicon-Sayner complex, 15 to 30% slopes	475D	Rubicon, Sayner	Dry Nutrient-Poor Sand	90%
	Sayner loamy sand, 0 to 6% slopes	574B	Sayner	Dry Nutrient-Poor Sand	85%
	Sayner loamy sand, 6 to 15% slopes	574C	Sayner	Dry Nutrient-Poor Sand	90%
	Sayner loamy sand, 15 to 45% slopes	574E	Sayner	Dry Nutrient-Poor Sand	90%
	Sayner-Lindquist complex, 0 to 6% slopes	9012B	Sayner	Dry Nutrient-Poor Sand	60%
	Sayner-Lindquist complex, 6 to 15% slopes	9012C	Sayner	Dry Nutrient-Poor Sand	60%
	Sayner-Lindquist complex, 15 to 30% slopes	9012D	Sayner	Dry Nutrient-Poor Sand	60%
	Sayner-Pence-Vilas complex, 0 to 6% slopes	974B	Sayner, Vilas	Dry Nutrient-Poor Sand	60%
	Sayner-Pence-Vilas complex, 6 to 15% slopes	974C	Sayner, Vilas	Dry Nutrient-Poor Sand	60%
	Sayner-Pence-Vilas complex, 15 to 30% slopes	974D	Sayner, Vilas	Dry Nutrient-Poor Sand	65%
	Vilas loamy sand, 0 to 6% slopes	74B	Vilas	Dry Nutrient-Poor Sand	90%
	Vilas loamy sand, 6 to 15% slopes	74C	Vilas	Dry Nutrient-Poor Sand	95%
	Vilas loamy sand, 15 to 30% slopes	74D	Vilas	Dry Nutrient-Poor Sand	95%
	Vilas loamy sand, 20 to 45% slopes	74E	Vilas	Dry Nutrient-Poor Sand	95%

County	Map unit name	Map unit symbol	Limited component(s)	Reason for limitation	Percent of map unit
Bayfield	Vilas-Lindquist complex, 6 to 15% slopes	594C	Vilas	Dry Nutrient-Poor Sand	50%
	Vilas-Lindquist complex, 15 to 30% slopes	594D	Vilas	Dry Nutrient-Poor Sand	50%
Brown	Namur silt loam, 1 to 6% slopes	NaB	Namur	Shallow Bedrock	100%
	Namur silt loam, 6 to 20% slopes	NaD	Namur	Shallow Bedrock	100%
	Namur silt loam, wet variant	Ne	Namur variant	Shallow Bedrock	100%
	Ruse silt loam	Ru	Ruse	Shallow Bedrock	100%
	Shawano fine sand, hilly	SeD	Shawano	Dry Nutrient-Poor Sand	100%
	Shawano fine sand, rolling	SeC	Shawano	Dry Nutrient-Poor Sand	100%
	Shawano loamy fine sand, 2 to 6% slopes	SfB	Shawano	Dry Nutrient-Poor Sand	100%
	Shawano loamy fine sand, 6 to 12% slopes	SfC	Shawano	Dry Nutrient-Poor Sand	100%
	Summerville loam, 1 to 6% slopes	SuB	Summerville	Shallow Bedrock	100%
	Summerville loam, 6 to 20% slopes, eroded	SuD2	Summerville	Shallow Bedrock	100%
	Summerville silt loam, clayey subsoil variant, 1 to 6% slopes	SvB	Summerville variant	Shallow Bedrock	100%
Buffalo	Boone fine sand, 2 to 6% slopes, eroded	BoB2	Boone	Dry Nutrient-Poor Sand	100%
	Boone fine sand, 6 to 12% slopes, eroded	BoC2	Boone	Dry Nutrient-Poor Sand	100%
	Boone fine sand, 12 to 40% slopes, eroded	BoD2	Boone	Dry Nutrient-Poor Sand	100%
	Plainfield loamy fine sand, 0 to 2% slopes	PfA	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy fine sand, 2 to 6% slopes	PfB	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy fine sand, 2 to 6% slopes, eroded	PfB2	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy fine sand, 6 to 12% slopes, eroded	PfC2	Plainfield	Dry Nutrient-Poor Sand	100%
	Sparta and Plainfield fine sands and dune land	Ss	Plainfield	Dry Nutrient-Poor Sand	30%
	Terrace escarpments, sandy	Tn	Terrace Escarpments	Dry Nutrient-Poor Sand	100%
Burnett	Amery, very stony-Greenwood complex, 0 to 35% slopes	443D	Greenwood	Dysic Histosol	30%
	Dairyland-Emmert complex, 0 to 6% slopes, very stony	471B	Emmert	Dry Nutrient-Poor Sand	30%
	Drylanding-Beartree complex, 0 to 12% slopes, rocky	634C	Drylanding, Beartree, Rock Outcrop	Shallow Bedrock	100%

County	Map unit name	Map unit symbol	Limited component(s)	Reason for limitation	Percent of map unit
Burnett	Drylanding-Beartree complex, 0 to 12% slopes, rocky, rarely flooded	635C	Drylanding, Beartree, Rock Outcrop	Shallow Bedrock	100%
	Emmert-Mahtomedi-Menahga complex, 2 to 6% slopes	426B	Emmert	Dry Nutrient-Poor Sand	50%
	Emmert-Mahtomedi-Menahga complex, 6 to 12% slopes	426C	Emmert	Dry Nutrient-Poor Sand	50%
	Emmert-Mahtomedi-Menahga complex, 12 to 30% slopes	426D	Emmert	Dry Nutrient-Poor Sand	50%
	Grayling sand, 0 to 6% slopes	399B	Grayling	Dry Nutrient-Poor Sand	97%
	Grayling sand, 6 to 12% slopes	399C	Grayling	Dry Nutrient-Poor Sand	98%
	Grayling sand, 12 to 30% slopes	399D	Grayling	Dry Nutrient-Poor Sand	98%
	Greenwood and Beseman soils, 0 to 1% s	484A	Greenwood, Beseman	Dysic Histosol	90%
	Haustrup-Lundeen-Rock outcrop complex, 12 to 65%, very stony	720F	Haustrup, Rock Outcrop	Shallow Bedrock	80%
	Keweenaw-Sayner-Vilas complex, 6 to 15% slopes	69C	Sayner, Vilas	Dry Nutrient-Poor Sand	50%
	Keweenaw-Sayner-Vilas complex, 15 to 45% slopes	69E	Sayner, Vilas	Dry Nutrient-Poor Sand	50%
	Loxley mucky peat, 0 to 1% slopes	406A	Loxley	Dysic Histosol	90%
	Loxley, Beseman, and Dawson soils, 0 to 1% slopes	3403A	Loxley, Beseman, Dawson	Dysic Histosol	98%
	Loxley, Daisybay, and Dawson soils, 0 to 1% slopes	459A	Loxley, Dawson	Dysic Histosol	75%
	Lundeen-Haustrup-Rock outcrop complex, 2 to 12% slopes, very stony	620C	Haustrup, Rock Outcrop	Shallow Bedrock	55%
	Plainbo sand, 2 to 6% slopes	3636B	Plainbo	Dry Nutrient-Poor Sand	95%
	Plainbo sand, 6 to 12% slopes	3636C	Plainbo	Dry Nutrient-Poor Sand	95%
	Shawano fine sand, 0 to 6% slopes	557B	Shawano	Dry Nutrient-Poor Sand	95%
	Shawano fine sand, 6 to 12% slopes	557C	Shawano	Dry Nutrient-Poor Sand	95%
	Shawano fine sand, 12 to 30% slopes	557D	Shawano	Dry Nutrient-Poor Sand	95%
Calumet	Channahon loam, 2 to 6% slopes	CnB	Channahon	Shallow Bedrock	100%
	Channahon loam, 6 to 12% slopes	CnC	Channahon	Shallow Bedrock	100%
	Plainfield loamy sand, 2 to 6% slopes	PlB	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy sand, 6 to 12% slopes	PlC	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy sand, 12 to 20% slopes	PlD	Plainfield	Dry Nutrient-Poor Sand	100%

County	Map unit name	Map unit symbol	Limited component(s)	Reason for limitation	Percent of map unit
Chippewa	Beseman muck, 0 to 1% slopes	Be	Beseman	Dysic Histosol	100%
	Boone fine sand, 20 to 45% slopes	BoE	Boone	Dry Nutrient-Poor Sand	100%
	Greenwood peat, 0 to 1% slopes	Gr	Greenwood	Dysic Histosol	100%
	Menahga loamy sand, 0 to 6% slopes	MkB	Menahga	Dry Nutrient-Poor Sand	100%
	Menahga loamy sand, 6 to 12% slopes	MkC	Menahga	Dry Nutrient-Poor Sand	100%
Clark	Boone sand, 6 to 15% slopes	BoC	Boone	Dry Nutrient-Poor Sand	100%
	Boone sand, 15 to 50% slopes	BoF	Boone	Dry Nutrient-Poor Sand	100%
	Boone-Elevasil complex, 15 to 50% slopes	BpF	Boone	Dry Nutrient-Poor Sand	55%
	Citypoint mucky peat, 0 to 1% slopes	Cd	Citypoint	Dysic Histosol	100%
	Dawsil mucky peat, 0 to 1% slopes	Da	Dawsil	Dysic Histosol	100%
	Loxley peat, 0 to 1% slopes	Lk	Loxley	Dysic Histosol	100%
	Loxley, Beseman, and Dawson peats 0 to 1% slopes	Lm	Loxley, Beseman, Dawson	Dysic Histosol	100%
	Menahga loamy sand, 0 to 6% slopes	MgB	Menahga	Dry Nutrient-Poor Sand	100%
	Ponycreek-Dawsil complex, 0 to 2% slopes	Pv	Dawsil	Dysic Histosol	45%
	Simescreek sand, 0 to 3% slopes	ScA	Simescreek	Dry Nutrient-Poor Sand	100%
	Tarr sand, 0 to 6% slopes	TrB	Tarr	Dry Nutrient-Poor Sand	100%
Columbia	Boone loamy fine sand, 6 to 12% slopes	BnC	Boone	Dry Nutrient-Poor Sand	100%
	Boone loamy fine sand, 12 to 45% slope	BnE	Boone	Dry Nutrient-Poor Sand	100%
	Northfield sandy loam, 2 to 6% slopes	NoB	Northfield	Shallow Bedrock	100%
	Northfield sandy loam, 6 to 12% slopes	NoC	Northfield	Shallow Bedrock	100%
	Northfield sandy loam, 12 to 30% slopes	NoE	Northfield	Shallow Bedrock	100%
	Plainfield loamy fine sand, loamy substratum, 2 to 6% slopes	PkB	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy fine sand, loamy substratum, 6 to 12% slopes	PkC	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy fine sand, loamy substratum, 12 to 20% slopes	PkD	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield sand, 2 to 12% slopes, eroded	PeC2	Plainfield	Dry Nutrient-Poor Sand	100%

County	Map unit name	Map unit symbol	Limited component(s)	Reason for limitation	Percent of map unit
Columbia	Rock land	Rk	Rock Land	Shallow Bedrock	100%
Crawford	Boone fine sand, 12 to 30% slopes	201E	Boone	Dry Nutrient-Poor Sand	95%
	Boone sand, 15 to 30% slopes	233E	Boone	Dry Nutrient-Poor Sand	95%
	Boone-Elevasil complex, 15 to 50% slopes	1224F	Boone	Dry Nutrient-Poor Sand	60%
	Elizabeth flaggy silt loam, 12 to 20% slopes	164D	Elizabeth	Shallow Bedrock	90%
	Elizabeth flaggy silt loam, 20 to 30% slopes	164E	Elizabeth	Shallow Bedrock	90%
	Gaphill-Rockbluff complex, 30 to 60% slopes	1145E	Rockbluff	Dry Nutrient-Poor Sand	35%
	Lacrescent-Dunbarton complex, very stony, 30 to 60% slopes	1130F	Dunbarton	Shallow Bedrock	30%
	Plainfield sand, 6 to 15% sopes	511C	Plainfield	Dry Nutrient-Poor Sand	98%
	Plainfield sand, 15 to 60% slopes	511F	Plainfield	Dry Nutrient-Poor Sand	97%
	Tarr sand, 15 to 60% slopes	561F	Tarr	Dry Nutrient-Poor Sand	90%
Dane	Dunbarton silt loam, 2 to 6% slopes, eroded	DuB2	Dunbarton	Shallow Bedrock	100%
	Dunbarton silt loam, 6 to 12% slopes, eroded	DuC2	Dunbarton	Shallow Bedrock	100%
	Dunbarton silt loam, 12 to 20% slopes, eroded	DuD2	Dunbarton	Shallow Bedrock	100%
	Dunbarton silt loam, 20 to 30% slopes, eroded	DuE2	Dunbarton	Shallow Bedrock	100%
	Edmund silt loam, 2 to 6% slopes, eroded	EdB2	Edmund	Shallow Bedrock	100%
	Edmund silt loam, 6 to 12% slopes, eroded	EdC2	Edmund	Shallow Bedrock	100%
	Edmund silt loam, 12 to 20% slopes, eroded	EdD2	Edmund	Shallow Bedrock	100%
	Plainfield sand, 1 to 6% slopes	PfB	Plainfield	Dry Nutrient-Poor Sand	100%
	Sogn silt loam, 2 to 20% slopes	SoD	Sogn	Shallow Bedrock	100%
	Sogn silt loam, 20 to 35% slopes	SoE	Sogn	Shallow Bedrock	100%
	Spinks and Plainfield loamy sands, 2 to 6% slopes	SpB	Plainfield	Dry Nutrient-Poor Sand	50%
	Spinks and Plainfield loamy sands, 6 to 12% slopes	SpC	Plainfield	Dry Nutrient-Poor Sand	50%
	Spinks and Plainfield loamy sands, 12 to 25% slopes	SpD	Plainfield	Dry Nutrient-Poor Sand	50%
Dodge	Channahon silt loam, 1 to 6% slopes	CdB	Channahon	Shallow Bedrock	90%
	Rock outcrop-Channahon complex, 5 to 30% slopes	RcE	Rock Outcrop, Channahon	Shallow Bedrock	95%

County	Map unit name	Map unit symbol	Limited component(s)	Reason for limitation	Percent of map unit
Door	Bonduel variant fine sandy loam, shallow	Bo	Bonduel variant	Shallow Bedrock	90%
	Kolberg variant loam, 1 to 6% slopes	KvB	Kolberg variant	Shallow Bedrock	100%
	Kolberg variant loam, 6 to 12% slopes, eroded	KvC2	Kolberg variant	Shallow Bedrock	100%
	Namur loam, 0 to 6% slopes	NaB	Namur	Shallow Bedrock	100%
	Namur loam, 6 to 12% slopes	NaC	Namur	Shallow Bedrock	100%
	Namur variant loam	Nv	Namur variant	Shallow Bedrock	100%
	Rock outcrop	Ra	Rock Outcrop	Shallow Bedrock	100%
	Rock outcrop-Namur complex, 6 to 20% slopes	Rb	Rock Outcrop, Namur	Shallow Bedrock	100%
	Rousseau fine sand, 2 to 6% slopes	RoB	Rousseau	Dry Nutrient-Poor Sand	100%
	Rousseau fine sand, 6 to 12% slopes	RoC	Rousseau	Dry Nutrient-Poor Sand	100%
	Rousseau-Deford fine sands, 2 to 6% slopes	RrB	Rousseau	Dry Nutrient-Poor Sand	40%
	Rousseau-Shawano fine sands, 2 to 12% slopes	RpC	Rousseau, Shawano	Dry Nutrient-Poor Sand	100%
	Rousseau-Shawano fine sands, 12 to 35% slopes	RpD	Rousseau, Shawano	Dry Nutrient-Poor Sand	100%
	Summerville loam, 0 to 2% slopes	SvA	Summerville	Shallow Bedrock	100%
	Summerville loam, 2 to 6% slopes	SvB	Summerville	Shallow Bedrock	100%
	Summerville loam, 6 to 12% slopes	SvC	Summerville	Shallow Bedrock	100%
	Summerville loam, 12 to 20% slopes	SvD	Summerville	Shallow Bedrock	100%
Douglas	Amnicon-Rock outcrop complex, 2 to 15% slopes	604C	Rock Outcrop	Shallow Bedrock	35%
	Dairyland-Emmert complex, 0 to 6% slopes, very stony	471B	Emmert	Dry Nutrient-Poor Sand	30%
	Drylanding-Beartree complex, 0 to 12% slopes, rocky	634C	Drylanding, Beartree	Shallow Bedrock	95%
	Drylanding-Beartree complex, 0 to 12% slopes, rocky, rarely flooded	635C	Drylanding, Beartree	Shallow Bedrock	95%
	Emmert-Mahtomedi-Menahga complex, 2 to 6% slopes	426B	Emmert	Dry Nutrient-Poor Sand	50%
	Emmert-Mahtomedi-Menahga complex, 6 to 12% slopes	426C	Emmert	Dry Nutrient-Poor Sand	50%
	Emmert-Mahtomedi-Menahga complex, 12 to 30% slopes	426D	Emmert	Dry Nutrient-Poor Sand	50%
	Grayling sand, 0 to 6% slopes	399B	Grayling	Dry Nutrient-Poor Sand	97%
	Grayling sand, 6 to 12% slopes	399C	Grayling	Dry Nutrient-Poor Sand	98%

County	Map unit name	Map unit symbol	Limited component(s)	Reason for limitation	Percent of map unit
Douglas	Grayling sand, 12 to 30% slopes	399D	Grayling	Dry Nutrient-Poor Sand	98%
	Ishpeming-Rock outcrop complex, 5 to 20% slopes, very stony	3601C	Rock Outcrop	Shallow Bedrock	30%
	Keweenaw, stony-Rubicon complex, 0 to 6% slopes	874B	Rubicon	Dry Nutrient-Poor Sand	30%
	Keweenaw, stony-Rubicon complex, 6 to 15% slopes	874C	Rubicon	Dry Nutrient-Poor Sand	30%
	Keweenaw, stony-Rubicon complex, 15 to 30% slopes	874D	Rubicon	Dry Nutrient-Poor Sand	30%
	Keweenaw, stony-Vilas-Cathro complex, 0 to 15% slopes	884C	Vilas	Dry Nutrient-Poor Sand	30%
	Keweenaw, stony-Vilas-Cathro complex, 0 to 55% slopes	884E	Vilas	Dry Nutrient-Poor Sand	30%
	Keweenaw-Sayner-Vilas complex, 2 to 6% slopes, stony	69B	Sayner, Vilas	Dry Nutrient-Poor Sand	50%
	Keweenaw-Sayner-Vilas complex, 6 to 15% slopes, stony	69C	Sayner, Vilas	Dry Nutrient-Poor Sand	50%
	Keweenaw-Sayner-Vilas complex, 15 to 45% slopes, stony	69E	Sayner, Vilas	Dry Nutrient-Poor Sand	50%
	Loxley mucky peat, 0 to 1% slopes	406A	Loxley	Dysic Histosol	90%
	Loxley, Beseman, and Dawson soils, 0 to 1% slopes	3403A	Loxley, Beseman, Dawson	Dysic Histosol	98%
	Rock outcrop-Frogcreek-Metonga complex, 2 to 45% slopes, very stony	524E	Rock Outcrop	Shallow Bedrock	30%
	Rousseau loamy fine sand, 0 to 6% slopes	339B	Rousseau	Dry Nutrient-Poor Sand	85%
	Rousseau loamy fine sand, 6 to 15% slopes	339C	Rousseau	Dry Nutrient-Poor Sand	90%
	Rousseau loamy fine sand, 15 to 30% slopes	339D	Rousseau	Dry Nutrient-Poor Sand	90%
	Rubicon sand, 0 to 6% slopes	174B	Rubicon	Dry Nutrient-Poor Sand	85%
	Rubicon sand, 6 to 15% slopes	174C	Rubicon	Dry Nutrient-Poor Sand	90%
	Rubicon sand, 15 to 30% slopes	174D	Rubicon	Dry Nutrient-Poor Sand	90%
	Rubicon sand, 30%to 60% slopes	174F	Rubicon	Dry Nutrient-Poor Sand	90%
	Rubicon-Sayner complex, 0 to 6% slopes	475B	Rubicon, Sayner	Dry Nutrient-Poor Sand	85%
	Rubicon-Sayner complex, 6 to 15% slopes	475C	Rubicon, Sayner	Dry Nutrient-Poor Sand	90%
	Rubicon-Sayner complex, 15 to 30% slopes	475D	Rubicon, Sayner	Dry Nutrient-Poor Sand	90%
	Sayner loamy sand, 0 to 6% slopes	574B	Sayner	Dry Nutrient-Poor Sand	85%
	Sayner loamy sand, 6 to 15% slopes	574C	Sayner	Dry Nutrient-Poor Sand	90%

County	Map unit name	Map unit symbol	Limited component(s)	Reason for limitation	Percent of map unit
Douglas	Sayner loamy sand, 15 to 45% slopes	574E	Sayner	Dry Nutrient-Poor Sand	90%
	Vilas loamy sand, 0 to 6% slopes	74B	Vilas	Dry Nutrient-Poor Sand	90%
	Vilas loamy sand, 6 to 15% slopes	74C	Vilas	Dry Nutrient-Poor Sand	95%
	Vilas loamy sand, 15 to 30% slopes	74D	Vilas	Dry Nutrient-Poor Sand	95%
Dunn	Boone sand, 6 to 15% slopes	233C	Boone	Dry Nutrient-Poor Sand	95%
	Boone-Elevasil complex, 15 to 50% slopes	1224F	Boone	Dry Nutrient-Poor Sand	60%
	Boone-Tarr sands, 15 to 50% slopes	1233F	Boone, Tarr	Dry Nutrient-Poor Sand	85%
	Boplain sand, 0 to 6% slopes	510B	Boplain	Dry Nutrient-Poor Sand	90%
	Boplain sand, 6 to 15% slopes	510C	Boplain	Dry Nutrient-Poor Sand	90%
	Gaphill-Rockbluff complex, 30%to 60% slopes	1145F	Rockbluff	Dry Nutrient-Poor Sand	35%
	Hayriver-Twinmound complex, 15 to 50% slopes	1275F	Twinmound	Dry Nutrient-Poor Sand	35%
	Menahga sand, valley train, 0 to 6% slopes	101B	Menahga	Dry Nutrient-Poor Sand	90%
	Menahga sand, valley train, 6 to 12% slopes	101C	Menahga	Dry Nutrient-Poor Sand	95%
	Menahga sand, valley train, 12 to 30% slopes	101E	Menahga	Dry Nutrient-Poor Sand	90%
	Plainfield sand, 0 to 3% slopes	511A	Plainfield	Dry Nutrient-Poor Sand	95%
	Plainfield sand, 2 to 6% slopes	511B	Plainfield	Dry Nutrient-Poor Sand	95%
	Plainfield sand, 6 to 15% slopes	511C	Plainfield	Dry Nutrient-Poor Sand	98%
	Plainfield sand, 15 to 60% slopes	511F	Plainfield	Dry Nutrient-Poor Sand	97%
	Tarr sand, 1 to 6% slopes	561B	Tarr	Dry Nutrient-Poor Sand	97%
	Twinmound fine sand, 6 to 15% slopes	282C	Twinmound	Dry Nutrient-Poor Sand	90%
	Twinmound fine sand, 15 to 50% slopes	282F	Twinmound	Dry Nutrient-Poor Sand	95%
Eau Claire	Boone-Plainbo complex, 2 to 6% slopes	BoB	Boone	Dry Nutrient-Poor Sand	60%
	Boone-Plainbo complex, 6 to 12% slopes	BoC	Boone	Dry Nutrient-Poor Sand	60%
	Boone-Plainbo complex, 12 to 45% slopes	BoE	Boone	Dry Nutrient-Poor Sand	60%
	Menahga sand, 1 to 6% slopes	MdB	Menahga	Dry Nutrient-Poor Sand	100%
	Menahga sand, 6 to 12% slopes	MdC	Menahga	Dry Nutrient-Poor Sand	100%
	Plainfield loamy sand, 1 to 6% slopes	PfB	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy sand, 6 to 12% slopes, eroded	PfC2	Plainfield	Dry Nutrient-Poor Sand	100%

County	Map unit name	Map unit symbol	Limited component(s)	Reason for limitation	Percent of map unit
Eau Claire	Plainfield loamy sand, loamy substratum, 1 to 6% slopes	PlB	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy sand, loamy substratum, 6 to 12% slopes, eroded	PlC2	Plainfield	Dry Nutrient-Poor Sand	100%
	Terrace escarpments, sandy	Tn	Udipsamments	Dry Nutrient-Poor Sand	100%
	Vilas sand, 1 to 6% slopes	VlB	Vilas	Dry Nutrient-Poor Sand	100%
Florence	Loxley, Beseman, and Dawson peats, 0 to 1% slopes	Lo	Loxley, Beseman, Dawson	Dysic Histosol	100%
	Pence-Vilas complex, 0 to 6% slopes	PsB	Vilas	Dry Nutrient-Poor Sand	35%
	Pence-Vilas complex, 6 to 15% slopes	PsC	Vilas	Dry Nutrient-Poor Sand	40%
	Pence-Vilas complex, 15 to 35% slopes	PsD	Vilas	Dry Nutrient-Poor Sand	45%
	Rock outcrop-Ishpeming-Vilas complex, 1 to 15% slopes	RkC	Rock Outcrop, Vilas	Shallow Bedrock, Dry Nutrient-Poor Sand	65%
	Rock outcrop-Ishpeming-Vilas complex, 15 to 35% slopes	RkD	Rock Outcrop, Vilas	Shallow Bedrock, Dry Nutrient-Poor Sand	65%
	Rock outcrop-Metonga-Sarona complex, 1 to 15% slopes	RmC	Rock Outcrop	Shallow Bedrock	45%
	Rock outcrop-Metonga-Sarona complex, 15 to 35% slopes	RmD	Rock Outcrop	Shallow Bedrock	45%
	Sarona-Vilas complex, 0 to 6% slopes, very stony	SlB	Vilas	Dry Nutrient-Poor Sand	30%
	Sarona-Vilas complex, 6 to 15% slopes, very stony	SlC	Vilas	Dry Nutrient-Poor Sand	35%
	Sarona-Vilas complex, 15 to 30% slopes, very stony	SlD	Vilas	Dry Nutrient-Poor Sand	40%
	Sayner loamy sand, 0 to 6% slopes	SnB	Sayner	Dry Nutrient-Poor Sand	100%
	Sayner loamy sand, 6 to 15% slopes	SnC	Sayner	Dry Nutrient-Poor Sand	100%
	Sayner loamy sand, 15 to 30% slopes	SnD	Sayner	Dry Nutrient-Poor Sand	100%
	Vilas loamy sand, 0 to 6% slopes	VsB	Vilas	Dry Nutrient-Poor Sand	100%
	Vilas loamy sand, 6 to 15% slopes	VsC	Vilas	Dry Nutrient-Poor Sand	100%
	Vilas loamy sand, 15 to 30% slopes	VsD	Vilas	Dry Nutrient-Poor Sand	100%
Fond du Lac	Rock land	Rm	Rock Land	Shallow Bedrock	100%
	Sogn stony silt loam, 0 to 6% slopes	SwB	Sogn	Shallow Bedrock	100%

County	Map unit name	Map unit symbol	Limited component(s)	Reason for limitation	Percent of map unit
Forest	Loxley, Beseman, and Dawson peats, 0 to 1% slopes	Lo	Loxley, Beseman, Dawson	Dysic Histosol	100%
	Pelissier gravelly sandy loam, 20 to 45% slopes, stony	PkE	Pelissier	Dry Nutrient-Poor Sand	100%
	Pence-Vilas complex, 0 to 6% slopes	PsB	Vilas	Dry Nutrient-Poor Sand	35%
	Pence-Vilas complex, 6 to 15% slopes	PsC	Vilas	Dry Nutrient-Poor Sand	35%
	Pence-Vilas complex, 15 to 35% slopes	PsD	Vilas	Dry Nutrient-Poor Sand	35%
	Rubicon loamy sand, 15 to 35% slopes	RuD	Rubicon	Dry Nutrient-Poor Sand	100%
	Vilas loamy sand, 0 to 6% slopes	VsB	Vilas	Dry Nutrient-Poor Sand	100%
	Vilas loamy sand, 6 to 15% slopes	VsC	Vilas	Dry Nutrient-Poor Sand	100%
Grant	Dubuque stony silt loam, 10 to 15% slopes, moderately eroded	DyD2	Dubuque	Shallow Bedrock	100%
	Dubuque stony silt loam, 15 to 20% slopes, moderately eroded	DyE2	Dubuque	Shallow Bedrock	100%
	Dubuque stony silt loam, 20 to 30% slopes, moderately eroded	DyF2	Dubuque	Shallow Bedrock	100%
	Dubuque stony silt loam, 30%to 45% slopes	DyG	Dubuque	Shallow Bedrock	100%
	Sogn loam, 10 to 15% slopes, moderately eroded	SnD2	Sogn	Shallow Bedrock	100%
	Sogn loam, 15 to 20% slopes, moderately eroded	SnE2	Sogn	Shallow Bedrock	100%
	Sogn silt loam, 10 to 15% slopes, moderately eroded	SoD2	Sogn	Shallow Bedrock	100%
	Sogn silt loam, 15 to 20% slopes, moderately eroded	SoE2	Sogn	Shallow Bedrock	100%
	Sogn silt loam, 2 to 10% slopes, moderately eroded	SoB2	Sogn	Shallow Bedrock	100%
Green	Boone fine sand, 2 to 20% slopes	BoD	Boone	Dry Nutrient-Poor Sand	100%
	Dunbarton silt loam, 2 to 6% slopes, moderately eroded	DuB2	Dunbarton	Shallow Bedrock	100%
	Dunbarton silt loam, 6 to 12% slopes, moderately eroded	DuC2	Dunbarton	Shallow Bedrock	100%
	Dunbarton silt loam, 12 to 20% slopes, moderately eroded	DuD2	Dunbarton	Shallow Bedrock	100%
	Dunbarton silt loam, 20 to 30% slopes, moderately eroded	DuE2	Dunbarton	Shallow Bedrock	100%
	Dunbarton silty clay loam, 10 to 20% slopes, moderately eroded	DvD2	Dunbarton	Shallow Bedrock	100%
	Edmund silt loam, 2 to 6% slopes, eroded	EdB2	Edmund	Shallow Bedrock	100%

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Green	Edmund silt loam, 6 to 12% slopes, moderately eroded	EdC2	Edmund	Shallow Bedrock	100%
	Edmund silt loam, 12 to 20% slopes, moderately eroded	EdD2	Edmund	Shallow Bedrock	100%
	Mifflin loam, shallow solum variant, 6 to 12% slopes, moderately eroded	MoC2	Mifflin	Shallow Bedrock	100%
	Mifflin loam, shallow solum variant, 12 to 20% slopes, moderately eroded	MoD2	Mifflin	Shallow Bedrock	100%
	Plainfield loamy sand, 0 to 6% slopes, moderately eroded	PrB2	Plainfield	Dry Nutrient-Poor Sand	100%
	Sogn silt loam, 2 to 12% slopes, moderately eroded	SoC2	Sogn	Shallow Bedrock	100%
	Sogn silt loam, 12 to 30% slopes, moderately eroded	SoE2	Sogn	Shallow Bedrock	100%
Green Lake	Oakville fine sand, 1 to 6% slopes	OaB	Oakville	Dry Nutrient-Poor Sand	100%
	Oakville fine sand, 6 to 12% slopes	OaC	Oakville	Dry Nutrient-Poor Sand	100%
	Oakville fine sand, 12 to 35% slopes	OaD	Oakville	Dry Nutrient-Poor Sand	100%
	Ritchey silt loam, 2 to 6% slopes, eroded	RhB2	Ritchey	Shallow Bedrock	100%
	Ritchey silt loam, 6 to 12% slopes, eroded	RhC2	Ritchey	Shallow Bedrock	100%
	Ritchey silt loam, 12 to 20% slopes, eroded	RhD2	Ritchey	Shallow Bedrock	100%
	Rock land and Ritchey soils, 6 to 45% slopes	RkE	Rock Land, Ritchey	Shallow Bedrock	100%
	Rock outcrop	Ro	Rock Outcrop	Shallow Bedrock	100%
Iowa	Boone fine sand, 6 to 12% slopes, moderately eroded	BoC2	Boone	Dry Nutrient-Poor Sand	100%
	Boone fine sand, 12 to 30% slopes, moderately eroded	BoD2	Boone	Dry Nutrient-Poor Sand	100%
	Dodgeville silt loam, shallow, 2 to 6% slopes, moderately eroded	DlB2	Dodgeville	Shallow Bedrock	100%
	Dodgeville silt loam, shallow, 6 to 12% slopes, moderately eroded	DlC2	Dodgeville	Shallow Bedrock	100%
	Dodgeville silt loam, shallow, 12 to 20% slopes, moderately eroded	DlD2	Dodgeville	Shallow Bedrock	100%
	Dubuque stony silt loam, 2 to 6% slopes, moderately eroded	DyB2	Dubuque	Shallow Bedrock	100%
	Dubuque stony silt loam, 6 to 12% slopes, moderately eroded	DyC2	Dubuque	Shallow Bedrock	100%
	Dubuque stony silt loam, 12 to 20% slopes, moderately eroded	DyD2	Dubuque	Shallow Bedrock	100%

County	Map unit name	Map unit symbol	Limited component(s)	Reason for limitation	Percent of map unit
Iowa	Dubuque stony silt loam, 20 to 30% slopes, moderately eroded	DyE2	Dubuque	Shallow Bedrock	100%
	Plainfield and Sparta fine sands and dune land	Ps	Plainfield	Dry Nutrient-Poor Sand	40%
	Plainfield fine sand, 0 to 6% slopes, moderately eroded	PfB2	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy fine sand, 0 to 2% slopes	PgA	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy fine sand, 2 to 6% slopes	PgB	Plainfield	Dry Nutrient-Poor Sand	100%
	Sogn and Dodgeville silt loams, shallow, 2 to 6% slopes, moderately eroded	SoB2	Sogn, Dodgeville	Shallow Bedrock	100%
	Sogn and Dodgeville silt loams, shallow, 6 to 12% slopes, moderately eroded	SoC2	Sogn, Dodgeville	Shallow Bedrock	100%
	Sogn and Dodgeville silt loams, shallow, 12 to 20% slopes, moderately eroded	SoD2	Sogn, Dodgeville	Shallow Bedrock	100%
	Sogn and Dodgeville silt loams, shallow, 20 to 30% slopes, moderately eroded	SoE2	Sogn, Dodgeville	Shallow Bedrock	100%
Iron	Amasa-Karlin complex, esker, 2 to 18% slopes	5146C	Karlin	Dry Nutrient-Poor Sand	40%
	Amasa-Karlin complex, esker, 18 to 35% slopes	5146D	Karlin	Dry Nutrient-Poor Sand	38%
	Amasa-Karlin complex, esker, 35 to 55% slopes	5146E	Karlin	Dry Nutrient-Poor Sand	38%
	Dawson, Greenwood, and Loxley soils, 0 to 1% slopes	5140A	Dawson, Greenwood, Loxley	Dysic Histosol	95%
	Dishno-Gogebic-Peshekee-Rock outcrop complex,18 to 35% slopes, very stony	5369D	Peshekee, Rock Outcrop	Shallow Bedrock	30%
	Haplosaprists, Peats, and Mucks, 0 to 1% slopes	9155A	Loxley, Beseman	Dysic Histosol	40%
	Keweenaw, stony-Vilas-Cathro complex, 0 to 15% slopes	884C	Vilas	Dry Nutrient-Poor Sand	30%
	Keweenaw-Sayner-Vilas complex, 2 to 6% slopes, stony	69B	Sayner, Vilas	Dry Nutrient-Poor Sand	50%
	Keweenaw-Sayner-Vilas complex, 6 to 15% slopes, stony	69C	Sayner, Vilas	Dry Nutrient-Poor Sand	50%
	Keweenaw-Sayner-Vilas complex, 15 to 45% slopes, stony	69E	Sayner, Vilas	Dry Nutrient-Poor Sand	50%
	Loxley and Beseman soils, 0 to 1% slopes	414A	Loxley, Beseman	Dysic Histosol	85%
	Loxley and Dawson soils, 0 to 1% slopes	418A	Loxley, Dawson	Dysic Histosol	98%
	Loxley, Beseman, and Dawson soils, 0 to 1% slopes	3403A	Loxley, Beseman, Dawson	Dysic Histosol	98%

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Iron	Michigamme-Schweitzer-Peshekee-Rock outcrop complex, 35 to 55% slopes, very stony	5369E	Peshekee, Rock Outcrop	Shallow Bedrock	35%
	Michigamme-Schweitzer-Peshekee-Rock outcrop complex, 55 to 75% slopes, very stony	5369F	Peshekee, Rock Outcrop	Shallow Bedrock	35%
	Pelissier gravelly sandy loam, 2 to 6% slopes	571B	Pelissier	Dry Nutrient-Poor Sand	80%
	Pelissier gravelly sandy loam, 6 to 15% slopes	571C	Pelissier	Dry Nutrient-Poor Sand	80%
	Pelissier gravelly sandy loam, 15 to 45% slopes	571E	Pelissier	Dry Nutrient-Poor Sand	80%
	Rousseau loamy fine sand, 0 to 6% slopes	339B	Rousseau	Dry Nutrient-Poor Sand	85%
	Rousseau loamy fine sand, 6 to 15% slopes	339C	Rousseau	Dry Nutrient-Poor Sand	90%
	Rousseau loamy fine sand, 15 to 30% slopes	339D	Rousseau	Dry Nutrient-Poor Sand	90%
	Rubicon sand, 0 to 6% slopes	174B	Rubicon	Dry Nutrient-Poor Sand	85%
	Rubicon sand, 6 to 15% slopes	174C	Rubicon	Dry Nutrient-Poor Sand	90%
	Rubicon sand, 15 to 30% slopes	174D	Rubicon	Dry Nutrient-Poor Sand	90%
	Rubicon-Sayner complex, 0 to 6% slopes	475B	Rubicon, Sayner	Dry Nutrient-Poor Sand	85%
	Rubicon-Sayner complex, 6 to 15% slopes	475C	Rubicon, Sayner	Dry Nutrient-Poor Sand	90%
	Rubicon-Sayner complex, 15 to 30% slopes	475D	Rubicon, Sayner	Dry Nutrient-Poor Sand	90%
	Sayner loamy sand, 0 to 6% slopes	574B	Sayner	Dry Nutrient-Poor Sand	85%
	Sayner loamy sand, 6 to 15% slopes	574C	Sayner	Dry Nutrient-Poor Sand	90%
	Sayner loamy sand, 15 to 45% slopes	574E	Sayner	Dry Nutrient-Poor Sand	90%
	Sayner-Pence-Vilas complex, 0 to 6% slopes	974B	Sayner, Vilas	Dry Nutrient-Poor Sand	60%
	Sayner-Pence-Vilas complex, 6 to 15% slopes	974C	Sayner, Vilas	Dry Nutrient-Poor Sand	60%
	Sayner-Pence-Vilas complex, 15 to 30% slopes	974D	Sayner, Vilas	Dry Nutrient-Poor Sand	65%
	Vilas loamy sand, 0 to 6% slopes	74B	Vilas	Dry Nutrient-Poor Sand	90%
	Vilas loamy sand, 6 to 15% slopes	74C	Vilas	Dry Nutrient-Poor Sand	95%
	Vilas loamy sand, 15 to 30% slopes	74D	Vilas	Dry Nutrient-Poor Sand	95%
	Vilas-Lindquist complex, 0 to 6% slopes	594B	Vilas	Dry Nutrient-Poor Sand	50%
	Vilas-Lindquist complex, 6 to 15% slopes	594C	Vilas	Dry Nutrient-Poor Sand	50%
Iron	Vilas-Lindquist complex, 15 to 30% slopes	594D	Vilas	Dry Nutrient-Poor Sand	50%
Jackson	Boone sand, 6 to 15% slopes	233C	Boone	Dry Nutrient-Poor Sand	95%
	Boone-Elevasil complex, 15 to 50% slopes	1224F	Boone	Dry Nutrient-Poor Sand	60%
	Boone-Tarr sands, 15 to 50% slopes	1233F	Boone	Dry Nutrient-Poor Sand	85%
	Citypoint mucky peat, 0 to 1% slopes	99A	Citypoint	Dysic Histosol	90%
	Dawsil mucky peat, 0 to 1% slopes	25A	Dawsil	Dysic Histosol	90%
	Dawsil mucky peat, lake terrace, 0 to 1% slopes	17A	Dawsil	Dysic Histosol	90%
	Gosil loamy sand, 1 to 6% slopes	562B	Gosil	Dry Nutrient-Poor Sand	95%
	Gosil loamy sand, 6 to 12% slopes	562C	Gosil	Dry Nutrient-Poor Sand	95%
	Impact sand, 0 to 3% slopes	551A	Impact	Dry Nutrient-Poor Sand	88%
	Loxley peat, 0 to 1% slopes	15A	Loxley	Dysic Histosol	95%
	Loxley peat, lake terrace, 0 to 1% slopes	37A	Loxley	Dysic Histosol	90%
	Plainfield sand, 2 to 6% slopes	511B	Plainfield	Dry Nutrient-Poor Sand	90%
	Plainfield sand, 6 to 15% slopes	511C	Plainfield	Dry Nutrient-Poor Sand	98%
	Plainfield sand, 15 to 60% slopes	511F	Plainfield	Dry Nutrient-Poor Sand	97%
	Ponycreek-Dawsil complex, 0 to 2% slopes	1519A	Dawsil	Dysic Histosol	42%
	Ponycreek-Dawsil complex, lake terrace, 0 to 2% slopes	1599A	Dawsil	Dysic Histosol	42%
	Tarr sand, 1 to 6% slopes	561B	Tarr	Dry Nutrient-Poor Sand	90%
	Tarr sand, 6 to 15% slopes	561C	Tarr	Dry Nutrient-Poor Sand	95%
	Tarr sand, 15 to 60% slopes	561F	Tarr	Dry Nutrient-Poor Sand	90%
Juneau	Boone-Plainfield-Rock outcrop complex, 12 to 60% slopes	BpF	Boone, Plainfield, Rock Outcrop	Dry Nutrient-Poor Sand, Shallow Bedrock	100%
	Dawson muck, 0 to 1% slopes	Dc	Dawson	Dysic Histosol	100%
	Eleva-Boone-Rock outcrop complex, 30%to 60% slopes	EkF	Boone, Rock Outcrop	Dry Nutrient-Poor Sand, Shallow Bedrock	55%
	Loxley muck, 0 to 1% slopes	Lx	Loxley	Dysic Histosol	100%
	Newson-Dawson complex, 0 to 2% slopes	Ns	Dawson	Dysic Histosol	35%
	Plainbo sand, 1 to 6% slopes	PdB	Plainbo	Dry Nutrient-Poor Sand	100%
	Plainbo sand, 6 to 12% slopes	PdC	Plainbo	Dry Nutrient-Poor Sand	100%
	Plainfield sand, 1 to 6% slopes	PfB	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield sand, 6 to 12% slopes	PfC	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield sand, 12 to 20% slopes	PfD	Plainfield	Dry Nutrient-Poor Sand	100%

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Kewaunee	Kolberg variant silt loam, 1 to 6% slopes	KxB	Kolberg variant	Shallow Bedrock	100%
	Namur loam, 1 to 6% slopes	NaB	Namur	Shallow Bedrock	100%
	Namur-Rock outcrop complex, 6 to 20% slopes	NrD	Namur, Rock Outcrop	Shallow Bedrock	95%
	Ruse loam	Ru	Ruse	Shallow Bedrock	100%
La Crosse	Boone sand, 6 to 15% slopes	233C	Boone	Dry Nutrient-Poor Sand	95%
	Boone-Tarr sands, 15 to 50% slopes	1233F	Boone, Tarr	Dry Nutrient-Poor Sand	85%
	Gaphill-Rockbluff complex, 30%to 60% slopes	1145F	Rockbluff	Dry Nutrient-Poor Sand	35%
	Gosil loamy sand, 1 to 6% slopes	562B	Gosil	Dry Nutrient-Poor Sand	95%
	Gosil loamy sand, 6 to 12% slopes	562C	Gosil	Dry Nutrient-Poor Sand	95%
	Impact sand, 0 to 3% slopes	551A	Impact	Dry Nutrient-Poor Sand	98%
	Plainfield sand, 2 to 6% slopes	511B	Plainfield	Dry Nutrient-Poor Sand	95%
	Plainfield sand, 6 to 15% slopes	511C	Plainfield	Dry Nutrient-Poor Sand	98%
	Plainfield sand, 15 to 60% slopes	511F	Plainfield	Dry Nutrient-Poor Sand	97%
	Tarr sand, 1 to 6% slopes	561B	Tarr	Dry Nutrient-Poor Sand	97%
	Tarr sand, 6 to 15% slopes	561C	Tarr	Dry Nutrient-Poor Sand	95%
	Tarr sand, 15 to 60% slopes	561F	Tarr	Dry Nutrient-Poor Sand	98%
Lafayette	Boone fine sand, 6 to 20% slopes, moderately eroded	BoD2	Boone	Dry Nutrient-Poor Sand	100%
	Dunbarton silt loam, 2 to 6% slopes	DuB	Dunbarton	Shallow Bedrock	100%
	Dunbarton silt loam, 6 to 12% slopes, moderately eroded	DuC2	Dunbarton	Shallow Bedrock	100%
	Dunbarton silt loam, 12 to 20% slopes, moderately eroded	DuD2	Dunbarton	Shallow Bedrock	100%
	Dunbarton silt loam, 20 to 30% slopes, moderately eroded	DuE2	Dunbarton	Shallow Bedrock	100%
	Dunbarton silt loam, 30%to 45% slopes	DuF	Dunbarton	Shallow Bedrock	100%
	Edmund silt loam, 2 to 6% slopes, moderately eroded	EdB2	Edmund	Shallow Bedrock	100%
	Edmund silt loam, 6 to 12% slopes, moderately eroded	EdC2	Edmund	Shallow Bedrock	100%
	Edmund silt loam, 12 to 20% slopes, moderately eroded	EdD2	Edmund	Shallow Bedrock	100%
	Sogn silt loam, 2 to 12% slopes, moderately eroded	SoC2	Sogn	Shallow Bedrock	100%
	Sogn silt loam, 12 to 20% slopes, moderately eroded	SoD2	Sogn	Shallow Bedrock	100%
	Sogn silt loam, 20 to 30% slopes, moderately eroded	SoE2	Sogn	Shallow Bedrock	100%

County	Map unit name	Map unit symbol	Limited component(s)	Reason for limitation	Percent of map unit
Lafayette	Sogn silt loam, 30%to 45% slopes	SoF	Sogn	Shallow Bedrock	100%
Langlade	Loxley peat	Lx	Loxley	Dysic Histosol	100%
	Pence sandy loam, 0 to 6% slopes	PsB	Pence	Dry Nutrient-Poor Sand	100%
	Pence sandy loam, 6 to 15% slopes	PsC	Pence	Dry Nutrient-Poor Sand	100%
	Pence sandy loam, 15 to 45% slopes	PsD	Pence	Dry Nutrient-Poor Sand	100%
	Vilas loamy sand, 0 to 6% slopes	VsB	Vilas	Dry Nutrient-Poor Sand	100%
	Vilas loamy sand, 6 to 15% slopes	VsC	Vilas	Dry Nutrient-Poor Sand	100%
Lincoln	Loxley and Dawson peats, 0 to 1% slopes	Lo	Loxley, Dawson	Dysic Histosol	100%
	Vilas-Sayner loamy sands, 1 to 6% slopes	VsB	Vilas, Sayner	Dry Nutrient-Poor Sand	100%
	Vilas-Sayner loamy sands, 6 to 15% slopes	VsC	Vilas, Sayner	Dry Nutrient-Poor Sand	100%
	Vilas-Sayner loamy sands, 15 to 35% slopes	VsD	Vilas, Sayner	Dry Nutrient-Poor Sand	100%
Manitowoc	Channahon loam, 2 to 6% slopes	CnB	Channahon	Shallow Bedrock	100%
	Channahon loam, 6 to 12% slopes	CnC	Channahon	Shallow Bedrock	100%
	Plainfield loamy sand, 2 to 6% slopes	PlB	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy sand, 6 to 12% slopes	PlC	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy sand, 12 to 20% slopes	PlD	Plainfield	Dry Nutrient-Poor Sand	100%
Marathon	Greenwood peat, 0 to 1% slopes	Gr	Greenwood	Dysic Histosol	100%
	Pits, quarries	Ph	Pits, Quarries	Shallow Bedrock	100%
Marinette	Emmert-Pence-Sarona complex, 6 to 15% slopes	EaC	Emmert	Dry Nutrient-Poor Sand	50%
	Emmert-Pence-Sarona complex, 15 to 35% slopes	EaD	Emmert	Dry Nutrient-Poor Sand	50%
	Loxley and Dawson peats, 0 to 1% slopes	Ls	Loxley, Dawson	Dysic Histosol	100%
	Menahga sand, 0 to 6% slopes	MhB	Menahga	Dry Nutrient-Poor Sand	100%
	Menahga sand, 6 to 15% slopes	MhC	Menahga	Dry Nutrient-Poor Sand	100%
	Menahga sand, 15 to 25% slopes	MhD	Menahga	Dry Nutrient-Poor Sand	100%
	Menahga-Mancelona-Menominee complex, 2 to 6% slopes	MmB	Menahga	Dry Nutrient-Poor Sand	40%
	Menahga-Mancelona-Menominee complex, 6 to 15% slopes	MmC	Menahga	Dry Nutrient-Poor Sand	40%
	Menahga-Mancelona-Menominee complex, 15 to 25% slopes	MmD	Menahga	Dry Nutrient-Poor Sand	45%

County	Map unit name	Map unit symbol	Limited component(s)	Reason for limitation	Percent of map unit
Marinette	Roscommon-Rock outcrop complex, 0 to 2% slopes	Rm	Rock Outcrop	Shallow Bedrock	30%
	Sayner loamy sand, 1 to 6% slopes	ScB	Sayner	Dry Nutrient-Poor Sand	100%
	Sayner loamy sand, 6 to 15% slopes	ScC	Sayner	Dry Nutrient-Poor Sand	100%
	Shawano loamy fine sand, 2 to 6% slopes	SfB	Shawano	Dry Nutrient-Poor Sand	100%
	Shawano loamy fine sand, 6 to 12% slopes	SfC	Shawano	Dry Nutrient-Poor Sand	100%
	Shawano loamy fine sand, 12 to 30% slopes	SfD	Shawano	Dry Nutrient-Poor Sand	100%
	Summerville fine sandy loam, 1 to 6% slopes	SuB	Summerville	Shallow Bedrock	100%
	Summerville fine sandy loam, 6 to 12% slopes	SuC	Summerville	Shallow Bedrock	100%
Marquette	Houghton peat, acid variant	Hp	Houghton variant	Dysic Histosol	100%
	Plainfield loamy fine sand, 0 to 2% slopes	PlA	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy fine sand, 2 to 6% slopes	PlB	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy fine sand, 6 to 12% slopes	PlC	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy fine sand, 12 to 20% slopes	PlD2	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield sand, 0 to 12% slopes, eroded	PfC2	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield sand, 12 to 20% slopes, eroded	PfD2	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield-Wyocena complex, 2 to 6% slopes	PnB	Plainfield	Dry Nutrient-Poor Sand	60%
	Plainfield-Wyocena complex, 6 to 12% slopes	PnC	Plainfield	Dry Nutrient-Poor Sand	55%
	Plainfield-Wyocena complex, 12 to 30% slopes	PnE	Plainfield	Dry Nutrient-Poor Sand	50%
Menominee	Grayling loamy sand, 0 to 6% slopes	GaB	Grayling	Dry Nutrient-Poor Sand	85%
	Grayling loamy sand, 6 to 15% slopes	GaC	Grayling	Dry Nutrient-Poor Sand	90%
	Grayling loamy sand, 15 to 35% slopes	GaD	Grayling	Dry Nutrient-Poor Sand	90%
	Grayling sand, 0 to 6% slopes	GyB	Grayling	Dry Nutrient-Poor Sand	85%
	Grayling sand, 6 to 15% slopes	GyC	Grayling	Dry Nutrient-Poor Sand	90%
	Grayling sand, 15 to 35% slopes	GyD	Grayling	Dry Nutrient-Poor Sand	90%
	Ishpeming-Rock outcrop complex, 0 to 6% slopes	IxB	Rock Outcrop	Shallow Bedrock	30%

County	Map unit name	Map unit symbol	Limited component(s)	Reason for limitation	Percent of map unit
Menominee	Ishpeming-Rock outcrop complex, 6 to 15% slopes	IxC	Rock Outcrop	Shallow Bedrock	30%
	Loxley peat, 0 to 1% slopes	LoA	Loxley	Dysic Histosol	94%
	Mequithy-Rock outcrop complex, 0 to 6% slopes	MqB	Rock Outcrop	Shallow Bedrock	30%
	Mequithy-Rock outcrop complex, 6 to 15% slopes	MqC	Rock Outcrop	Shallow Bedrock	30%
	Rousseau fine sand, 0 to 6% slopes	RsB	Rousseau	Dry Nutrient-Poor Sand	94%
	Rousseau fine sand, 6 to 15% slopes	RsC	Rousseau	Dry Nutrient-Poor Sand	95%
	Rousseau fine sand, 15 to 35% slopes	RsD	Rousseau	Dry Nutrient-Poor Sand	95%
	Shawano fine sand, 0 to 6% slopes	SfB	Shawano	Dry Nutrient-Poor Sand	95%
	Shawano fine sand, 6 to 15% slopes	SfC	Shawano	Dry Nutrient-Poor Sand	95%
	Shawano fine sand, 15 to 35% slopes	SfD	Shawano	Dry Nutrient-Poor Sand	95%
	Udipsamments, moderately steep or steep (earthen dam)	UdD	Udipsamments	Dry Nutrient-Poor Sand	100%
	Vilas loamy sand, 0 to 6% slopes	VsB	Vilas	Dry Nutrient-Poor Sand	88%
	Vilas loamy sand, 6 to 15% slopes	VsC	Vilas	Dry Nutrient-Poor Sand	90%
	Vilas loamy sand, 15 to 35% slopes	VsD	Vilas	Dry Nutrient-Poor Sand	90%
Milwaukee	Ritchey silt loam, 1 to 6% slopes	RkB	Ritchey	Shallow Bedrock	100%
	Ritchey silt loam, 6 to 12% slopes, eroded	RkC2	Ritchey	Shallow Bedrock	100%
	Ritchey silt loam, 12 to 30% slopes	RkE	Ritchey	Shallow Bedrock	100%
Monroe	Boone sand, 6 to 12% slopes	BoC	Boone	Dry Nutrient-Poor Sand	100%
	Boone sand, 12 to 45% slopes	BoF	Boone	Dry Nutrient-Poor Sand	100%
	Boone-Rock outcrop complex, 30%to 70% slopes	BpF	Boone, Rock Outcrop	Dry Nutrient-Poor Sand, Shallow Bedrock	95%
	Dawson peat	Dc	Dawson	Dysic Histosol	100%
	Impact sand, 0 to 2% slopes	ImA	Impact	Dry Nutrient-Poor Sand	100%
	Impact sand, 2 to 6% slopes	ImB	Impact	Dry Nutrient-Poor Sand	100%
	Loxley mucky peat	Lx	Loxley	Dysic Histosol	100%
	Tarr sand, 0 to 6% slopes	TrB	Tarr	Dry Nutrient-Poor Sand	100%
	Tarr sand, 6 to 12% slopes	TrC	Tarr	Dry Nutrient-Poor Sand	100%
	Tarr sand, 12 to 20% slopes	TrD	Tarr	Dry Nutrient-Poor Sand	100%
	Tarr sand, 20 to 45% slopes	TrE	Tarr	Dry Nutrient-Poor Sand	100%

County	Map unit name	Map unit symbol	Limited component(s)	Reason for limitation	Percent of map unit
Oconto	Loxley mucky peat, 0 to 1% slopes	Lx	Loxley	Dysic Histosol	100%
	Menahga sand, 0 to 6% slopes	MnB	Menahga	Dry Nutrient-Poor Sand	100%
	Menahga sand, 6 to 15% slopes	MnC	Menahga	Dry Nutrient-Poor Sand	100%
	Menahga sand, 15 to 35% slopes	MnD	Menahga	Dry Nutrient-Poor Sand	100%
	Peshekee-Rock outcrop complex, 4 to 30% slopes	PsD	Peshekee, Rock Outcrop	Shallow Bedrock	100%
	Shawano fine sand, 2 to 6% slopes	SfB	Shawano	Dry Nutrient-Poor Sand	100%
	Shawano fine sand, 6 to 12% slopes	SfC	Shawano	Dry Nutrient-Poor Sand	100%
	Shawano fine sand, 12 to 30% slopes	SfD	Shawano	Dry Nutrient-Poor Sand	100%
	Summerville fine sandy loam, 2 to 8% slopes	SuB	Summerville	Shallow Bedrock	100%
	Summerville fine sandy loam, 20 to 45% slopes	SuE	Summerville	Shallow Bedrock	100%
Oneida	Emmert very gravelly sand, 20 to 45% slopes	EmE	Emmert	Dry Nutrient-Poor Sand	100%
	Greenwood, Loxley, and Dawson peats, 0 to 1% slopes	Gr	Greenwood, Loxley, Dawson	Dysic Histosol	100%
	Keweenaw-Sayner complex, 15 to 30% slopes, stony	KrD	Sayner	Dry Nutrient-Poor Sand	45%
	Keweenaw-Vilas complex, 1 to 6% slopes, stony	KnB	Vilas	Dry Nutrient-Poor Sand	45%
	Keweenaw-Vilas complex, 6 to 15% slope, stony	KnC	Vilas	Dry Nutrient-Poor Sand	45%
	Sayner loamy sand, 0 to 6% slopes	SaB	Sayner	Dry Nutrient-Poor Sand	100%
	Sayner loamy sand, 6 to 15% slopes	SaC	Sayner	Dry Nutrient-Poor Sand	100%
	Sayner loamy sand, 15 to 45% slopes	SaD	Sayner	Dry Nutrient-Poor Sand	100%
	Vilas loamy sand, 0 to 6% slopes	VsB	Vilas	Dry Nutrient-Poor Sand	100%
	Vilas loamy sand, 6 to 15% slopes	VsC	Vilas	Dry Nutrient-Poor Sand	100%
	Vilas loamy sand, 15 to 25% slopes	VsD	Vilas	Dry Nutrient-Poor Sand	100%
Outagamie	Channahon silt loam, 2 to 6% slopes	CnB	Channahon	Shallow Bedrock	100%
	Limestone quarries	Ln	Limestone Quarries	Shallow Bedrock	100%
	Lobo peat	Lo	Lobo	Dysic Histosol	100%
	Namur silt loam, 1 to 6% slopes	NaB	Namur	Shallow Bedrock	100%
	Rock outcrop	Ra	Rock Outcrop	Shallow Bedrock	100%

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Outagamie	Rousseau loamy fine sand, 2 to 6% slopes	RoB	Rousseau	Dry Nutrient-Poor Sand	100%
	Shawano fine sand, hilly	SeD	Shawano	Dry Nutrient-Poor Sand	100%
	Shawano fine sand, rolling	SeC	Shawano	Dry Nutrient-Poor Sand	100%
Ozaukee	Ritchey silt loam, 0 to 6% slopes	RkB	Ritchey	Shallow Bedrock	100%
	Ritchey silt loam, 6 to 20% slopes, eroded	RkD2	Ritchey	Shallow Bedrock	100%
Pepin	Boone sand, 6 to 15% slopes	233C	Boone	Dry Nutrient-Poor Sand	95%
	Boone-Elevasil complex, 15 to 50% slopes	1224F	Boone	Dry Nutrient-Poor Sand	60%
	Boplain sand, 0 to 6% slopes	510B	Boplain	Dry Nutrient-Poor Sand	90%
	Boplain sand, 6 to 15% slopes	510C	Boplain	Dry Nutrient-Poor Sand	90%
	Gaphill-Rockbluff complex, 30%to 60% slopes	1145F	Rockbluff	Dry Nutrient-Poor Sand	35%
	Plainfield sand, 0 to 3% slopes	511A	Plainfield	Dry Nutrient-Poor Sand	95%
	Plainfield sand, 2 to 6% slopes	511B	Plainfield	Dry Nutrient-Poor Sand	95%
	Plainfield sand, 6 to 15% slopes	511C	Plainfield	Dry Nutrient-Poor Sand	98%
	Plainfield sand, 15 to 60% slopes	511F	Plainfield	Dry Nutrient-Poor Sand	97%
	Tarr sand, 1 to 6% slopes	561B	Tarr	Dry Nutrient-Poor Sand	97%
Pierce	Boone loamy fine sand, till plain, 6 to 15% slopes	230C	Boone	Dry Nutrient-Poor Sand	85%
	Boone loamy fine sand, till plain, 15 to 50% slopes	230F	Boone	Dry Nutrient-Poor Sand	90%
	Gaphill-Rockbluff complex, 30%to 60% slopes	1145F	Rockbluff	Dry Nutrient-Poor Sand	35%
	Plainfield sand, 0 to 3% slopes	511A	Plainfield	Dry Nutrient-Poor Sand	95%
	Plainfield sand, 2 to 6% slopes	511B	Plainfield	Dry Nutrient-Poor Sand	95%
	Plainfield sand, 6 to 15% slopes	511C	Plainfield	Dry Nutrient-Poor Sand	98%
	Plainfield sand, 15 to 60% slopes	511F	Plainfield	Dry Nutrient-Poor Sand	97%
Polk	Amery complex, 6 to 12% slopes	AoC	Menahga	Dry Nutrient-Poor Sand	35%
	Amery complex, 12 to 20% slopes	AoD	Menahga	Dry Nutrient-Poor Sand	35%
	Amery complex, 20 to 30% slopes	AoE	Menahga	Dry Nutrient-Poor Sand	40%
	Amery-Rock outcrop complex, 2 to 12% slopes	ArC	Rock Outcrop	Shallow Bedrock	30%
	Amery-Rock outcrop complex, 12 to 45% slopes	ArD	Rock Outcrop	Shallow Bedrock	30%
	Cushing complex, 6 to 12% slopes, eroded	CxC2	Menahga	Dry Nutrient-Poor Sand	35%
	Cushing complex, 12 to 20% slopes, eroded	CxD2	Menahga	Dry Nutrient-Poor Sand	35%
	Emmert gravelly sandy loam, 12 to 35% slopes	EmD	Emmert	Dry Nutrient-Poor Sand	100%
	Menahga loamy sand, 1 to 6% slopes	MnB	Menahga	Dry Nutrient-Poor Sand	100%

County	Map unit name	Map unit symbol	Limited component(s)	Reason for limitation	Percent of map unit
Polk	Menahga loamy sand, 6 to 12% slopes	MnC	Menahga	Dry Nutrient-Poor Sand	100%
	Menahga loamy sand, 12 to 25% slopes	MnD	Menahga	Dry Nutrient-Poor Sand	100%
	Nymore fine sand, 0 to 3% slopes	NyA	Nymore	Dry Nutrient-Poor Sand	100%
	Omega fine sand, 2 to 6% slopes	OgB	Omega	Dry Nutrient-Poor Sand	100%
	Omega fine sand, 6 to 12% slopes	OgC	Omega	Dry Nutrient-Poor Sand	100%
	Omega fine sand, 12 to 20% slopes	OgD	Omega	Dry Nutrient-Poor Sand	100%
Portage	Plainfield and Kranski soils	Ph	Plainfield	Dry Nutrient-Poor Sand	55%
	Plainfield loamy sand, 0 to 2% slopes	PfA	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy sand, 2 to 6% slopes	PfB	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy sand, 6 to 12% slopes	PfC	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield sandy loam, gravelly variant, 2 to 6% slopes	PkB	Plainfield variant	Dry Nutrient-Poor Sand	100%
	Rock land	Rk	Rock Outcrop	Shallow Bedrock	100%
Price	Haplosaprists, Peats, and Mucks, 0 to 1% slopes	9155A	Loxley, Beseman	Dysic Histosol	40%
	Loxley and Beseman soils, 0 to 1% slopes	414A	Loxley, Beseman	Dysic Histosol	85%
	Loxley and Dawson soils, 0 to 1% slopes	418A	Loxley, Dawson	Dysic Histosol	98%
	Loxley, Beseman, and Dawson soils, 0 to 1% slopes	3403A	Loxley, Beseman, Dawson	Dysic Histosol	98%
	Pelissier gravelly sandy loam, 2 to 6% slopes	571B	Pelissier	Dry Nutrient-Poor Sand	80%
	Pelissier gravelly sandy loam, 6 to 15% slopes	571C	Pelissier	Dry Nutrient-Poor Sand	80%
	Pelissier gravelly sandy loam, 15 to 45% slopes	571E	Pelissier	Dry Nutrient-Poor Sand	80%
	Pelissier sandy loam, 20 to 45% slopes	9060D	Pelissier	Dry Nutrient-Poor Sand	80%
	Rubicon-Sayner complex, 15 to 30% slopes	475D	Rubicon, Sayner	Dry Nutrient-Poor Sand	90%
	Sayner-Lindquist complex, 0 to 6% slopes	9012B	Sayner	Dry Nutrient-Poor Sand	60%
	Sayner-Lindquist complex, 6 to 15% slopes	9012C	Sayner	Dry Nutrient-Poor Sand	60%
	Sayner-Lindquist complex, 15 to 30% slopes	9012D	Sayner	Dry Nutrient-Poor Sand	60%
	Sayner-Pence-Vilas complex, 0 to 6% slopes	974B	Sayner, Vilas	Dry Nutrient-Poor Sand	60%

County	Map unit name	Map unit symbol	Limited component(s)	Reason for limitation	Percent of map unit
Price	Sayner-Pence-Vilas complex, 6 to 15% slopes	974C	Sayner, Vilas	Dry Nutrient-Poor Sand	60%
	Sayner-Pence-Vilas complex, 15 to 30% slopes	974D	Sayner, Vilas	Dry Nutrient-Poor Sand	65%
	Vilas-Lindquist complex, 0 to 6% slopes	594B	Vilas	Dry Nutrient-Poor Sand	50%
	Vilas-Lindquist complex, 6 to 15% slopes	594C	Vilas	Dry Nutrient-Poor Sand	50%
	Vilas-Lindquist complex, 15 to 30% slopes	594D	Vilas	Dry Nutrient-Poor Sand	50%
Richland	Gaphill-Rockbluff complex, 30 to 60% slopes	1145F	Rockbluff	Dry Nutrient-Poor Sand	35%
	Plainfield sand, 6 to 15% slopes	511C	Plainfield	Dry Nutrient-Poor Sand	98%
	Plainfield sand, 15 to 60% slopes	511F	Plainfield	Dry Nutrient-Poor Sand	97%
Rock	Edmund loam, 2 to 6% slopes, eroded	EdB2	Edmund	Shallow Bedrock	100%
	Edmund loam, 6 to 12% slopes, eroded	EdC2	Edmund	Shallow Bedrock	100%
	Edmund loam, 12 to 20% slopes, eroded	EdD2	Edmund	Shallow Bedrock	100%
	Edmund loam, 20 to 35% slopes	EdE	Edmund	Shallow Bedrock	100%
	Rock land	Ro	Rock Land	Shallow Bedrock	100%
	Sogn loam, 2 to 6% slopes	SoB	Sogn	Shallow Bedrock	100%
	Sogn loam, 6 to 12% slopes, eroded	SoC2	Sogn	Shallow Bedrock	100%
	Sogn loam, 12 to 20% slopes	SoD	Sogn	Shallow Bedrock	100%
	Sogn loam, 30%to 45% slopes	SoF	Sogn	Shallow Bedrock	100%
Rusk	Greenwood mucky peat, 0 to 1% slopes	415A	Greenwood	Dysic Histosol	90%
	Loxley and Beseman soils, 0 to 1% slopes	414A	Loxley, Beseman	Dysic Histosol	85%
	Loxley mucky peat, 0 to 1% slopes	406A	Loxley	Dysic Histosol	90%
	Pelissier gravelly sandy loam, 15 to 45% slopes	571E	Pelissier	Dry Nutrient-Poor Sand	80%
	Sayner loamy sand, 6 to 15% slopes	574C	Sayner	Dry Nutrient-Poor Sand	90%
	Sayner loamy sand, 15 to 45% slopes	574E	Sayner	Dry Nutrient-Poor Sand	90%
	Vilas-Lindquist complex, 0 to 6% slopes	594B	Vilas	Dry Nutrient-Poor Sand	50%
	Vilas-Lindquist complex, 6 to 15% slopes	594C	Vilas	Dry Nutrient-Poor Sand	50%
Sauk	Boone sand, 2 to 6% slopes	BoB	Boone	Dry Nutrient-Poor Sand	100%
	Boone sand, 6 to 12% slopes	BoC	Boone	Dry Nutrient-Poor Sand	100%
	Boone sand, 12 to 30% slopes	BoD	Boone	Dry Nutrient-Poor Sand	100%

County	Map unit name	Map unit symbol	Limited component(s)	Reason for limitation	Percent of map unit
Sauk	Plainfield loamy sand, 1 to 6% slopes	PfB	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy sand, 6 to 12% slopes	PfC	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy sand, 12 to 30% slope	PfD	Plainfield	Dry Nutrient-Poor Sand	100%
	Rock outcrop, quartzite	Rt	Rock Outcrop	Shallow Bedrock	100%
Sawyer	Amery, very stony-Greenwood complex, 0 to 35% slopes	443D	Greenwood	Dysic Histosol	30%
	Greenwood mucky peat, 0 to 1% slopes	415A	Greenwood	Dysic Histosol	90%
	Haplosaprists, Peats, and Mucks, 0 to 1% slopes	9155A	Loxley, Beseman	Dysic Histosol	40%
	Keweenaw, stony-Rubicon complex, 20 to 45% slopes	874E	Rubicon	Dry Nutrient-Poor Sand	30%
	Keweenaw-Sayner-Vilas complex, 2 to 6% slopes	69B	Sayner, Vilas	Dry Nutrient-Poor Sand	50%
	Keweenaw-Sayner-Vilas complex, 6 to 15% slopes	69C	Sayner, Vilas	Dry Nutrient-Poor Sand	50%
	Keweenaw-Sayner-Vilas complex, 15 to 45% slopes	69E	Sayner, Vilas	Dry Nutrient-Poor Sand	50%
	Loxley and Beseman soils, 0 to 1% slopes	414A	Loxley, Beseman	Dysic Histosol	85%
	Loxley mucky peat, 0 to 1% slopes	406A	Loxley	Dysic Histosol	90%
	Loxley, Beseman, and Dawson soils, 0 to 1% slopes	3403A	Loxley, Beseman, Dawson	Dysic Histosol	98%
	Pelissier gravelly sandy loam, 6 to 15% slopes	571C	Pelissier	Dry Nutrient-Poor Sand	80%
	Pelissier gravelly sandy loam, 15 to 45% slopes	571E	Pelissier	Dry Nutrient-Poor Sand	80%
	Rock outcrop-Ishpeming complex, 0 to 15% slopes	925C	Rock Outcrop	Shallow Bedrock	50%
	Sayner loamy sand, 0 to 6% slopes	574B	Sayner	Dry Nutrient-Poor Sand	85%
	Sayner loamy sand, 6 to 15% slopes	574C	Sayner	Dry Nutrient-Poor Sand	90%
	Sayner loamy sand, 15 to 45% slopes	574E	Sayner	Dry Nutrient-Poor Sand	90%
	Sayner-Lindquist complex, 0 to 6% slopes	9012B	Sayner	Dry Nutrient-Poor Sand	60%
	Sayner-Lindquist complex, 6 to 15% slopes	9012C	Sayner	Dry Nutrient-Poor Sand	60%
	Sayner-Lindquist complex, 15 to 30% slopes	9012D	Sayner	Dry Nutrient-Poor Sand	60%
	Sayner-Pence-Vilas complex, 6 to 15% slopes	974C	Sayner, Vilas	Dry Nutrient-Poor Sand	60%

County	Map unit name	Map unit symbol	Limited component(s)	Reason for limitation	Percent of map unit
Sawyer	Sayner-Pence-Vilas complex, 15 to 30% slopes	974D	Sayner, Vilas	Dry Nutrient-Poor Sand	65%
	Vilas-Lindquist complex, 0 to 6% slopes	594B	Vilas	Dry Nutrient-Poor Sand	50%
	Vilas-Lindquist complex, 6 to 15% slopes	594C	Vilas	Dry Nutrient-Poor Sand	50%
	Vilas-Lindquist complex, 15 to 30% slopes	594D	Vilas	Dry Nutrient-Poor Sand	50%
Shawano	Loxley mucky peat	Lx	Loxley	Dysic Histosol	100%
	Mahtomedi-Menahga loamy sands, 0 to 2% slopes	MaA	Menahga	Dry Nutrient-Poor Sand	30%
	Mahtomedi-Menahga loamy sands, 2 to 6% slopes	MaB	Menahga	Dry Nutrient-Poor Sand	30%
	Mahtomedi-Menahga loamy sands, 6 to 12% slopes	MaC	Menahga	Dry Nutrient-Poor Sand	30%
	Mahtomedi-Menahga loamy sands, 12 to 30% slopes	MaD	Menahga	Dry Nutrient-Poor Sand	30%
	Menahga loamy sand, 0 to 2% slopes	MnA	Menahga	Dry Nutrient-Poor Sand	100%
	Menahga loamy sand, 2 to 6% slopes	MnB	Menahga	Dry Nutrient-Poor Sand	100%
	Menahga loamy sand, 6 to 12% slopes	MnC	Menahga	Dry Nutrient-Poor Sand	100%
	Menahga loamy sand, 12 to 30% slopes	MnD	Menahga	Dry Nutrient-Poor Sand	100%
	Rock outcrop-Rosholt variant complex, 2 to 35% slopes	RmD	Rock Outcrop	Shallow Bedrock	70%
	Rosholt-Rock outcrop complex, 2 to 35% slopes	RrD	Rock Outcrop	Shallow Bedrock	40%
	Rubicon sand, 1 to 6% slopes	RuB	Rubicon	Dry Nutrient-Poor Sand	100%
	Rubicon sand, 6 to 12% slopes	RuC	Rubicon	Dry Nutrient-Poor Sand	100%
	Rubicon sand, 12 to 20% slopes	RuD	Rubicon	Dry Nutrient-Poor Sand	100%
	Shawano loamy fine sand, 1 to 6% slopes	SfB	Shawano	Dry Nutrient-Poor Sand	100%
	Shawano loamy fine sand, 6 to 12% slopes	SfC	Shawano	Dry Nutrient-Poor Sand	100%
	Shawano loamy fine sand, 12 to 20% slopes	SfD	Shawano	Dry Nutrient-Poor Sand	100%
	Shawano-Briggsville complex, 2 to 6% slopes	SgB	Shawano	Dry Nutrient-Poor Sand	70%
	Shawano-Briggsville complex, 6 to 12% slopes	SgC	Shawano	Dry Nutrient-Poor Sand	70%
St. Croix	Boone loamy fine sand, 2 to 6% slopes	BnB	Boone	Dry Nutrient-Poor Sand	100%
	Boone loamy fine sand, 6 to 12% slopes	BnC	Boone	Dry Nutrient-Poor Sand	100%
	Boone loamy fine sand, 12 to 20% slope	BnD	Boone	Dry Nutrient-Poor Sand	100%

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St. Croix	Emmert loamy sand, 12 to 35% slopes	EmE	Emmert	Dry Nutrient-Poor Sand	100%
	Plainfield loamy sand, 2 to 6% slopes	PmB	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy sand, 6 to 12% slopes	PmC	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy sand, 12 to 20% slope	PmD	Plainfield	Dry Nutrient-Poor Sand	100%
	Ritchey silt loam, 2 to 6% slopes	RnB	Ritchey	Shallow Bedrock	100%
	Ritchey silt loam, 6 to 12% slopes, eroded	RnC2	Ritchey	Shallow Bedrock	100%
	Ritchey silt loam, 12 to 20% slopes, eroded	RnD2	Ritchey	Shallow Bedrock	100%
	Ritchey soils and rock outcrop, 20 to 35% slopes	RoE	Ritchey, Rock Outcrop	Shallow Bedrock	100%
Taylor	Loxley and Beseman soils, 0 to 1% slopes	414A	Loxley, Beseman	Dysic Histosol	85%
	Loxley peat, 0 to 1% slopes	9055A	Loxley	Dysic Histosol	95%
	Pelissier gravelly sandy loam, 15 to 45% slopes	571E	Pelissier	Dry Nutrient-Poor Sand	80%
	Pelissier sandy loam, 20 to 45% slopes	9060D	Pelissier	Dry Nutrient-Poor Sand	80%
	Pelissier very cobbly sandy loam, 10 to 30% slopes	9197C	Pelissier	Dry Nutrient-Poor Sand	80%
Trempealeau	Boone loamy sand, 2 to 6% slopes	BnB	Boone	Dry Nutrient-Poor Sand	100%
	Boone loamy sand, 6 to 12% slopes, eroded	BnC2	Boone	Dry Nutrient-Poor Sand	100%
	Boone loamy sand, 12 to 30% slopes, eroded	BnE2	Boone	Dry Nutrient-Poor Sand	100%
	Eleva-Boone complex, 20 to 45% slopes	EnF	Boone	Dry Nutrient-Poor Sand	30%
Vernon	Boone fine sand, 12 to 30% slopes	201E	Boone	Dry Nutrient-Poor Sand	95%
	Elizabeth flaggy silt loam, 12 to 20% slopes	164D	Elizabeth	Shallow Bedrock	90%
	Elizabeth flaggy silt loam, 20 to 30% slopes	164E	Elizabeth	Shallow Bedrock	90%
	Gaphill-Rockbluff complex, 30 to 60% slopes	1145F	Rockbluff	Dry Nutrient-Poor Sand	35%
	Gosil loamy sand, 1 to 6% slopes	562B	Gosil	Dry Nutrient-Poor Sand	95%
	Gosil loamy sand, 6 to 12% slopes	562C	Gosil	Dry Nutrient-Poor Sand	95%
	Lacresent-Dunbarton complex, very stony, 30 to 60% slopes	1130F	Dunbarton	Shallow Bedrock	30%
	Plainfield sand, 6 to 15% slopes	511C	Plainfield	Dry Nutrient-Poor Sand	98%
	Plainfield sand, 15 to 60% slopes	511F	Plainfield	Dry Nutrient-Poor Sand	97%

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Vernon	Tarr sand, 15 to 60% slopes	561F	Tarr	Dry Nutrient-Poor Sand	90%
Vilas	Keweenaw-Sayner complex, 15 to 30% slopes	KnD	Sayner	Dry Nutrient-Poor Sand	30%
	Loxley and Dawson peats, 0 to 1% slopes	Lo	Loxley, Dawson	Dysic Histosol	100%
	Rubicon sand, 0 to 6% slopes	RoB	Rubicon	Dry Nutrient-Poor Sand	100%
	Rubicon sand, 6 to 15% slopes	RoC	Rubicon	Dry Nutrient-Poor Sand	100%
	Rubicon sand, 15 to 30% slopes	RoD	Rubicon	Dry Nutrient-Poor Sand	100%
	Sayner-Rubicon complex, 0 to 6% slopes	SaB	Sayner, Rubicon	Dry Nutrient-Poor Sand	100%
	Sayner-Rubicon complex, 6 to 15% slopes	SaC	Sayner, Rubicon	Dry Nutrient-Poor Sand	100%
	Sayner-Rubicon complex, 15 to 35% slopes	SaD	Sayner, Rubicon	Dry Nutrient-Poor Sand	100%
Washburn	Amery, very stony-Greenwood complex, 0 to 35% slopes	443D	Greenwood	Dysic Histosol	30%
	Grayling sand, 0 to 6% slopes	399B	Grayling	Dry Nutrient-Poor Sand	97%
	Grayling sand, 6 to 12% slopes	399C	Grayling	Dry Nutrient-Poor Sand	98%
	Grayling sand, 12 to 30% slopes	399D	Grayling	Dry Nutrient-Poor Sand	98%
	Greenwood and Beseman soils, 0 to 1% slopes	484A	Greenwood, Beseman	Dysic Histosol	90%
	Greenwood mucky peat, 0 to 1% slopes	415A	Greenwood	Dysic Histosol	90%
	Haugen, very stony-Greenwood complex, 0 to 15% slopes	442C	Greenwood	Dysic Histosol	25%
	Keweenaw-Sayner-Vilas complex, 2 to 6% slopes	69B	Sayner, Vilas	Dry Nutrient-Poor Sand	50%
	Keweenaw-Sayner-Vilas complex, 6 to 15% slopes	69C	Sayner, Vilas	Dry Nutrient-Poor Sand	50%
	Keweenaw-Sayner-Vilas complex, 15 to 45% slopes	69E	Sayner, Vilas	Dry Nutrient-Poor Sand	50%
	Loxley mucky peat, 0 to 1% slopes	406A	Loxley	Dysic Histosol	90%
	Loxley, Beseman, and Dawson soils, 0 to 1% slopes	3403A	Loxley, Beseman, Dawson	Dysic Histosol	98%
	Rock outcrop-Frogcreek-Metonga complex, 2 to 45% slopes, very stony	524E	Rock Outcrop	Shallow Bedrock	30%
	Sayner loamy sand, 0 to 6% slopes	574B	Sayner	Dry Nutrient-Poor Sand	85%
	Sayner loamy sand, 6 to 15% slopes	574C	Sayner	Dry Nutrient-Poor Sand	90%
	Sayner loamy sand, 15 to 45% slopes	574E	Sayner	Dry Nutrient-Poor Sand	90%
	Vilas loamy sand, 0 to 6% slopes	74B	Vilas	Dry Nutrient-Poor Sand	90%

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Washburn	Vilas loamy sand, 6 to 15% slopes	74C	Vilas	Dry Nutrient-Poor Sand	95%
	Vilas loamy sand, 15 to 30% slopes	74D	Vilas	Dry Nutrient-Poor Sand	95%
Washington	Ritchey silt loam, 2 to 6% slopes	RkB	Ritchey	Shallow Bedrock	100%
	Ritchey silt loam, 6 to 12% slopes, eroded	RkC2	Ritchey	Shallow Bedrock	100%
Waukesha	Ritchey silt loam, 1 to 6% slopes	RkB	Ritchey	Shallow Bedrock	100%
	Ritchey silt loam, 6 to 12% slopes, eroded	RkC2	Ritchey	Shallow Bedrock	100%
	Ritchey silt loam, 12 to 30% slopes	RkE	Ritchey	Shallow Bedrock	100%
Waupaca	Elderon-Rosholt complex, 6 to 12% slopes	EcC	Elderon	Dry Nutrient-Poor Sand	45%
	Elderon-Rosholt complex, 12 to 30% slopes	EcD	Elderon	Dry Nutrient-Poor Sand	60%
	Loxley mucky peat	Lx	Loxley	Dysic Histosol	100%
	Plainfield loamy sand, 0 to 2% slopes	PfA	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy sand, 2 to 6% slopes	PfB	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy sand, 6 to 12% slopes	PfC	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy sand, 12 to 30% slopes	PfD	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy sand, loamy substratum, 2 to 6% slopes	PlB	Plainfield	Dry Nutrient-Poor Sand	100%
	Rosholt-Rock outcrop complex, 2 to 10% slopes	RrB	Rock Outcrop	Shallow Bedrock	45%
	Shawano loamy fine sand, 2 to 6% slopes	SfB	Shawano	Dry Nutrient-Poor Sand	100%
	Shawano loamy fine sand, 6 to 12% slopes	SfC	Shawano	Dry Nutrient-Poor Sand	100%
	Shawano loamy fine sand, 12 to 20% slopes	SfD	Shawano	Dry Nutrient-Poor Sand	100%
Waushara	Plainfield sand, 0 to 2% slopes	PfA	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield sand, 2 to 6% slopes	PfB	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield sand, 6 to 12% slopes	PfC	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield sand, 12 to 30% slopes	PfD	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield sand, loamy substratum, 2 to 6% slopes	PlB	Plainfield	Dry Nutrient-Poor Sand	100%

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Winnebago	Pits, quarries	Ph	Pits	Shallow Bedrock	100%
	Ritchey silt loam, 2 to 6% slopes	RhB	Ritchey	Shallow Bedrock	100%
	Ritchey silt loam, 6 to 12% slopes, eroded	RhC2	Ritchey	Shallow Bedrock	100%
	Ritchey silt loam, 12 to 30% slopes, eroded	RhD2	Ritchey	Shallow Bedrock	100%
Wood	Dawson mucky peat	Dc	Dawson	Dysic Histosol	100%
	Dawson peat	Db	Dawson	Dysic Histosol	100%
	Greenwood peat	Gr	Greenwood	Dysic Histosol	100%
	Plainfield loamy sand, 0 to 2% slopes	PgA	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield loamy sand, 2 to 6% slopes	PgB	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield sand, 0 to 2% slopes	PfA	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield sand, 2 to 6% slopes	PfB	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield sand, 6 to 12% slopes	PfC	Plainfield	Dry Nutrient-Poor Sand	100%
	Plainfield sand, 12 to 35% slopes	PfE	Plainfield	Dry Nutrient-Poor Sand	100%

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