

Biomass Harvesting Guidelines for Forestlands, Brushlands and Open Lands

December 2007

The Minnesota Forest Resources Council (MFRC) has completed development of its biomass harvesting guidelines for forestlands, brushlands and open lands.

These new guidelines are designed to be included in the MFRC's 2005 forest management guidebook titled *Sustaining Minnesota Forest Resources: Voluntary Site-Level Forest Management Guidelines for Landowners, Loggers and Resource Managers*. The new biomass guidelines are presented as two additional chapters for the 2005 guidebook:

- Biomass Harvesting on Forest Management Sites
- Woody Biomass Harvesting for Managing Brushlands and Open Lands

Please insert the two enclosed chapters, with tabs, at the back of your 2005 loose-leaf guidebook (directly after the Appendices section). Insert this cover sheet directly before the Table of Contents (to become the fourth sheet in the guidebook).

For the sake of efficiency, and to avoid having to reprint multiple sections of the existing 2005 guidebook, the two new chapters are **not** integrated into the rest of the guidebook. Instead of updating the existing *Rationale, Resource Directory, Glossary* and *Appendices* with biomass harvest information, the two biomass harvest chapters include their own *Rationale, Additional Resources, Glossary* and *Appendices* sections.

In addition, the full guidebook Table of Contents, located at the beginning of the guidebook, has not been revised to reflect the two new chapters. Full integration of the new biomass harvest guidelines with the General Guidelines and activity-specific guidelines is expected to occur at the time of the next revision of the entire 2005 guidebook.

(continued on back)

While these new biomass chapters have not been integrated into the rest of the 2005 guidebook, the existing guidelines **have** been fully integrated into the two new chapters. The biomass harvest chapters include extensive references to both the *General Guidelines* and the *Timber Harvesting* guidelines.

As is the case with the rest of the activity-specific forest management guidelines in the guidebook (such as *Timber Harvesting* and *Forest Road Construction and Maintenance*), **it is essential that the biomass harvest guidelines be considered and implemented in close conjunction with the General Guidelines** (the green tabbed section of the guidebook) and, in some instances, the *Timber Harvesting* guidelines (the light blue tabbed section).

For additional hard copies of these two biomass harvest chapters, as well as copies of the entire 2005 *Guidelines*, call or email the Minnesota Forest Resources Council (651-603-6761 or mcine017@umn.edu), or visit the MFRC website (www.frc.state.mn.us) to download copies.

Woody Biomass Harvesting for Managing Brushlands and Open Lands

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Woody Biomass Harvesting for Managing Brushlands and Open Lands

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REMEMBER:

Guidelines help with how to manage, not whether to manage.

These guidelines focus on **how** to protect the functions and values of brushland and open land resources during woody biomass harvesting management activities. They generally **do not** provide advice on **whether** to manage or **which** management activities are needed. These guidelines do, however, recommend avoiding or modifying biomass harvest of some sites of statewide ecological significance or ecological sensitivity.

Guidelines provide a menu, not a mandate.

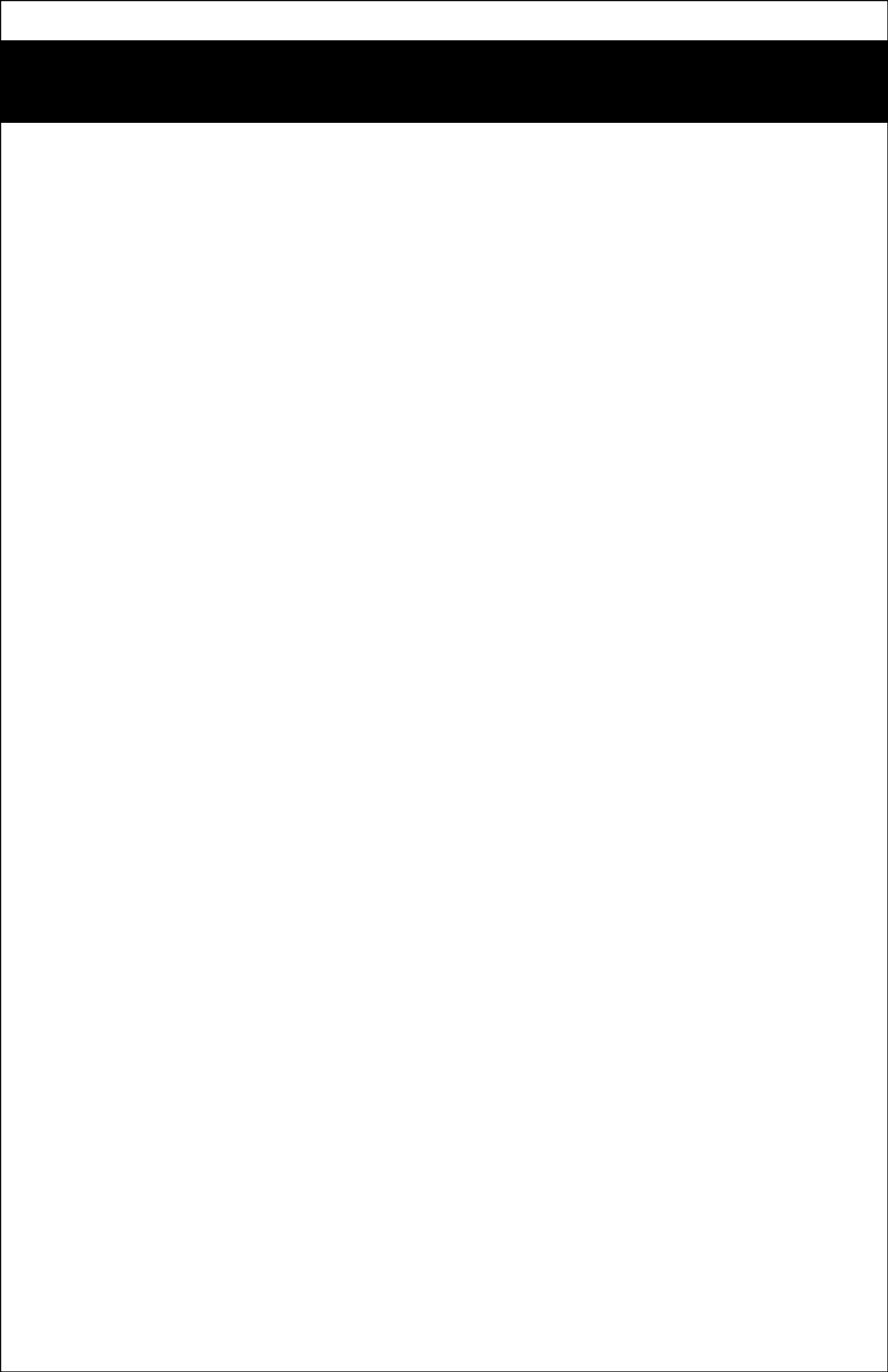
Site-level resource management decisions are based on many different factors, including resource needs, landowner objectives, site capabilities, existing regulations, economics and the best information available at any given time. **No one will apply all of the guidelines** related to a particular activity. Instead, the landowner, resource manager or logger will consider many different factors in determining which combination of guidelines provides the best “fit” for a particular site at a particular time. The intent of these guidelines is to provide a menu of site-level management practices that provide for the harvesting of woody biomass while ensuring the sustainability of brushland and open land habitats in Minnesota.

General guidelines and activity-specific guidelines are closely related.

Frequent references from activity-specific guidelines back to the General Guidelines will make it easy for landowners, resource managers, loggers, biomass harvesters and others to consider all of the related guidelines—both general and specific—that apply to a particular management activity.

Guidelines are supplemented from time to time by “Additional Considerations.”

The guidelines are supplemented from time to time by “Additional Considerations,” which provide additional guidance to further promote sustainable brushland and open land resources.



INTRODUCTION AND RATIONALE

New Opportunities for Managing Minnesota Brushlands

Recent legislation and increased demand for woody biomass as a source of renewable fuel have provided new opportunities for managing Minnesota's brushlands. Recent expansion of the definition of *farm-grown closed-loop biomass*, which public utilities seeking to fulfill the state's biomass mandate must meet, includes the term *sustainably managed woody biomass*. This term, as defined in Minnesota Statutes Chapter 216B, Section 2424 (M.S. § 216B.2424), includes the following:

- Brush and trees removed from rights-of-way
- Upland and lowland brush harvested as part of brushland habitat management
- Logging slash or residue created by timber harvest, timber stand improvement, fuel management, or insect and disease control or treatments

These guidelines or best management practices (BMPs) for *sustainably managing woody biomass* have been developed to guide the use of woody biomass harvesting as a tool for "managing and maintaining brushland and open land habitat on public and private lands" (as designated in M.S. § 216B.2424, Subd. 1a, Paragraph h). These guidelines are **not** intended to apply to agricultural lands actively managed for woody biomass.

For purposes of these guidelines, **the term "biomass harvesting" includes the process of cutting, collecting and removing woody biomass from brushland or open land management sites.** This woody biomass might include tops and limbs from trees, snags and coarse woody debris (CWD). Primarily, however, it would include woody shrubs (e.g., willow and alder) harvested on **lowland** brushland sites. Woody biomass may also include **upland** brush species harvested on upland sites. (See photo on page 6.)

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Winter shearing of this brushland management site resulted in significant amounts of potential biomass. *Photo courtesy of Minnesota DNR Wildlife*

Brushland and Open Land Habitats

Brushlands and open land habitats are found throughout Minnesota.

Brushlands and open lands are predominantly non-forested habitats dominated by shrubs (i.e., alder, willow), grasses, sedges and herbs.

Brushlands differ from open lands only by the percent cover of trees and shrubs. Open lands are open habitats with less than one-third total cover by trees and shrubs, while brushlands have higher tree and shrub cover. Both habitats are found in the following ecological systems as defined by the Minnesota Department of Natural Resources (DNR) *Field Guides to the Native Plant Communities of Minnesota*: acid peatlands, forested rich peatlands, open rich peatlands, upland prairies, rock outcrops, wet meadow/carrs and wetland prairies.

Some fire-dependent woodlands and wet forests may also be considered brushlands; these habitats are included in the chapter titled *Biomass Harvesting on Forest Management Sites*.

Often, brushlands and open lands are early successional or “young” habitats, which typically require periodic disturbances to maintain themselves. Historically, these habitats tend to be fire dependent. Other brushlands and open lands, however, including most lowland shrub habitats and nutrient-poor peatlands, are relatively stable or “slow-to-change” habitats. For these habitats, management disturbance intervals are much longer than for more fire-dependent communities. Changes in hydrology are more likely to affect succession in such peatlands.

Wildlife and Brushland/Open Land Habitats

Many wildlife species use these habitats, and many of these species are rare or declining, especially those dependent on open land habitats. A total of 154 species of vertebrate wildlife are considered dependent on open lands, and 18 species are considered dependent on brushland habitats in Minnesota. Sharp-tailed grouse, moose, woodcock, alder and willow fly-catchers, and golden-winged warblers are examples of species that are dependent upon brushland habitats. See *Appendix 1* for a complete list of brushland- and open land-dependent species.



The woodcock is an example of a species that is dependent on brushlands for habitat. *Photo by Richard Baetsen, U.S. Fish and Wildlife Service Digital Library System*

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Open land-dependent species need sites hundreds to thousands of acres in size to sustain their populations. For brushland-dependent species, some require large areas of brushland, while others are equally at home in smaller brushland areas.

Protecting Soil Resources

Appropriate woody biomass harvesting strategies should be employed to ensure that harvesting does not reduce the primary productivity of brushlands or open lands through inappropriate removal of nutrients or disruptions of nutrient cycles. It is important to maintain an appropriate balance among nutrient capital, rates of nutrient replenishment and rates of nutrient removal associated with harvesting.

On most Minnesota brushland and open land soils, nutrient removal through harvest of biomass is not a concern, since brushland species have relatively high rates of mortality. Therefore, even sites with high nutrient capital do not attain the same levels of above-ground biomass as those of forests:

- Sites with highest biomass—and therefore the greatest rates of nutrient removal associated with harvesting—are also sites with highest levels of nutrient capital and highest rates of nutrient replenishment. As a result, data indicate that nutrients lost during harvest are usually replaced in less than 10 years.
- On less-productive sites, rates of nutrient replenishment are lower. At the same time, though, biomass—and, hence, nutrient removal—is also lower. As a result, nutrients lost during harvest are replaced in less than 10 years. In other words, a site's inherent productivity influences the rate of nutrient removal and helps maintain the site's appropriate nutrient balance.

Soils provide an environment suitable for a vast array of plants and animals, ranging from microscopic bacteria to small mammals. Careful guideline implementation that sustains the physical and chemical characteristics of the soil will, in large part, maintain the biological characteristics, as well.

Most biological activity in the soil takes place in the surface soil or litter layers. Organisms that thrive on a site depend on characteristics of the organisms, as well as such soil factors

as moisture, temperature, aeration, and nutrient and energy supplies. The importance of retaining organic material at the soil surface (including the litter layer) and also retaining root systems cannot be stressed enough. Although these components are a potential source of biomass, they are also extremely important to a wide variety of ecosystem functions, such as nutrient supply, erosion control, water retention and rooting medium, as well as biological aspects of the soil.

The Process of Woody Biomass Harvesting

Woody biomass harvest provides the opportunity to manage brushland and open land habitats, as well as provide a source of renewable products, such as fuel. Generally, woody biomass harvest involves the mechanical removal of most of the woody brush and trees from a managed site.

In recent years, these brushland and open land communities have been managed by shearing, mowing or burning, and did not include the removal of this material from the site. "Shearing" with a bulldozer over frozen ground is often used to regenerate large stands of "stagnant" brushland. Brush and trees are sheared at ground level, after which new growth sprouts vigorously, providing optimum habitat for brushland species for several years. (See Figure BHB-1, page 10.)

Woody biomass harvest of brushlands may involve the following steps:

- Planning for harvest and regeneration
- Cutting woody vegetation (possibly bundling)
- Moving the product to a landing
- Processing the product (chipping or bundling and perhaps drying)
- Loading and transporting the product

These activities involve the operation of heavy equipment, creation of temporary roads for access to sites, and creation of landings. Harvest of brushlands may occur on upland sites; however, the majority of woody biomass harvesting will likely occur in lowland brush communities (wetlands).

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Figure BHB-1

Approaches To Managing Brushlands and Open Lands



Mowing



Burning



Shearing

Approaches to managing brushlands and open lands may include mowing, burning or shearing. *Photos courtesy of Minnesota DNR Wildlife*

A Menu of Site-Level Management Practices

Landowners and managers need to make decisions and set goals for site management. The intent of these guidelines is to provide a menu of site-level management practices that provide for the harvesting of woody biomass while ensuring the sustainability of brushland and open land habitats in Minnesota.

The Benefits of Guidelines

Benefits to cultural resources: Woody biomass harvesting guidelines can minimize the potential negative effects of harvesting activities, such as mixing of surface soils, rutting, compaction and erosion, which can damage certain kinds of cultural resources. Guidelines for construction of haul roads and landings, felling, skidding and slash management can help to protect cultural resources.

Benefits to soils: Woody biomass harvesting guidelines are designed to help protect the physical, chemical and biological properties of soils by minimizing the effects of soil compaction and rutting, erosion and nutrient removal that can result from woody biomass harvesting activities.

Benefits to riparian areas: Woody biomass harvesting guidelines are designed to maintain or restore vegetation within the riparian area that is characteristic of the desired condition of the site. Riparian vegetation is important for retaining nutrients, sediment and energy; stabilizing banks and shorelines; maintaining moderate water temperatures; and providing wildlife habitat.

Benefits to water quality, water quantity and wetlands: Woody biomass harvesting guidelines are designed to protect water quality and quantity for all water bodies by minimizing excessive soil disturbance and impacts in close proximity to streams, lakes and wetlands. Guidelines that address equipment operations and maintenance can help protect water bodies from excessive sediment and nutrient loadings by minimizing rutting

and damage to wetland surface features, such as hummocks. Guidelines that address vegetation management planning can also help maintain normal water flows.

Benefits to wildlife habitat: Guidelines related to woody biomass harvesting suggest management activities that resemble relevant natural disturbance regimes and natural stand development processes. They are designed to maintain or improve structural components of the brushland or open land site for the benefit of wildlife.

Benefits to restoration of native plant communities: As a result of fire suppression, many brushland and savanna native plant communities have become overgrown with woody vegetation when compared with historical conditions. Woody biomass harvest, if conducted carefully, can be an important tool for restoring these native plant communities.

Choosing Appropriate Guidelines for Woody Biomass Harvesting

Specific site-level guidelines may vary depending on both the current condition and the desired future condition of a biomass harvesting site. The user should define the desired future condition as brushland, open land or forest, using the decision key in Figure BHB-2 (see page 14). Keep in mind the following definitions:

- Forests** are communities of plants, animals and microorganisms, and the physical environment they inhabit, in which trees are the dominant life form.
- Brushlands and open lands** are predominantly non-forested plant communities dominated by shrubs, grasses or sedges, and herbs. Brushlands and open lands differ from each other only by the percent cover of trees and shrubs:
 - Open lands are plant communities with less than one-third (1/3) total cover by trees and shrubs.
 - Brushlands have higher tree and shrub cover.

Both brushlands and open lands may be found in the following ecological systems: peatlands, upland prairies, rock outcrops, wet meadow/carrs and wetland prairies. These systems are defined in the Minnesota DNR *Field Guides to the Native Plant Communities of Minnesota*. (For visual examples of these various ecological systems, refer to photos on pages 40-42.)

The decision key in Figure BHB-2 (page 14) is designed to direct the user to the appropriate set of biomass harvest guidelines for these plant communities:

Forest biomass harvest: Follow guidelines in the chapter titled *Biomass Harvesting on Forest Management Sites*.

Brushland woody biomass harvest: Follow guidelines found in this chapter; however, where specific differences are indicated between brushland habitats and open land habitats, follow recommendations made for structural habitat for brushland habitats (see Table BHB-1, page 38-39).

Open land woody biomass harvest: Follow guidelines found in this chapter; however, where specific differences are indicated between brushland habitats and open land habitats, follow recommendations made for structural habitat for open land habitats (see Table BHB-1, page 38-39).

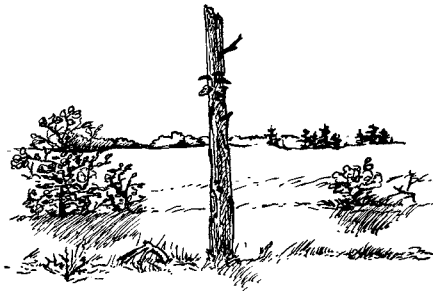
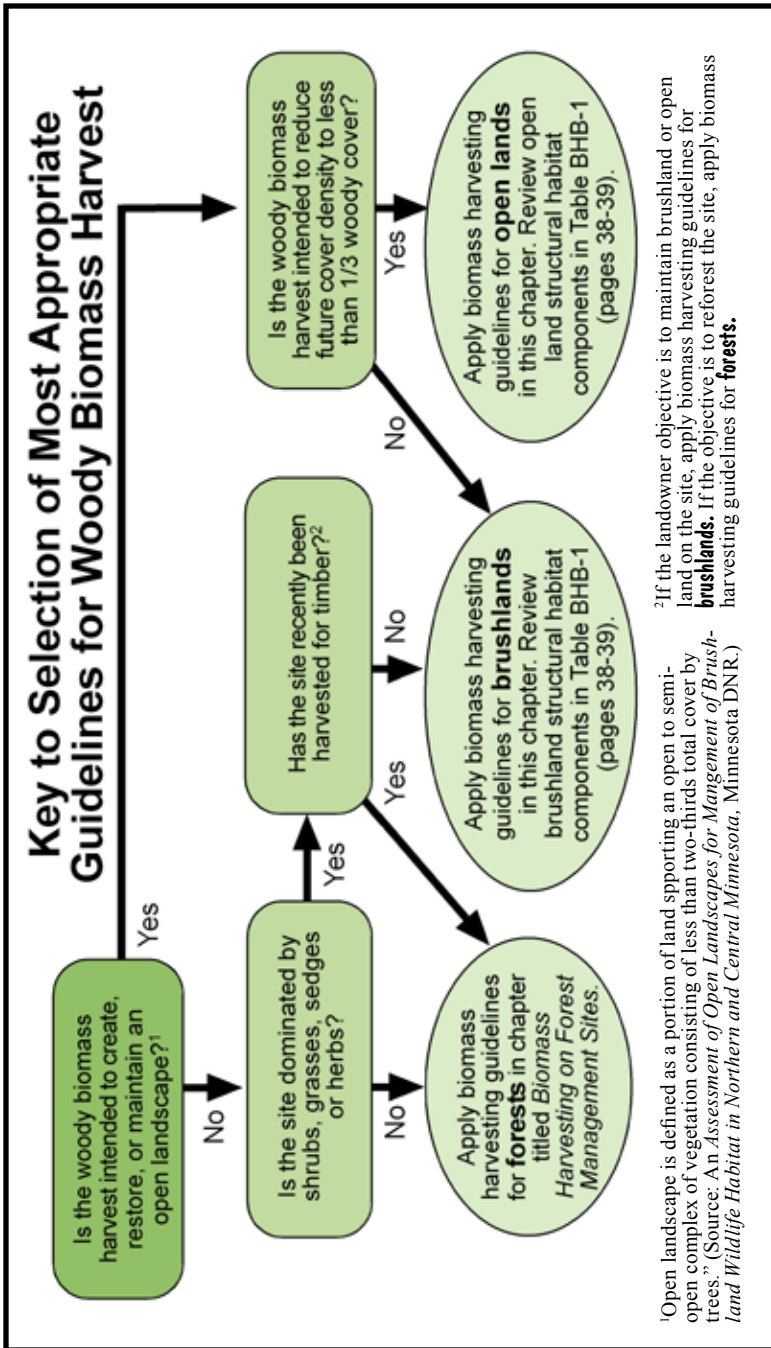


Figure BHB-2



¹Open landscape is defined as a portion of land supporting an open to semi-open complex of vegetation consisting of less than two-thirds total cover by trees.” (Source: *An Assessment of Open Landscapes for Management of Brushland Wildlife Habitat in Northern and Central Minnesota*, Minnesota DNR.)

²If the landowner objective is to maintain brushland or open land on the site, apply biomass harvesting guidelines for **brushlands**. If the objective is to reforest the site, apply biomass harvesting guidelines for **forests**.



- **Have you identified your objectives?**
See *Identifying Goals and Objectives*
in *General Guidelines* (pages 7-9).
- **Have you conducted a site inventory?**
See *Conducting a Site Inventory*
in *General Guidelines* (pages 10-17).

PLANNING, DESIGN AND OPERATIONAL ACTIVITIES

Using General Guidelines for biomass harvesting activities

Not all General Guidelines will fit biomass harvesting in brushlands and open lands. For example, retention of leave trees and CWD may not be appropriate for brushland and open land sites. In addition, riparian management zone (RMZ) guidelines in this chapter differ from those in the General Guidelines.

In addition, for many of the General Guidelines, you will need to **substitute the existing words "forest management" with the words "brushland and open land management."** With those substitutions, the majority of existing General Guidelines apply to brushland and open land biomass harvesting.

➤ **IMPORTANT!** For all activities, review and implement **General Guidelines**, including:

- Incorporating Sustainability into Forest Management Plans (pages 17-24)
- Maintaining Filter Strips (pages 24-28)
- Protecting Cultural Resources (pages 68-69)
- Managing Equipment, Fuel and Lubricants (page 70)
- Protecting the Normal Flow of Streams and Wetlands (pages 71-72)
- Protecting Non-Open Water Wetlands and Seasonal Ponds (page 73)
- Managing Dry Washes in Southeastern Minnesota (pages 74-75)

In addition:

For activities involving constructing and maintaining haul roads, refer to *Forest Road Construction and Maintenance* guidelines.

These guidelines combine planning and design activities with operational activities. This combined approach recognizes a commitment to resource sustainability related to both planning/design and operational considerations:

Planning guidelines recognize that many considerations related to resource protection and sustainability are common to most management activities, and that the commitment to sustainability begins in the early planning stages—long before the actual management activity begins.

Operational guidelines recognize that on-site activities carry out the commitment to sustainability that was begun during the planning phase.

Designing Operations To Fit a Sustainable Management Plan

Management activities should follow a well-thought-out plan that defines such factors as resource protection, the extent and duration of the activity, the most appropriate season and method of operation for the activity, appropriate biomass harvesting management guidelines to limit site disturbance, and other management objectives related to brushland or open land resource sustainability.

The timing of management activities can be constrained by pre-existing or seasonal conditions, regulations and limitations, such as seasonal road load limits, seasonal access limitations, fire hazard conditions, and appropriate times for such activities as road construction.

☛ Review existing guidelines, including:

General Guidelines:

- Identifying Goals and Objectives (pages 7-9)
- Conducting a Site Inventory (pages 10-17)
- Incorporating Sustainability into Forest Management Plans (pages 17-24)

☛ In addition:

- ✓ **Determine whether the site is appropriate** for biomass harvest.
- ✓ **Prepare an inventory of important resources** (i.e., trees, shrubs, soil, water, recreation, wildlife, fish).
- ✓ **Consider and incorporate brushland and open land management goals**, harvesting efficiencies and site impacts.
- ✓ **Address the practical application of stated goals and objectives** for the site.
- ✓ **Determine the regeneration goals** and desired vegetative composition for the site.

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✓ **Determine whether the site includes areas** with known occurrence of endangered or threatened species, rare native plant communities or imperiled native plant communities listed in Appendix J and/or Appendix 2 addendum on pages 54-55.

- To determine whether any of these species or native plant communities are known to occur on a site, consult with local DNR offices and/or the Minnesota County Biological Survey (MCBS) Native Plant Communities GIS (geographic information system) layers, which may be downloaded from the DNR Data Deli at <http://deli.dnr.state.mn.us> (GIS software and skills are necessary).

✓ **Document the location** of sensitive native plant communities.

✓ **Document reserve areas** within the general harvest area and adjacent to RMZs.

✓ **Employ operators trained in guideline implementation** to aid in proper and efficient application of site-level woody biomass harvesting guidelines.

✓ **Use natural features and avoid artificial patterns where possible.** These natural features may correspond to changes in topography, soils, wetland interfaces, and brushland and open land communities.

✓ **Document the filter strip and/or RMZ width** and the management objective.

- The RMZ management objective (e.g., brushland or open land habitat) may be the same as or different from the objective for the general harvest area.
- Indicate the preferred residual species, as well as the distribution of those residuals within the RMZ (e.g., clumped, scattered).

✓ **Conduct on-site meetings** with the operator, landowner and resource manager prior to moving equipment onto a site. Such meetings can help assure common understanding of landowner objectives, woody biomass harvest specifications and site conditions.

Cultural Resource Protection

☞ **Review existing guidelines**, including:

General Guidelines:

- Protecting Cultural Resources (pages 68-69)

☞ **In addition:**

✓ **Exclude cultural resource areas** from brushland or open land harvest unless protected under frozen conditions.

✓ **Keep roads, haul trails and landings away from cultural resource areas.**

✓ **If harvest will take place on or near a cultural resource**, consider applying guidelines in *Timber Harvesting: Protecting Sensitive Areas* (pages 20-21).



Sensitive Area and Species Protection

☛ **Review existing guidelines**, including:

General Guidelines:

- Gathering Information (pages 10-11)
- Rare or Sensitive Species (pages 23-24)

☛ **In addition:**

✓ **Avoid or modify management in native plant communities** that are listed in Appendix J, along with Appendix 2 of this chapter.

- To determine whether these native plant communities are known to occur on the site, consult with the local DNR offices and/or the Minnesota County Biological Survey (MCBS) Native Plant Communities GIS (geographic information system) layers, which may be downloaded from the DNR Data Deli at <http://deli.dnr.state.mn.us> (GIS software and skills are necessary).

- **Biomass harvesting may still be appropriate** under the following conditions:

- * If management plans specifically include strategies to maintain habitat for rare species and/or to restore degraded native plant communities.

- * If biomass harvesting is used as a tool to restore degraded native plant communities (e.g., overgrown savanna plant communities). Consult appropriate DNR Ecological Resources regional plant ecologist.

- * If biomass harvesting is used as a management tool to assist with ecological management of the native plant community (e.g., creating a fire break as part of burning a fire-dependent native plant community). Consult appropriate DNR wildlife manager and DNR regional plant ecologist.

✓ **Avoid biomass harvest within specific sites where plant or animal species listed as endangered or threatened** at the state or federal level are known to exist (e.g., sites identified in the DNR Natural Heritage Information System), or where such species are discovered during operations and where biomass harvest would harm them (unless harvest has been demonstrated to maintain or improve habitat for these species).

- To determine whether these species are known to occur on the site, consult local DNR offices.
- If a bald eagle nest occurs on or near the site, see *Recommendations for Avoiding and Minimizing Impacts* at http://files.dnr.state.mn.us/natural_resources/animals/birds/eagles/factsheet.pdf

✓ **Reference M.S. § 216B.2424 for Biomass Power Mandate** and urge affected utilities to follow the statute as reference.

- M.S. § 216B.2424 Subd. 1a and f, directs that, for utilities specified within this statute, no woody biomass may be harvested from any lands identified by the final or preliminary Minnesota County Biological Survey as having statewide significance as native plant communities, large populations or concentrations of rare species, or critical animal habitat. See *Additional Resources* (page 46) to access complete statute online.

✓ **Avoid or modify management activities on sensitive locations** (either identified during the planning process or discovered during the actual woody biomass harvest) to maintain, promote or enhance sensitive features.

- Sensitive areas may include known locations of endangered or threatened species, imperiled communities, special soil conditions, lagg areas, topographic features, cultural resources, rare features and other areas that make them more sensitive to disturbance than others. (See photo on page 22.)



This sharp-tail dancing ground, or “lek,” is one example of the kinds of sensitive areas that may be found in brushland or open land management sites. *Photo courtesy of Minnesota DNR Wildlife*

- ✓ **Employ harvesting techniques that minimize the need** to operate equipment on steep slopes. When harvesting steep slopes is unavoidable, employ appropriate harvesting techniques and equipment.
- ✓ **Prevent tearing of the root mat when crossing lagg areas** (see Figure BHB-3 on page 23) by applying such techniques as the use of low ground pressure equipment; not turning equipment while traversing the lagg; and the use of corduroy, slash mats or tire mats when crossing the lagg. Refer to local, state and federal wetland regulations when placing materials in wetlands.

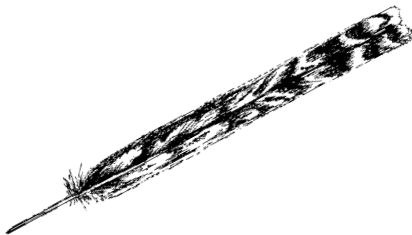
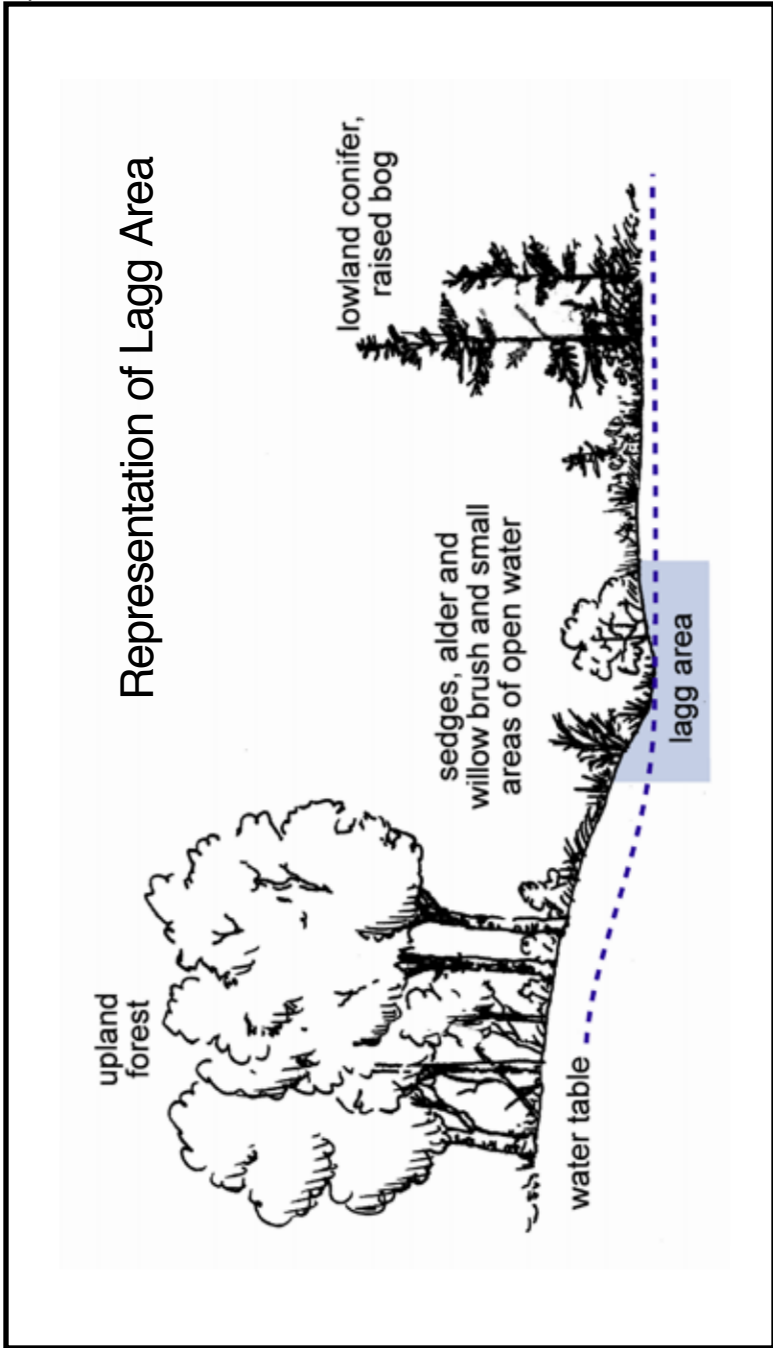


Figure BHB-3



Maintaining Visual Quality and Reducing Conflicts with Recreational Users

By their very nature, brushland and open land habitats provide broad, open vistas. The concepts of small openings and reduced harvest size are often not applicable with open lands management. At the same time, though, a well-managed site (even a large one) can be managed to improve visual quality. With this understanding in mind, follow the *General Guidelines* relating to noise and visual quality (page 19).

In all areas:

- ✓ **Encourage full utilization of all species** harvested in the management area.
- ✓ **Remove biomass products from visible landings** as soon as possible (practical).

In areas classified as most or moderately sensitive:

- ✓ **Avoid landings, when possible, within view of travel routes** or recreation areas.
- ✓ **Keep number of landings to a minimum.**
- ✓ **Treat any products and waste material at landings** as soon as possible.
- ✓ **Seed, plant and regenerate landings** promptly.
- ✓ **Remove all trash from landings** upon completion of harvesting.

In areas classified as less sensitive:

- ✓ **Avoid landings within a travel route right-of-way.**
- ✓ **Consider locating landings outside of maintained road rights-of-way** whenever possible.
- ✓ **Remove all trash from landings** upon completion of harvesting.

See Part 2 (yellow section), *Visual Quality: Visual Sensitivity Classifications* (pages 6-9) for information related to how classifications are determined and which Minnesota counties have developed visual sensitivity classification maps.

Soil Resource Protection

Susceptibility to compaction and rutting on wetlands is dependent on several factors, including frequency of equipment trafficking, type of equipment used, soil type (mineral or organic), soil water content at the time the activity is conducted, and season of activity.

In general, for mineral soil wetlands, compaction and rutting increase as soil texture becomes finer and soil water content increases. In unfrozen peatland, deep rutting can bring muck to the surface and block normal water flow.

Winter alone does not ensure frozen ground. Often brushlands and open lands are located on hydric soils, causing difficulty in freezing down areas of impact beyond haul roads. With sites susceptible to rutting and compaction, specify frozen conditions rather than setting an arbitrary date or season.

Removal of vegetation may increase the wetness of the site due to reduced transpiration, affecting the vigor, composition, structure and regeneration of the residual vegetation.

☐ **Soil impacts can be minimized** by limiting the soil area impacted by infrastructure (roads, landings), and by careful consideration of timing, equipment being used and harvesting methods.

☞ **Review existing guidelines**, including:

General Guidelines:

- Timing and Coordination of Activities (pages 17-18)
- Designing Operations To Fit Site Conditions (page 20)
- Managing and Minimizing Infrastructure (pages 20-21)

☞ **In addition:**

✓ **Retain the soil's hydrologic condition.** Alterations to drainage patterns (especially enhanced flooding) can change the availability of pore space and oxygen levels, which impact soil flora and fauna.

✓ **Consider soil or site conditions that may dictate specific timing,** harvest methods or equipment to be used, or that may lead to weather-related or seasonal closure of the operation to protect water and cultural resources.

✓ **Conduct management operations during preferred operating seasons.** The use of low ground pressure equipment, as well as such operating techniques as using slash mats, can extend operating seasons on low-strength soils. (See photo page 27.)

✓ **Minimize rutting in primary haul trails,** roads and landings.



Winter harvesting is one example of timing management activities to protect soil and cultural resources. *Photo courtesy of Minnesota DNR Wildlife*

✓ **Avoid rutting in the general harvest area.**

- If repeated rutting occurs in the general harvest area (outside of primary haul trails), use alternative operating techniques, such as the following:

- * Shifting harvest operations to a stable portion of the harvest area.
- * Using low ground pressure equipment.
- * Using slash on haul trails as a driving surface.
- * Reducing loads carried by harvesting equipment.
- * Packing the snow or ground cover with low ground pressure equipment to enhance freezing and permit off-trail operation of equipment.

✓ **If alternative operating techniques fail to eliminate rutting, stop harvesting operations.**

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✓ **Avoid harvesting in or on sites that are extremely wet**, such as water tracks or lagg areas. These sites exhibit conditions that make it unlikely to produce enough frozen material to support heavy equipment. These sites could include the native plant community OPn91–Northern rich fen–water track.

Woody biomass harvesting should be conducted to sustain the productivity of the soil and ensure the survival and long-term growth of desired vegetation on the site. To accomplish this, the following guidelines are recommended:

✓ **Use a site's inherent productivity** (as indicated by rate of vegetative regrowth) and management strategy to indicate frequency of biomass harvest. Rapid regrowth allows for more frequent harvest; slow regrowth suggests longer intervals between harvests.

✓ **Lay out haul trails to minimize site disturbance** while achieving necessary operating efficiency.

✓ **Occupy no more than 1-3% of the woody biomass harvest area** by roads and landings (small or irregularly shaped units may result in higher percentages).

✓ **Stabilize bare soil areas and haul trails** that are susceptible to erosion.

When shearing or harvesting brush:

✓ **Conduct shearing activities under frozen** soil conditions.

✓ **Sever stems cleanly** at or just above ground level.

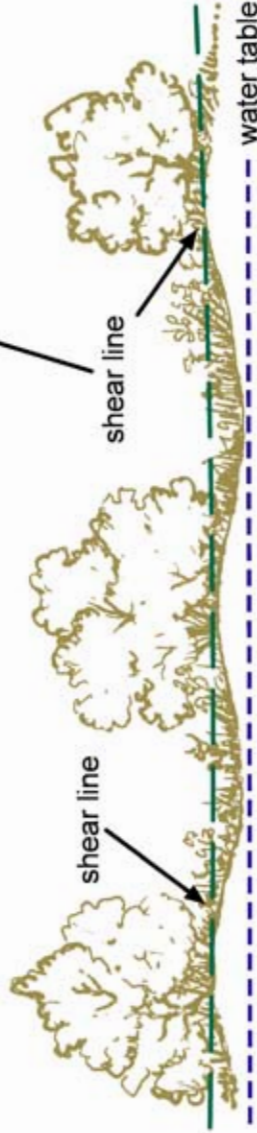
✓ **Avoid uprooting vegetation**, including brush.

✓ **Avoid scraping soil material or hummocks into windrows or piles.** Shearing off hummocks reduces the roughness of a wetland's surface, increasing runoff flows and channeling water. (See Figure BHB-4, page 29.)

Figure BHB-4



View from above of sheared brush at correct shear depth.



Shearing Hummocks

Avoid scraping soil material or hummocks into windrows or piles. Shearing off hummocks reduces the roughness of a wetland's surface, increases runoff flows, and channelizes water. *Photos courtesy of Minnesota DNR Forestry*

Water Resource Protection

- Wetlands are highly productive sites**, which are essential for maintaining and enhancing water quality. All biomass management operations in or adjacent to wetlands should be planned and conducted in a manner that protects water quality.
- Using appropriate biomass management guidelines for harvesting activities** will minimize the potential for sediment, chemical, nutrient and debris movement into streams, ditches, lakes, wetlands, seasonal ponds and ground water, as well as minimizing thermal (heating) impacts on surface waters.
- Operations in wetlands are regulated.** The Minnesota Wetland Conservation Act requires that anyone proposing to drain, fill or excavate a wetland contact the local government unit (cities, counties, watershed management organizations, soil and water conservation districts or townships) for the necessary permits.
- Contact the appropriate local governmental unit for advice** on federal, state and/or local wetland regulations.
- Plan biomass harvesting activities to avoid building landings**, haul trails and roads in wetlands. Where avoidance is not practical, minimize impacts by limiting the extent of these activities in wetlands.
- Include provisions for water quality protection** in the biomass sale contract.
- Minimize the crossing of intermittent or perennial streams and open water wetlands.** On both upland and lowland sites, install bridges, culverts, snow or ice bridges, fords or other structures, if necessary, to prevent repeated soil and ditch or streambank disturbance where no practical alternative exists to crossing a ditch or stream.

IMPORTANT: Such activity may require a permit from the Minnesota DNR. See *Appendix H: Work Activities That Do Not Require a DNR Public Waters Permit on Public Waters, Public Water Wetlands and Public Watercourses.*

✓ **Minimize long, straight haul roads that channel water.**

- If long stretches cannot be avoided by careful design and location, provide adequate drainage to avoid concentration of surface water flow.

- Divert water by proper shaping of the road surface and by using broad-based dips, lead-off ditches or water bars. See *Forest Road Construction and Maintenance: Drainage* (pages 25-27) and *Cross-Road Drainage* (pages 28-31).

✓ **Incorporate water diversion and erosion control practices** where needed during woody biomass harvest activity (including water bars, tops and branches, ditch blocks and lead-offs).

- Divert surface flow before it enters landings or a water body.

- Incorporate water diversion devices and erosion control practices during construction rather than as a remedial activity. See *Forest Road Construction and Maintenance: Drainage* (pages 25-27) and *Cross-Road Drainage* (pages 28-31).

✓ **Avoid scraping soil material or hummocks into windrows or piles.**

Shearing off hummocks, tussocks or other surface roughness of wetlands increases runoff flows and channelizes water.

Filter Strips

Managing a filter strip between the water body and the disturbance on site can protect surface water quality and maintain streambank stability. Biomass harvesting activities, prescribed burning and road construction may increase the potential for sedimentation due to soil exposure. Management activities may be conducted in filter strips as long as the integrity of the filter strip is maintained. These activities should produce minimal exposure of mineral soil.

Filter strips are areas adjacent to perennial and intermittent streams, ditches, lakes, open water wetlands, non-open water wetlands, seasonal ponds, seeps and springs. They provide a zone of undisturbed soil to help slow runoff, provide greater infiltration, prevent erosion and trap sediment, debris, nutrients and pesticides from adjacent land areas.

☞ Review existing guidelines, including:

General Guidelines:

- Maintaining Filter Strips (pages 24-28)

☞ In addition:

✓ **Apply filter strip guidelines** to all perennial and intermittent streams, ditches, lakes, open water wetlands, non-open water wetlands, seasonal ponds, seeps and springs. Filter strips should border and parallel the edge of all water bodies. Apply them independently of the width of the RMZ. (See Figure BHB-5 on page 33.)

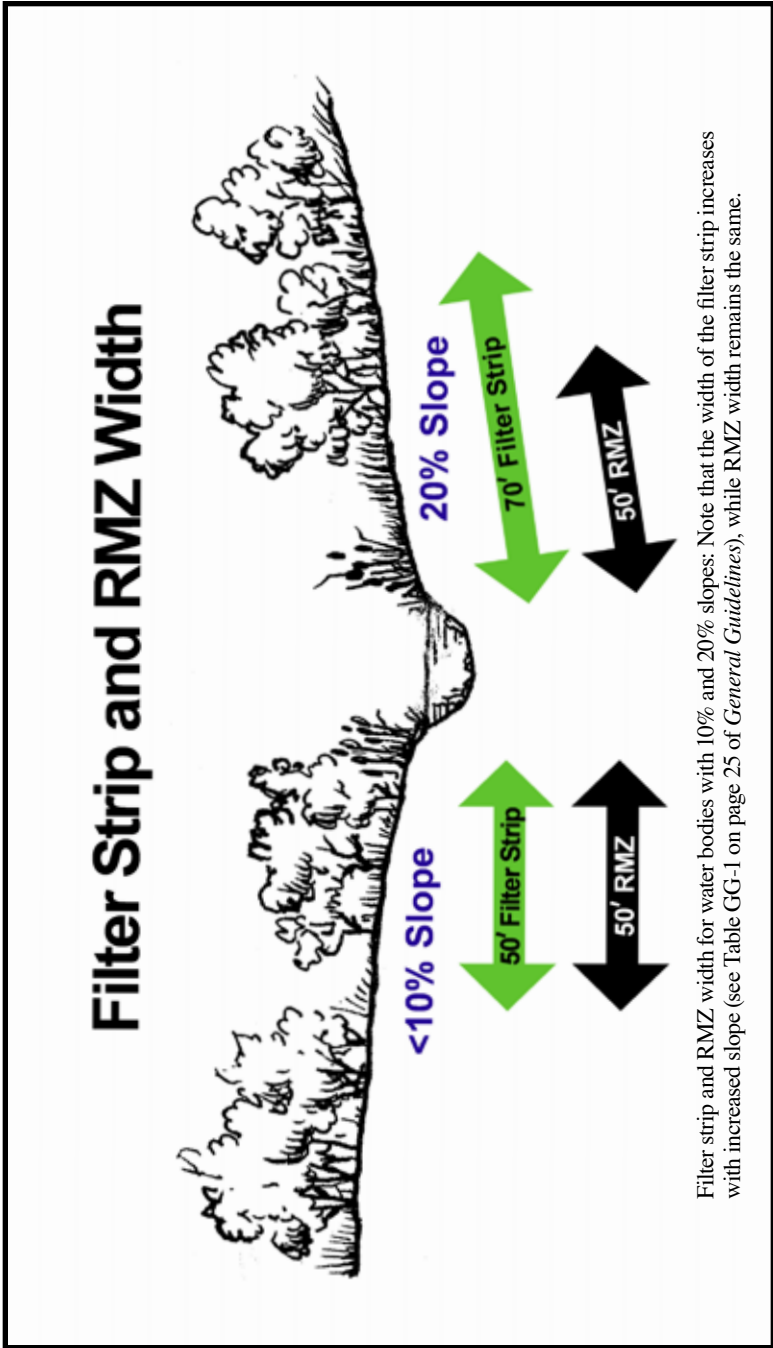
✓ **Avoid operation of heavy equipment directly adjacent to streambanks** or shorelines of water bodies. Utilize hand felling and/or equipment with the ability to reach into this zone (such as boom cutting heads) as a means of managing vegetation.

✓ **Consider additional stabilization measures**, when necessary (such as the use of slash, mulch and silt fences), including instances when:

- An area of soil is exposed within the filter strip and sedimentation is likely to result.
- Management objectives preclude the use of a filter strip and sedimentation is likely to occur.



Figure BHB-5



Filter strip and RMZ width for water bodies with 10% and 20% slopes: Note that the width of the filter strip increases with increased slope (see Table GG-1 on page 25 of *General Guidelines*), while RMZ width remains the same.

Riparian Management Zones

Primarily, riparian management zones (RMZs) help protect riparian functions, such as habitat, water quality, thermal protection for aquatic habitats, and streambank stability. Landowners, resource managers and operators should consider habitat needs of plant and animal species to be managed, as well as the protection and maintenance of supporting riparian functions, such as water temperature, sedimentation and recreation.

When operations occur for woody biomass harvest of brushlands or open lands, water quality and streambank stability functions are protected through the design and use of both filter strips and RMZs. Habitat functions, on the other hand, are protected with the design and inclusion of appropriate reserve areas.

The goal of brushland or open land RMZ guidelines is to provide for functions related to thermal protection and flow detention/retention:

- Thermal protection is necessary for cold-water fisheries and other species that require cold waters.
- Flow detention/retention is necessary to retain channel stability in the interim between harvest and regrowth.

Loss of plant matter due to harvest operations changes the hydrologic regime by increasing bankfull and flood storage patterns. These alterations may influence the pattern and stability of watercourses by changing meander patterns, increasing bank cuts and inducing higher amounts of sediment deposition.

The following RMZ guidelines apply to sites that occur in large brushland or open land landscapes. For management of RMZs occurring in relatively narrow corridors of lowland or upland brush adjacent to streams and lakes within a **forested** landscape, refer to the chapter titled *Biomass Harvesting on Forest Management Sites*. (See photos page 35.)



Brush within an RMZ in a forested landscape: In a brushy riparian zone within a forested setting, use forest biomass harvesting guidelines to determine RMZs. *Photo courtesy of Minnesota DNR Fisheries*



RMZ in a brushland landscape: In a brushland or open land riparian zone, use brushland and open land biomass harvesting guidelines to determine riparian management zones. *Photo courtesy of Minnesota DNR Forestry*

✓ **Provide for an RMZ width of 50 feet** from the water's edge for all designated trout waters and Public Water Inventory watercourses, as determined by the DNR or discovered during on-site inspection:

- Contact the local DNR hydrologist or area fisheries supervisor, or check the website at www.dnr.state.mn.us/waters/watermgmt_section/pwi
- RMZ width is measured as slope distance (the linear distance along the ground), not horizontal distance from the streamcourse edge at bankfull width.

✓ **Manage vegetation composition within the RMZ** (50 feet from the water's edge) appropriate to native plant community structure (as defined in Table BHB-1, pages 38-39) to protect water temperatures and hydrological functions during regrowth of vegetation:

Brushland or open land management activities may be conducted within the RMZ while reserving the canopy or shrub cover appropriate for the ecological system as recommended in Table BHB-1.

Normal operations apply beyond the 50-foot RMZ boundary.

Removal of trees is acceptable under the condition that RMZ functions are maintained.

✓ **Clearly identify the RMZ** so that operators can identify its location as they work with large equipment. Options to consider include flagging, paint lines or delineation on a map.

✓ **Avoid operation of heavy equipment within the RMZ** of streams or shorelines of water bodies. Utilize hand felling or equipment with the ability to reach into this zone (such as boom cutting heads) as a means of managing vegetation.

✓ **Distribute residual vegetation within the RMZ** relatively evenly, but allow for gap and clump patterns. Avoid creating large cleared areas within the RMZ.

✓ **For beaver ponds**, determine the width of the RMZ calculated from the edge of the stream channel projected through the beaver pond, rather than from the edge of the flooding caused by the presence of beavers. Determine filter strip width from the edge of the pond.

Reserve Areas

Reserve areas are intended to provide for protection of habitat functions within the brushland and open land site.

✓ **Retain 5-10% of the area in reserve areas.** Habitats in reserve patches can be dominated by grasses, sedges or brush, but they should be consistent with the composition of the desired ecological system. A minimum patch area of one acre (0.4 hectares) is recommended.

✓ **Determine the recommended composition** of reserve areas using Table BHB-1 (pages 38-39).

✓ **Create a variety of reserve areas** within harvest sites:

- Composition of reserve areas should vary depending on the ecological system in which the harvest site occurs.
- Reserve areas of trees and snags may not be appropriate for many brushland and open land ecological systems.

✓ **Mimic natural disturbance** by leaving some reserve areas within harvest sites.

Table BHB-1 describes desired structural habitat conditions for various habitat classes associated with brushlands or open lands.

Table BHB-1

Structural Habitat Components of Reserve Areas and RMZs in Woody Biomass Harvest Sites

Habitat Class	Ecological System ¹	Open Land Habitat	Brushland Habitat
Lowland shrub	See definitions on pages 40-42.		
	Open peatland²	Primarily herbaceous. No live trees, shrubs and snags > 2 meters or 6.6 feet tall.	Herbaceous with widely scattered stunted trees and snags (< 10 meters or 33 feet) and sparse tall shrubs.
	Forested rich peatland	Tall shrub-dominated (> 50% cover). No live trees and snags > 2 meters or 6.6 feet tall. (Note: Applies primarily to Northern Alder Swamp.)	Apply woody biomass guidelines for forests.
	Wet meadow/carr	Primarily herbaceous with sparse (< 25% cover) tall shrubs. No live trees, tree regeneration and snags.	Variable tall shrub cover. Tall trees (> 10 meters or 33 feet) occasionally present. Leave all snags and down CWD.
	Wetland prairie	Primarily herbaceous. No trees, tall shrubs and snags.	Primarily herbaceous. No trees, tall shrubs and snags.

table continues on page 39

Table BHB-1 (cont'd)

Upland shrub	Upland prairie³	Primarily herbaceous with sparse low shrubs. No trees, snags, tall shrubs and CWD.	Primarily herbaceous with sparse low shrubs. No trees, snags, tall shrubs and CWD.
Rock outcrop⁴	Rock outcrop⁴	Primarily herbaceous with variable shrub density. No live trees and snags.	Primarily herbaceous with variable shrub density with widely scattered tall trees and snags. Retain all down CWD.
Old fields⁵	Fire-dependent forest/woodland (cut-over) None	Primarily herbaceous. No live trees, shrubs and snags > 2 meters or 6.6 feet tall. Primarily herbaceous. Sparse tall shrubs acceptable. No live trees and snags.	Apply woody biomass guidelines for forests. Dependent upon management objectives.

table begins on page 38

¹ Minnesota DNR, Field Guides to the Native Plant Communities of Minnesota, Ecological Land Classification Program, Minnesota County Biological Survey, and Natural Heritage and Nongame Research Program. St. Paul, Minnesota.

² Includes both open rich and acid peatlands

³ When managing for brush prairies and savanna communities, taller shrubs (1.5-2 meters or 4.9-6.6 feet) are appropriate. Additionally, for savannas, scattered trees (typically less than 10 meters or 33 feet tall) are appropriate.

⁴ This system contains rare native plant communities that are sensitive to woody biomass harvesting. Consult DNR Division of Ecological Resources prior to operating in rock outcrop communities.

⁵ Old fields, or surrogate grasslands, are those developed as a result of human activities since European settlement; they are typically dominated by non-native, cool-season grasses.

Refer to pages 40-42 for definitions and visual examples of ecological systems.

Visual Examples and Definitions of Ecological Systems

For each ecological system defined and represented below, the photo at left represents a more open land habitat, while the photo at right represents more of a brushland habitat, or, in some cases, a woodland habitat.



Open peatland (including open rich peatlands and some acid peatlands): *Open rich peatlands* are areas of grass and/or sedge or low shrub-dominated wetlands influenced by ground-water flow zones. They often have higher concentrations of minerals and higher species diversity compared to acid peatlands. *Acid peatlands* are grass and/or sedge or low shrub-dominated wetlands primarily influenced by precipitation. They are extremely low in nutrients and are acidic and separated from ground water. *Photos courtesy of Minnesota DNR Ecological Resources*



Forested rich peatland: Conifer-dominated or tall shrub-dominated wetlands on deep peat. The water table is normally immediately below peat surface. *Photos courtesy of Minnesota DNR Ecological Resources*



Wet meadow/carr: Grass and/or sedge and shrub-dominated wetland communities subjected annually to moderate inundation following spring thaw and heavy rains. Willows and dogwoods dominate drier sites. *Photos courtesy of Minnesota DNR Ecological Resources (left) and Minnesota DNR Forestry (right)*



Wetland prairie: Prairie habitat dominated by native grasses with species-rich component of forbs (herbaceous plants other than grasses or sedges). Big bluestem and prairie cord grass are the major species on wetter sites, which also support a variety of sedge species. Wetland prairies also support dwarf shrubs (e.g., prairie rose) and true shrubs (e.g., red-osier dogwood). *Photos courtesy of Minnesota DNR Ecological Resources*



Upland prairie: Prairie areas dominated by native grasses with species-rich component of forbs (herbaceous plants other than grasses or sedges). On upland sites, woody species are limited to dwarf shrubs, such as leadplant and prairie rose. Without fire, trees and shrubs invade prairie areas throughout the state. For purposes of this table, savannas and brush prairies are also included in this system. *Photos courtesy of Minnesota DNR Ecological Resources*

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Rock outcrop: Open or shrub-dominated communities on shallow or exposed bedrock, generally less than 25 acres in size. Shrub communities have a greater accumulation of soil. *Photos courtesy of Minnesota DNR Ecological Resources*



Fire-dependent forest/woodland: An ecological system where forest and woodland communities are strongly influenced by wildfires. Fires are a major source of species mortality and strongly influence patterns of plant reproduction and survival. Periodic fires remove much of the litter, duff and other organic material from communities in the system and can have significant effects on nutrient cycling and nutrient availability. Plants and animals characteristic of this system are well adapted to the effects of periodic fires, including removal of organic material. *Photo courtesy of Minnesota DNR Ecological Resources*

Additional Consideration

☛ **Consider retaining oak trees and other hard mast-producing trees and shrubs** or perpetuating existing stands as required by the management plan.

Snags

In most situations, snags are not a desirable part of the brushland or open land habitat; they may reduce the quality of the habitat. In some instances, however, such as in forested rich peatlands, snags may enhance the quality of wildlife habitats, providing nesting, denning, feeding and roosting sites.

✓ **Refer to Table BHB-1 to determine desired outcomes** of snag management (pages 38-39).

Managing the Harvest Site and Infrastructure

✓ **Locate windrows and biomass piles** so as to:

- Avoid cultural resources.
- Minimize interference with natural drainage patterns.
- Be outside of filter strips, RMZs and leave patches.
- Follow contours when possible to mitigate the effects of overland flow.

✓ **Locate and design haul trails** so as to:

- Minimize damage to cultural resources or leave patches.
- Minimize rutting.
- Maintain surface and subsurface water flows in wetlands.
- Reduce erosion and sedimentation to protect water quality.
- Minimize site disturbance and the number of haul trails, while also achieving necessary operating efficiency.

✓ **Avoid locating haul trails in filter strips** and RMZs.

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✓ **Anticipate traffic needs** to avoid unnecessary maintenance or relocation of trails. Techniques include:

- Packing of snow or ground cover to ensure freezing
- Placing of slash mats in high-traffic areas
- Use of appropriate wetland road construction methods to stabilize the trail surface

✓ **Maintain haul trails** to avoid the need for additional haul trails.

✓ **Curtail operations until soils dry out or freeze solid** if haul trails do not hold up (resulting in excessive rutting or requiring the need to create new haul trails).

Landings and Stockpile Areas

✓ **Specify the number and location of landings** as part of the harvesting agreement.

✓ **Size landings to the minimum required** for the acres to be harvested, the equipment likely to be used and the products to be cut.

✓ **Plan roads and landings to occupy no more than 1-3%** of the woody biomass harvest area.

✓ **Locate landings to be:**

- On upland areas whenever practical
- On stable ground
- Outside of filter strips or the RMZs
- Away from areas where a cultural resource is present

- ✓ **Avoid landings in locations that will concentrate runoff** from surrounding areas onto the landing. Use an appropriate combination of ditches, waterbars and outsloping to keep the landing area dry.
- ✓ **Avoid locating landings** and yarding areas on open water wetlands.
- ✓ **Locate landings for best economy and reuse** on subsequent harvests.

POST-OPERATIONAL ACTIVITIES

➤ **IMPORTANT! Review General Guidelines:**
*Post Operational Activities
 and Followup Visits (pages 80-81)*

In addition to the *General Guidelines*:

- ✓ **Evaluate the harvest operation and plan future alterations** during post-harvest conferences with the operator and landowner.
- ✓ **Avoid removing soil from the general harvest area** to rehabilitate roads, landings and haul roads. Use already disturbed soil, if needed, rather than disturbing additional soil.
- ✓ **Rehabilitate landings and haul roads**, when necessary, to mitigate soil compaction and reduce erosion.
- ✓ **Use seed with native vegetation** and fertilize as appropriate when rehabilitating landings and haul roads.

ADDITIONAL RESOURCES

Minnesota state statutes, laws and rules

General:

www.leg.state.mn.us/leg/statutes.asp

www.revisor.leg.state.mn.us/

Biomass Power Mandate: Go to www.leg.state.mn.us/leg/statutes.asp and enter *216B.2424* under *Retrieve a section*.

Sustainable Forest Resources Act, Chapter 89A: Go to www.leg.state.mn.us/leg/statutes.asp and search for Chapter 89A in *Table of Chapters*.

Potential markets for woody biomass

Potential markets, including a directory of primary and secondary forest products in Minnesota: www.dnr.state.mn.us/forestry/um under *Wood Industry Directories*.

The MarketPlace Bulletin: www.dnr.state.mn.us/publications under *Division publications*.

Managing brushlands for wildlife

A brochure titled *Managing Your Brushland for Wildlife* is available at www.dnr.state.mn.us/publications/wildlife

Woody biomass resources and opportunities in the emerging energy industry

For additional information, refer to *Minnesota's Woody Biomass Resources and Opportunities in the Emerging Energy Industry*, a paper written by Bill Berguson, University of Minnesota, Natural Resources Research Institute, Duluth, Minnesota.

Go to www.blandinfoundation.org. Click on *Public Policy & Engagement*; then click on *Vital Forests/Vital Communities*; then click on *Conferences & Events*; then click on *Seizing Opportunity: Forestry and the BioEconomy*; and then look for *Informing Report: Minnesota's Woody Biomass Resources and Opportunities in the Emerging Energy Industry*.

Minnesota DNR Ecological Classification System

For additional information, including descriptions of Native Plant Communities (NPCs), visit www.dnr.state.mn.us/eecs



GLOSSARY

Acid peatlands: Conifer, low shrub and grass-dominated and/or sedge-dominated wetland communities on *Sphagnum*. Hydrological inputs are dominated by precipitation, not ground water.

Bagasse: The biomass remaining after sugarcane stalks are crushed to extract their juice. (Source: en.wikipedia.org/wiki/Bagasse)

Biomass: The organic materials produced by plants, such as leaves, roots, seeds and stalks. In some cases, microbial and animal metabolic wastes are also considered biomass. The term *biomass* is intended to refer to materials that do not directly go into foods or consumer products but may have alternative industrial uses. Common sources of biomass are (1) agricultural wastes, such as corn stalks, straw, seed hulls, sugarcane leavings, bagasse, nutshells, and manure from cattle, poultry and hogs; (2) wood materials, such as wood or bark, sawdust, timber slash and mill scrap; (3) municipal waste, such as waste paper and yard clippings; and (4) energy crops, such as poplars, willows, switchgrass, alfalfa, prairie bluestem, corn (starch) and soybean (oil). (Source: *McGraw-Hill Encyclopedia of Science and Technology*, 5th edition, The McGraw-Hill Companies, Inc.)

Brushland habitat: A habitat consisting of a semi-open complex of vegetation with greater than one-third cover by shrubs and/or one-third to two-thirds total cover by trees. These habitats are typically found in the following ecological systems: peatlands, wet forests, upland prairies, rock outcrops, wet meadow/carrs and wetland prairies.

Carr: A wetland usually supporting small shrub or thin tree cover.

Desired future conditions: The goal of a site's ecosystem type outlined in a management plan that is designed to move the site toward this self-sustaining or successional ecosystem type.

Ecological system: Groups of native plant communities unified by strong influence from a major ecological process or set of processes, especially nutrient cycling and natural disturbances.

Fire-dependent forest/woodland: An ecological system where forest and woodland communities are strongly influenced by wildfires. Fires are a major source of species mortality and strongly influence patterns of plant reproduction and survival. Periodic fires remove much of the litter, duff and other organic material from communities in the system and can have significant effects on nutrient cycling and nutrient availability. Plants and animals characteristic of this system are well adapted to the effects of periodic fires, including removal of organic material.

Forest ecosystem: A community of plants, animals and micro-organisms, and the physical environment they inhabit, in which trees are the dominant life form.

Forested rich peatland: Conifer-dominated or tall shrub-dominated wetlands on deep peat. The water table is normally immediately below peat surface.

Hydric soil: Soil formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions favoring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anerobic soils).

Lagg: A wet, moat-like depression that occurs where a peatland comes in contact with an upland.

Lek: An open area, relatively free of brush and trees, that is used by sharp-tailed grouse and prairie chickens as a display and mating area in the spring.

Lowland shrub: Habitat that occurs in areas with high water tables where broad-leaved shrubs are the dominant plant growth form. This habitat is found in basins, along streams and rivers, and around lakes and ponds.

Old fields: Agricultural fields that have reverted to a non-agricultural condition.

Open lands habitat: Habitat consisting of an open complex of vegetation with less than or equal to one-third total cover by shrubs and/or trees. This habitat is typically found in the following ecological systems: peatlands, upland prairies, rock outcrops, wet meadow/carrs and wetland prairies.

Open landscape: A portion of land supporting an open to semi-open complex of vegetation consisting of less than two-thirds total cover by trees.

Open peatland (including open rich peatlands and some acid peatlands): *Open rich peatlands* are areas of grass and/or sedge or low shrub-dominated wetlands influenced by ground-water flow zones. They often have higher concentrations of minerals and higher species diversity than acid peatlands. *Acid peatlands* are grass and/or sedge or low shrub-dominated wetlands primarily influenced by precipitation. They are extremely low in nutrients and are acidic and separated from ground water.

Reserve area: A portion of the management area set aside for a special purpose or use or to protect specific resources.

Rock outcrop: Open or shrub-dominated communities on shallow or exposed bedrock, generally less than 25 acres in size.

Seasonal ponds: A type of wetland not always easily discernible in the field. They are depressions in the soil surface where water pools during wet periods of the year, typically in spring and fall. A seasonal pond will have an identifiable edge caused by seasonal inundation and local topography. Seasonal ponds are small, typically less than 1/2 acre in size. The edge is best identified during the spring or fall.

Seral: A stage of succession in a plant community that is transitional. If left undisturbed, a seral stage will give way to another plant community that represents a further stage of succession. (Source: www.umpqua-watersheds.org/glossary/gloss_s.html)

Shearing: The operation of cutting off trees and brush at ground level by pushing a sharpened bulldozer blade along the frozen surface in winter.

Sustainably managed woody biomass: For purposes of biomass guideline development and in accordance with M.S. § 216B.2424 Subd. 1 (d), *sustainably managed woody biomass* is defined as: (1) brush, trees, and other biomass harvested from within designated utility, railroad, and road rights-of-way [*Note: Guidelines will not be developed for this category of biomass*]; (2) upland and lowland brush harvested from lands incorporated into brushland habitat management activities of the Minnesota Department of Natural Resources; (3) upland and lowland brush harvested from lands managed in accordance with the Minnesota Forest Resources Council's *Woody Biomass Harvesting for Managing Brushlands and Open Lands*; (4) logging slash or waste wood that is created by harvest, by pre-commercial timber stand improvement to meet silvicultural objectives, or by fire, disease, or insect control treatments, and that is managed in compliance with the Minnesota Forest Resources Council's *Sustaining Minnesota Forest Resources: Voluntary Site-Level Forest Management Guidelines for Landowners, Loggers and Resource Managers*, as modified by the requirement of this subdivision; and (5) trees or parts of trees that do not meet the utilization standards for pulpwood, posts, bolts, or sawtimber as described in Minnesota Department of Natural Resources Division of Forestry *Timber Sales Manual*, 1998, as amended as of May 1, 2005, and the Minnesota Department of Natural Resources *Timber Scaling Manual*, 1981, as amended as of May 1, 2005, except as provided by M.S. § 216B.2424—Biomass Power Mandate, Subdivision 1, in paragraph (a), clause (1)—“[biomass that] is intentionally cultivated, harvested, and prepared for use, in whole or in part, as a fuel for the generation of electricity”—and this paragraph, clauses (1) to (3).

Upland prairie: Prairie habitat dominated by native grasses with species-rich component of forbs (herbaceous plants other than grasses or sedges). On upland sites, woody species are limited to dwarf shrubs, such as leadplant and prairie rose. Without fire, trees and shrubs invade prairie areas throughout the state.

Upland shrub/woodland: Habitat that is a combination of (1) savannas and brush prairies, (2) bedrock shrublands, and (3) seral and edge upland shrub areas.

Wet forest: Forest communities characterized by muck soils that are saturated in the spring but dry out later in the growing season. They occur in narrow zones along margins of lakes, rivers and peatlands and in depressions. Black ash is often a dominant species.

Wet meadow/carr: Grass and/or sedge and shrub-dominated wetland communities subjected annually to moderate inundation following spring thaw and heavy rains. Willows and dogwoods dominate drier sites.

Wetland prairie: Prairie habitat dominated by native grasses with species-rich component of forbs (herbaceous plants other than grasses or sedges). Big bluestem and prairie cord grass are the major species on wetter sites, which also support a variety of sedge species. Wetland prairies also support dwarf shrubs (e.g., prairie rose) and true shrubs (e.g., red-osier dogwood).

Woody biomass: See *Sustainably managed woody biomass*.



APPENDICES

Appendix 1: Wildlife Species That Depend on Brushland Habitats in Minnesota¹

Moose
Sharp-tailed Grouse²
American Woodcock²
Alder Flycatcher
Willow Flycatcher²
Gray Catbird
Brown Thrasher²
Loggerhead Shrike^{2,3}
Blue-winged Warbler²
Golden-winged Warbler²
Yellow Warbler
Chestnut-sided Warbler
Common Yellowthroat
Yellow-breasted Chat
Clay-colored Sparrow
Song Sparrow
Lincoln's Sparrow

¹ From Appendix A of *An Assessment of Open Landscapes for Management of Brushland Wildlife Species in Northern and Central Minnesota*, Minnesota Department of Natural Resources. The Appendix also lists the 154 species dependent upon open land habitats.

² Species in Greatest Conservation Need, *Tomorrow's Habitat for the Wild and Rare*, Minnesota Department of Natural Resources

³ Listed on Minnesota Threatened Species List

Appendix 2: Additional Sensitive Native Plant Communities

The table on page 55 includes additional non-forested rare native plant communities to supplement Appendix J of *Sustaining Minnesota Forest Resources: Voluntary Site-Level Forest Management Guidelines for Landowners, Loggers and Resource Managers*. This list of communities follows Minnesota's Native Plant Community Classification (Version 2.0).

These communities are described in *Field Guide to the Native Plant Communities of Minnesota: The Laurentian Mixed Forest Province* (Minnesota Department of Natural Resources, 2003), *Field Guide to the Native Plant Communities of Minnesota: The Eastern Broadleaf Forest Province* (Minnesota Department of Natural Resources, 2005), or *Field Guide to the Native Plant Communities of Minnesota: The Prairie Parklands and Tallgrass Aspen Parklands Provinces* (Minnesota Department of Natural Resources, 2005).

Each community name is followed by a unique code from Minnesota's Native Plant Community Classification (Version 2.0).

Important note:

The table in this appendix **is not a stand-alone listing**; it is an addendum to the existing Appendix J. Please refer to both the original Appendix J, as well as this Appendix 2 addendum.

Sensitive Native Plant Communities
(addendum to Appendix J, pages 2-3)

Type	ECS section	Classification code
Juniper Dune Shrubland (Lake Superior)	NSU (Northern Superior Uplands)	LKu32b
Beach Ridge Shrubland (Lake Superior)	NSU (Northern Superior Uplands)	LKu32d
Sandstone Outcrop (Northern)	WSU (Western Superior Uplands)	ROn12a
Bedrock Shrubland (Lake Superior)	NSU (Northern Superior Uplands)	ROn23b
Aspen Openings (Northern)	LAP (Lake Agassiz Aspen Parklands)	UPn24b
Dry Sand-Gravel Brush-Prairie	LAP (Lake Agassiz Aspen Parklands)	UPn12c
Mesic Brush-Prairie (Northern)	LAP, RRV (Lake Agassiz Aspen Parklands and Red River Valley)	UPn23a

