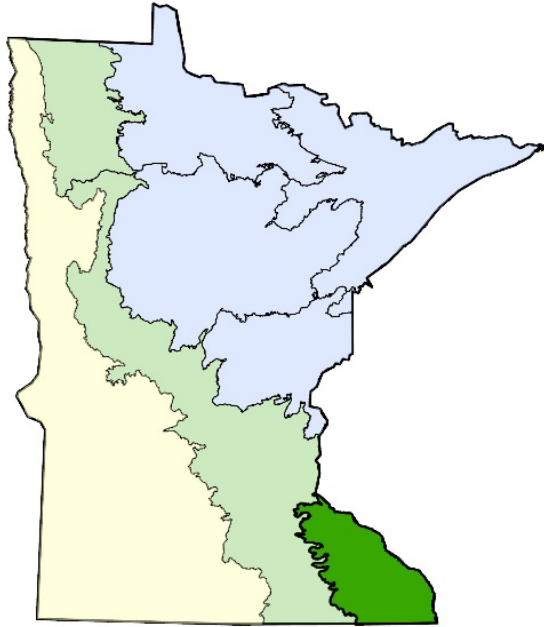


Paleozoic Plateau

Section Forest Resources Management Plan Narrative Guidance

March 2026





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List of Abbreviations

Abbreviation	Description
APA	Annual plan addition
Con-Con	Consolidated-conservation land
DFC	Desired future condition
DNR	Department of Natural Resources
ECS	Ecological classification system
ELB	Eastern larch beetle
ETS	Endangered, threatened, and special concern species
FAW	Fish and Wildlife Division
FIA	Forest inventory and analysis
FIM	Forest inventory module
FRIT	Forest Resources Issues Team
FSC	Forest Stewardship Council
GDS	General direction statement
GIS	Geographic information system
HCVF	High conservation value forest
MBS	Minnesota Biological Survey
MFRC	Minnesota Forest Resources Council
PP	Paleozoic Plateau
MOA	Management opportunity area
NHIS	Natural heritage information system
NORP	Natural origin red pine
NPC	Native plant community
OFMC	Old forest management complex
RAN	Region area number
RGMA	Ruffed grouse management area
RMZ	Riparian management zone
RSA	Representative sample area
SFI	Sustainable Forestry Initiative
SFRMP	Section Forest Resource Management Plan
SGCN	Species in Greatest Conservation Need
SI	Site Index
SMZ	Special management zone
SNA	Scientific and natural area
STH(A)	Sustainable Timber Harvest (Analysis)
WMA	Wildlife management area

See the [Glossary](#) for definitions of terms used in this document.

Executive Summary

This Section Forest Resource Management Plan (SFRMP) narrative provides guidance for vegetation management on state forest lands administered by the Minnesota Department of Natural Resources (DNR) Divisions of Forestry and Fish and Wildlife in the [Paleozoic Plateau \(PP\) Section](#). The primary audience for this document is land managers within the DNR; however, it also informs stakeholders and the interested public about DNR forest resource management in the PP Section. This SFRMP replaces the narrative guidance replaces the former Blufflands/Rochester Plateau SFRMP.

DNR forest management is shaped by a wide range of statutes, policies, plans, and site-level guidance. Section Forest Resource Management Plans, which include both strategic and operational components, play a key role in this broader network of direction and guidance, and are developed and implemented accordingly. For example, all SFRMP components are developed to meet statutory requirements and DNR policies, and considering other information such as wildlife management area (WMA) unit plans. Likewise, DNR forest managers account for DNR policies, procedures, and other relevant plans, such as WMA unit plans, alongside SFRMP guidance when deciding if and how to manage specific forest stands.

This SFRMP narrative informs implementation of the 10-year stand exam list and documents management opportunity areas (MOAs), which are areas on DNR-administered lands that offer good opportunities to maintain or create spatial patterns to address natural resource values that are difficult to achieve through individual stand management. It is intended to inform management for approximately the next 10 years or until replaced.

Guiding Principles for the SFRMP process

- Provide guidance for forest management activities that address ecological protection, timber production, fish and wildlife habitat, and cultural/recreational values at the landscape scale.
- Provide guidance to managers and foresters implementing the SFRMP strategic direction and stand exam list.
- Ensure recommendations for vegetation management adhere to Department directions, guidelines, policy, and informational resources within the interdisciplinary forest management policy system.
- Use the expertise of interdisciplinary team members across DNR divisions to identify issues, direction, and strategies for vegetation management on state-administered land in the PP Section.
- Consider and incorporate public input in the planning process.

Planning Outcomes and Summary

- This plan calls for increasing within-stand compositional and structural diversity appropriate to native plant communities to address habitat objectives and increase resilience to climate change.
- The plan provides that younger and older forests for all cover types will continue to be represented on DNR-administered land, with amounts determined through this plan period's strategic direction. This plan recommends strategies to provide older forest characteristics

within stands on Division of Fish and Wildlife administered lands, in management opportunity areas such as old forest management complexes and older forest patches, riparian areas, and natural-origin pine stands.

- The plan includes strategies for managing riparian areas to retain their integrity and provide habitat for fish, wildlife, and plant species, including increasing longer-lived species and conifers, increasing the age of some stands and stand components, and applying [Minnesota Forest Resource Council Voluntary Site-Level Forest Management Guidelines](#) in riparian areas.
- Forest cover type conversion goals in this plan will emphasize:
 - Increasing acres of oak across the Section on sites appropriate to the native plant community.
 - Maintaining northern hardwood cover types across the Section on sites appropriate to the native plant community while minimizing the natural conversion of oak and aspen to mixed northern hardwoods.
 - Maintaining the amount of central hardwood cover type on sites appropriate to the native plant community.
 - Decreasing the amount of red cedar cover types.
 - Decreasing the amount of red pine cover types.
 - Maintaining ash and lowland hardwood cover types while recognizing the potential decrease of ash cover type within the Section.
- Oak and northern hardwoods will remain the most abundant cover types in the Section.
- Additional topics addressed in the plan include limiting damage from insects, disease, and non-native species; producing forest conditions that support a range of wildlife habitats; managing for endangered, threatened, and rare species; managing areas of high and outstanding biodiversity significance; minimizing forest management impacts on visual quality; protecting cultural resources; considering climate change mitigation and adaptation needs and opportunities; and evaluating and responding to disturbance events (e.g., fire and wind).

Chapter 1: Introduction

State statutes, including the Sustainable Forest Resources Act ([Minnesota Statute 89A](#)), provide direction for forest management conducted by the Minnesota Department of Natural Resources (DNR). Accordingly, it is the state's policy to "pursue the sustainable management, use, and protection of the state's forest resources to achieve the state's economic, environmental, and social goals," with sustainability defined as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." In addition, the DNR's mission is to work with Minnesotans to conserve and manage the state's natural resources, provide outdoor recreation opportunities, and provide for commercial uses of natural resources in a way that creates a sustainable quality of life. State-owned, DNR-administered lands and associated resources are foundational to the DNR's ability to execute its mission for the benefit of all Minnesotans.

State Lands Foundational to Forest Management

The DNR manages approximately 5.6 million surface acres of state-owned land and 12 million acres of state-owned mineral rights that significantly contribute to Minnesota's quality of life and economic opportunity. These lands and resources support natural resource-based economies, provide tourism and recreation opportunities, protect rare resources, provide habitat for fish and wildlife, and provide important ecological services, like clean air and water.

State Trust Lands

The DNR manages school trust (2.5 million acres statewide) and university trust lands (25,840 acres statewide) for their beneficiaries, Minnesota's public schools, and the University of Minnesota. The Permanent School Fund and Permanent University Fund are trusts established in the Minnesota State Constitution and designated as perpetual sources of income for the named beneficiaries. The funds consist of two parts: the physical lands granted to the state by the federal government and the dollars in the fund that are generated from those lands. The Department manages the physical lands as a trustee. This trustee obligation imposes fiduciary responsibilities on the Department to manage the trust fund lands in the best interests of the beneficiaries to fund Minnesota's public schools and the University of Minnesota.

School trust lands are managed to maximize long-term economic return consistent with sound natural resource conservation and management principles ([Minn. Stat. 127A.31](#); see the Department's *Operational Order 121: Management of School Trust Lands* for more information about how we operationalize this constitutional and statutory directive). Investment income is distributed to the state's public school districts annually to fund operations. Approximately 790 (2008 GAP analysis program) acres of school trust lands are in the Paleozoic Plateau (PP) Section.

State Non-Trust Lands

The DNR manages non-trust lands according to their applicable statutory purposes. In the PP Section, these lands primarily include acquired lands, approximately 113,314 acres (2008 GAP).

Acquired lands were gifted from private owners, organizations, or governmental entities, purchased to meet specific management or habitat needs, or otherwise conveyed to the state. These lands are managed according to the statutory authority under which they were acquired. Approximately 113,314 acres in the PP Section are acquired lands.

Recreation Unit

This guidance in this SFRMP narrative applies to lands of these various statuses in recreation units that have different statutory purposes.

Wildlife Management Areas (WMA) are managed in accordance with MN Statutes section [86A.05](#). Specifically, WMAs are managed “...for the production of wildlife, for public hunting, fishing, and trapping, and for other compatible outdoor recreational uses.”

WMAs acquired or developed with funds authorized through the Federal Aid in Wildlife Restoration Act must comply with federal regulation [50 CFR Part 80.14](#): they must continue to serve the purpose for which they were acquired or developed and may not be used to produce income unless incidental to approved purposes. The harvest of timber on WMAs and AMA/FMAs must be for habitat management purposes consistent with federal regulations.

WMAs may include some percentage of school trust lands (approximately 7 acres). These portions are treated as school trust lands but also incorporate goals of the WMA.

Approximately 47,563 acres (2008 GAP) within the PP Section are in WMAs.

State forest lands are managed by the DNR as described in [chapter 89](#). They are managed under the principles of multiple use and sustained yield to provide multiple forest benefits over time, including wildlife habitat, biodiversity, wood supply and healthy natural resource economies, carbon storage, forest health, recreation, and water quality. State forest lands include school trust lands (approximately 790 acres) which are managed under the additional requirements of school trust lands. About 49,846 acres (2008 GAP) of acquired state forest lands are within the PP Section.

Layers of DNR Forest Management Direction and Guidance

Multiple layers of laws, policies, guidelines, and plans direct and inform forest management on DNR-administered lands. Together, they shape the DNR’s mission, vision, goals, objectives, and strategies for forest management, with the aim of optimizing the balance of multiple forest values and their corresponding benefits sustainably over time. Because requirements differ across recreational units and land statuses managed by the DNR, the “optimal balance” of forest benefits varies depending on the authorized purpose of those lands.

Within this network of forest management direction and guidance, DNR forest management objectives are informed by data and analysis and are predicated on:

- Minnesota statutes that lay out the purpose and management goals of the units of the Outdoor Recreation System and forest management goals and policies (see above). For example, DNR’s forest management on WMAs and aquatic management areas (AMAs), is conducted to advance fish

and wildlife habitat, and forest management on state forest lands provides for multiple use and sustained yield.

- Key state statutes include Outdoor Recreation System Classification and Purposes (Minn Stat. 86A.05); State Forests, Tree Planting, Forest Roads (Minn. Stat. Ch. 89); Sustainable Forest Resources Act (Minn. Stat. 89A.02); Permanent School Fund (Minn. Stat. 127A.30—127A.353); Wildlife Management Areas (Minn. Stat. 86A.05, subd. 8).
- The multiple forest values (i.e., wildlife habitat, biodiversity, wood supply and healthy natural resource economies, climate mitigation and adaptation, forest health, recreation, and water quality and quantity) toward which the DNR manages, with the relative emphasis among these values depending on the recreation unit and land status.
- The long-term, landscape-level desired future forest conditions (DFFCs) described in SFRMPs that DNR is seeking to achieve through forest management.

Additional direction clarifies how the DNR will advance forest management objectives, including:

- The Interdisciplinary Forest Management Coordination Framework, which governs how DNR disciplines work together to meet requirements and advance goals through forest management, including operational procedures such as the dispute resolution process and the Procedure: *Forest Habitat Management on Lands Administered by the Fish & Wildlife Division*.
- All policies, guidelines, and short-term direction included in the DNR's Interdisciplinary Forest Management Policy System.
- Minnesota's Forest Resources Council's Voluntary Site-Level Forest Management Guidelines, which the DNR uses as best management practices (BMPs) for all forest management work.
- The spatial 10-year Stand Exam List, which identifies the forest stands to consider for management (see the [Development of the DNR 10-year Stand Exam List report](#) for more details).
- Annual stand exam lists derived from the 10-year Stand Exam List.
- Strategies in SFRMPs and WMA plans.
- Other applicable division guidance, procedures, and manuals such as the Division of Fish and Wildlife directive on forest management on WMAs and AMAs/FMAs.

Together, these laws, policies, guidelines, procedures, and plans ensure the DNR manages forests sustainably; adheres to its mission; and meets its statutory, forest certification, contractual, and fiduciary obligations.

Section Forest Resource Management Plans are a key layer that interacts with others in DNR's broader network of forest management direction and guidance. They are developed to comply with all requirements, including applicable state and federal laws and DNR policies. Additional information from sources such as WMA unit plans, which provide fish and wildlife habitat management guidance within WMAs, are also considered when developing SFRMPs. Likewise, when implementing SFRMP direction and guidance, DNR forest managers comply with all requirements, including DNR policies and procedures, consider additional relevant guidance, and consult WMA plans when working within WMAs.

Examples of the layers of direction and guidance for forest management on DNR-administered lands

Laws and statewide strategic plans	Policies and procedures	Landscape and sub-landscape plans and direction	Site-level guidance and information
Sustainable Forest Resources Act (MS 89A) Forest Resource Management (MS 89) School Trust Lands (MS 84, subd. 18) State Outdoor Recreation Act (MS 86A.05) State Forests Wildlife Management Areas Federal Endangered Species Act DNR Strategic Conservation Agenda State Forest Action Plan State Wildlife Action Plan	Operational orders School trust lands Invasive species Climate adaptation and mitigation Interdisciplinary forest management policy system Rare species and native plant communities (NPCs) Bald eagle nests High conservation value forest (HCVF) Bat habitat conservation plan (HCP) policy Old growth forest Department and division policies, directives, procedures, guidelines and manuals	SFRMP WMA plans Minnesota Forest Resources Council (MFRC) landscape plans Sub-landscape direction (e.g., HCVF direction documents)	MFRC site-level guidelines NPC field guides and silvicultural strategies Silvicultural case studies

Section Forest Resource Management Plans

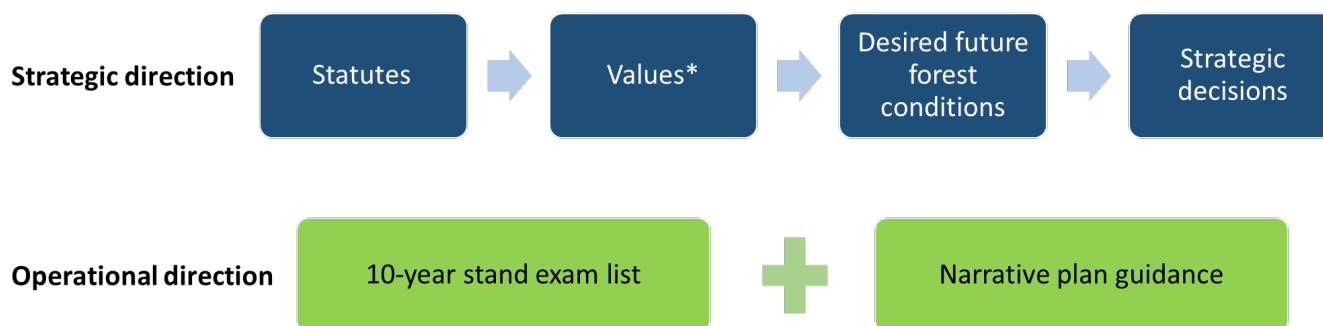
Section Forest Resource Management Plans guide forest management activities on state-administered forest lands, primarily in state forests and WMAs, at the ecological section scale. SFRMPs have both strategic and operational components designed to advance long-term (50+ year) landscape scale goals over 10-year planning periods.

SFRMP strategic direction includes desired future forest conditions designed to sustainably supply a balance of forest benefits - wildlife habitat, biodiversity, wood supply and healthy natural resource economies, carbon storage and sequestration, forest health, recreation, and water quality and quantity - over the long-term at the landscape scale according to the statutory purpose and other requirements associated with the different lands the DNR manages.

SFRMP operational direction includes information regarding which forest stands DNR forest managers will visit for potential management (stand exam lists) and narrative guidance for what to consider when deciding if and how to manage a specific forest stand. Implementation of stand exam lists and the guidance in this SFRMP narrative is conducted in the context of the broader network of DNR forest management direction (see above), which includes policies, procedures, and other plans that may influence forest management decisions for a particular stand. For example, the guidance in this SFRMP narrative is implemented in the context of policies for how to coordinate among DNR disciplines, procedures for how to administer the stand exam list and conduct forest management on Fish and Wildlife-administered lands, and state or federal requirements based on the recreation unit, land status, and resources on the ground.

SFRMP Components

SFRMP desired future conditions (DFCs) and strategic decisions meet statutory requirements and are informed by values. SFRMP operational direction includes the 10-year stand exam list and narrative guidance for advancing long-term landscape objectives through site-level decisions.



*wildlife habitat, biodiversity, wood supply and healthy natural resource economies, climate adaptation and mitigation, forest health, recreation, and water quality and quantity

SFRMP Implementation

As this SFRMP is implemented, DNR staff visit and evaluate stands in the PP Section on the stand exam list for potential management. After receiving comments from internal staff, tribes, and the public, DNR staff conduct stand examinations. These stand examinations can have several different outcomes. Some stand exams result in postponing management to another planning period for biodiversity, habitat, or silvicultural reasons (e.g., the stand is not ready to harvest). Sometimes, the forest inventory requires correction, and the site is not ready to harvest. In other cases, a treatment other than timber harvest is deemed most appropriate to meet the stand goals. And in still other cases, timber harvest is appropriate. Timber harvest can take many forms, including regenerating an entire site, applying an intermediate treatment such as thinning to improve tree growth, selectively cutting trees to adjust forest composition and structure, or addressing a forest health issue. DNR forest managers incorporate many sources of information and direction into these management decisions, including:

- Current site conditions

- Comments from DNR foresters, wildlife biologists, ecologists, and archaeologists; tribal natural resources staff; and the public
- Specific considerations regarding:
 - recreation unit classification (e.g., WMA, state forest)
 - land status (e.g., school trust, acquired, consolidated conservation)
 - resources on the site (e.g., rare native plant communities, federal or state endangered or threatened species, High Conservation Value Forest, water features, wildlife habitat components, legacy trees, bald eagle nests, recreational trails, roads, etc.)
- Best practices outlined in Minnesota Forest Resource Council Voluntary Site-Level Guidelines
- Narrative SFRMP guidance, including MOA goals and strategies
- WMA unit plan goals and strategies

DNR staff then develop site-specific prescriptions for stands that are identified for timber harvest that achieve landscape- and site-level forest management goals.

Scope of this Section Forest Resource Management Plan (SFRMP)

This SFRMP provides guidance for vegetation management on DNR-administered forest lands in the Paleozoic Plateau (PP) Ecological Section, which contains the Rochester Plateau and the Blufflands Subsections; a detailed explanation of DNR’s ecological classification system (ECS), including sections and subsections, is available on the [DNR ECS webpage](#)). Vegetation management includes actions that affect the composition and structure of forest lands, such as timber harvesting, thinning, prescribed burning, biomass harvest, and reforestation. SFRMP planning considers the condition and management of forest lands in other ownerships but only proposes forest management direction and actions for DNR-administered lands.

This plan considers only a portion of DNR-administered lands in the PP Section and uses cover type to classify vegetation for management on those lands (the cover type of a stand is generally determined by the predominant tree species or vegetation type in that stand). The following terms describe subsets of DNR-administered lands and how they relate to the SFRMP:

- “Forest land” includes lands in the DNR forest stand inventory, including cover types from aspen to stagnant conifers, muskeg, upland and lowland grass and brush, and other wetlands.
- “Managed acres” refers to a subset of forest lands for which the SFRMP provides guidance. Managed acres exclude areas that are managed under other processes, such as scientific and natural areas, state parks, and aquatic management areas outside of Lake County.
- “Timberland” refers to managed acres for which timber harvest is a feasible management tool. Timberland includes cover types capable of producing merchantable timber and excludes very slow-growing trees (e.g., stagnant lowland conifers or offsite aspen). Timberland is the pool of acres that were used to develop stand-exam lists for this planning period (see [Appendix A](#) for the full forest inventory query for managed and timberland acres).

This SFRMP provides direction and guidance for managed acres in the PP ecological section. Approximately 84,756 acres, or 74 percent of DNR-administered lands, are managed acres (2017 FIM). Furthermore, 79,236

acres, or 69 percent, of DNR-administered lands in this Section are managed timberland acres, representing approximately 12.4 percent of the total forest land across all ownerships in the PP Section.

Not all forest management planning is addressed in this SFRMP, however. Examples of planning activities related to forest management that are beyond the scope of SFRMPs include comprehensive road access plans, state park land management planning, old-growth forest designation, scientific and natural area (SNA) establishment, wilderness designation, establishment of wildlife population goals, cumulative effects analysis at the watershed level, fire management, and recreation facilities and systems planning (e.g., hunter walking trails, forest recreation areas, or off-highway vehicle trails planning).

SFRMP Goals

This SFRMP document includes goals and direction for resource managers in the PP Section, including:

- **Desired Future Condition (DFC) Goals:**
 - These are long-term (50+ years) and short-term (10 years) changes in vegetation structure and composition.
 - DFCs are achieved through management activities, including no action, which will best move the forest landscape toward the goals for state forest lands.
 - Strategic planning decisions include the [estimated amount of timber volume necessary to offer during FY2019-2028](#) to advance DFCs over that period.
 - DFCs, including cover type goals, are developed from existing long-term SFRMP goals, assessment information, and identified issues.
- **Guidance to staff on stand exam list implementation**
 - General direction statements and strategies in Chapter 3 guide staff on what to consider when making forest stand management decisions while completing stand exams.
 - Products of this SFRMP planning process include an implementation training and field guide for DNR staff so they understand how to apply SFRMP guidance during stand exams.
- **Management Opportunity Areas (MOAs)**
 - MOAs identify good opportunities to address particular values on DNR-administered lands that can be difficult to achieve at the stand level. See [Section 3.13 in Chapter 3](#) for more information on MOAs.
 - MOAs include old forest management complexes (OFMCs), interior forest management areas, turkey and ruffed grouse management areas, and bluff prairie open landscape management areas.
 - Links to management guidance documents developed for MOAs are included in Appendix E: Management Opportunity Areas in this plan.

Staff Involved in Developing SFRMPs

While the Division of Forestry is the lead division for developing and maintaining SFRMPs, the development process is interdisciplinary. Planners and personnel from the DNR Divisions of Forestry, Fish and Wildlife, and Ecological and Water Resources contribute to the development of SFRMP components, with oversight

from forest resource issues teams (FRITs). Regional and executive FRITs are comprised of the regional director and managers of the three divisions and division directors, respectively. The central (Region 3) FRIT oversaw staff work on the PP SFRMP planning effort. Additional staff, such as geographic information system (GIS) or administrative specialists, support SFRMP planning as needed.

Monitoring the SFRMP

The SFRMP will be monitored near the mid-point and end of the plan. It will mainly look at alignment with the plan direction and usability of the plan.

Tribal Coordination Opportunities

Forest planners coordinate with American Indian tribes during the development of the SFRMP. This occurs through a comment period on the draft plan. Tribal comment periods occur before public comment periods.

Additional opportunities to coordinate on forest planning may arise if plan revisions are proposed during plan implementation.

Public Involvement Opportunities

Public involvement in SFRMP development occurs through a comment period on the draft plan. Additional public review and comment opportunities may arise if plan revisions are proposed during plan implementation.

Narrative SFRMP Development Process Overview

Development of this narrative SFRMP guidance occurred in several steps (Table 1.1). In Step 1, DNR staff prepared information to assess the current forest resource conditions in the Section and prepared for the planning process. In Step 2, the SFRMP team updated the issues and the general directions, strategies, and cover type recommendations to address the issues. In Step 3-4, the plan was shared first with tribal natural resource agency staff and then with the public. In step 5, the plan is finalized and distributed.

Table 1.1: Summary of the planning process for the PP SFRMP

Steps	SFRMP Process Description
<p>Step 1</p>	<p>Initiating the Planning Process</p> <ul style="list-style-type: none"> • Form an interdisciplinary team for the Section. • Assemble baseline assessment information. • Prepare draft SFRMP template. • Establish a web page on the DNR website. • Update the mailing list of stakeholders.
<p>Step 2</p>	<p>Develop Draft Plan</p> <ul style="list-style-type: none"> • Review and update the list of issues to be addressed in the plan. • Update general direction statements (GDSs) in response to the final list of issues. • Review and update strategies and desired future condition (DFC) goals consistent with the general direction statements and policy. • Prioritize, develop, and revise Management Opportunity Area (MOA) guidance documents.
<p>Step 3</p>	<p>Tribal Input</p> <ul style="list-style-type: none"> • Make the draft plan available for tribal input. • Review comments received, respond to them, and incorporate them into the draft plan as appropriate.
<p>Step 4</p>	<p>Public Input</p> <ul style="list-style-type: none"> • Make the draft plan available for public input. • Review comments received, respond to them, and incorporate them into the draft plan as appropriate.
<p>Step 5</p>	<p>Final Plan</p> <ul style="list-style-type: none"> • Present a summary of comments, responses, and plan revisions for the Commissioner’s approval. • Commissioner approves final plan. • Distribute the final plan. • Provide plan implementation training to DNR staff involved in forest management and coordination.
<p>Step 6</p>	<p>Monitoring</p> <ul style="list-style-type: none"> • After implementation, plans are periodically monitored to assess their implementation and effectiveness.

Other Planning Efforts

Several other DNR planning efforts inform the creation of the PP SFRMP, including the [Forest Action Plan](#), [Wildlife Action Plan](#), and Wildlife Management Area Plans.

MFRC Regional Landscape Planning

This plan also aligns with the goals and strategies related to vegetation management in the Minnesota Forest Resources Council (MFRC) [Southeast Landscape Plan](#). By aligning with this MFRC plan, the decisions for the management of DNR-administered lands in this SFRMP incorporate recommendations that were developed with a broader landscape perspective across all ownerships. Having aligned goals and strategies assists in cooperation across ownerships in this larger landscape area.

Planning Area Description

The PP Section consists of a total land area of approximately 2.6 million acres, including all or parts of the following counties: Dakota, Dodge, Fillmore, Goodhue, Houston, Mower, Olmsted, Rice, Wabasha, Washington, and Winona (Map 1.1).

Much of this Section is rural but it also contains the cities of Rochester, Red Wing, and Caledonia. According to the most recent national land cover database (NCLD) classification information (NLCD 2016), the largest land cover in the Section is agriculture (approximately 55%). Forests and woody vegetation (approximately 16%) are the second largest land cover within the Section.

Based on the DNR forest inventory of timberland considered in this plan, oak, mixed upland hardwoods, and lowland hardwoods are the most abundant timber species (Table 1.2).

Most of the land within the Section is in private ownership (over 2.5 million acres; approximately 95%), with the State of Minnesota administering approximately 3.9% (about 102,634 acres) of the land (Table 1.3). Other landowners in the Section include tribes, counties, and the federal government (Table 1.3). The DNR Division of Forestry administers most of the DNR-administered land in the PP Section (47%), followed by the Division of Fish and Wildlife section of Wildlife (41.2%), and then the Division of Parks and Trails (9.7%; Table 1.4). Approximately 0.9% of state-administered forest land available for management is school trust land (Table 1.5). For more detailed descriptions of the planning area, refer to the PP SFRMP Preliminary Issues and Assessment document on the [PP SFRMP Website](#).

Map 1.1: Location of the Paleozoic Plateau Section

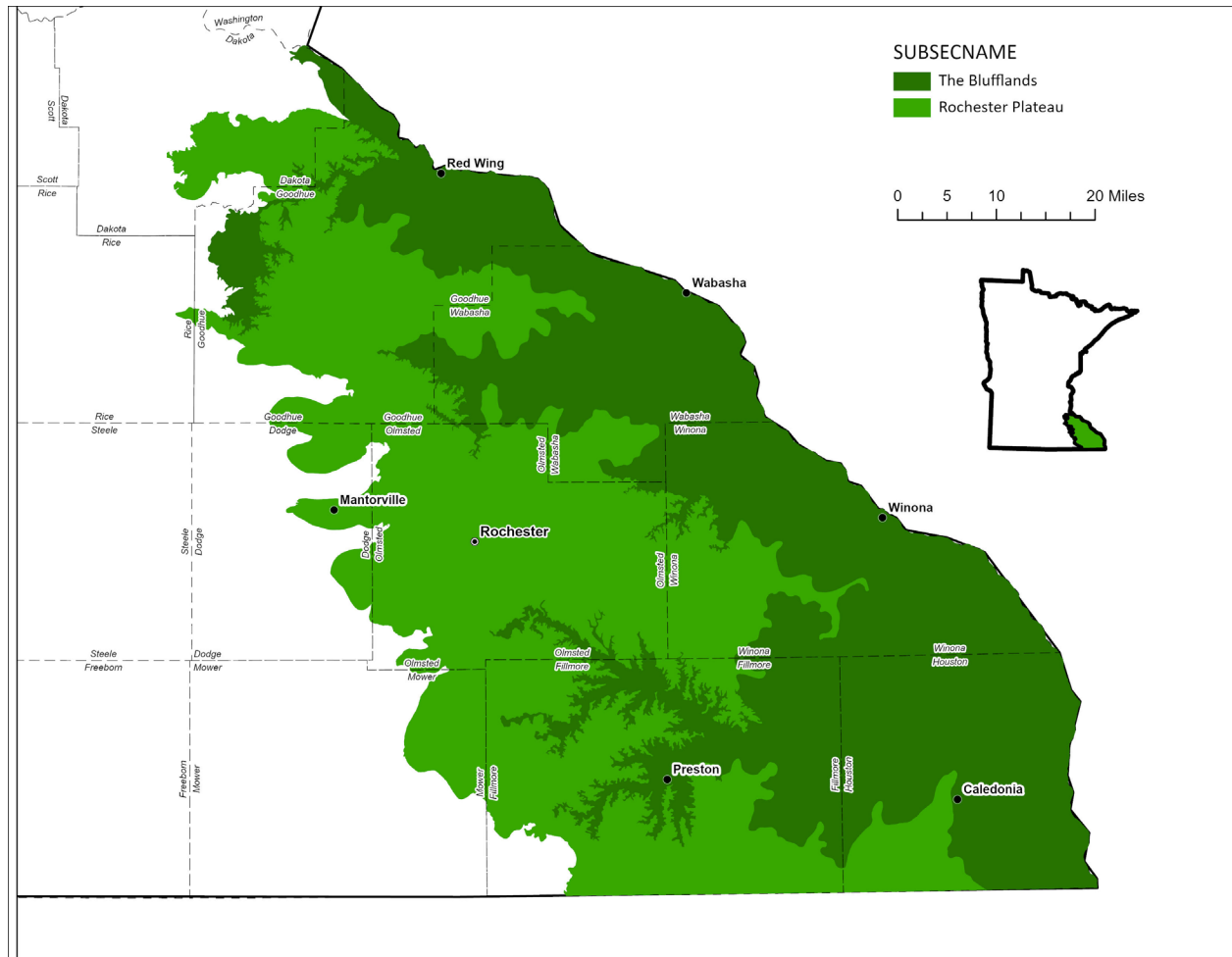


Table 1.2: Generalized cover type composition of DNR-administered lands in the PP (2017 FIM)

Cover Type Group	Acres	Percent
Hardwoods (central and northern hardwoods including oak and walnut)	60,244	60.3%
Lowland hardwoods (ash, elm, willow, cottonwood, and silver maple)	9,294	9.3%
Pine (red pine, white pine, scotch pine, and jack pine)	2,780	2.8%
Aspen, birch, balm-of-Gilead, and hybrid poplar	1,378	1.4%
White spruce, balsam fir, Norway spruce, upland larch, red cedar, scotch pine, and upland black spruce	564	0.6%
Lowland conifers (black spruce, tamarack, and white cedar)	33	<0.1%
Other non-forest (developed areas, lowland grass and brush, water)	25,701	25.7%
Totals	99,995	100%

Table 1.3: Land ownership in the PP Section (2008 GAP)

Ownership	Acres	Percent
State-administered ¹	102,634	3.9%
Private	2,506,023	94.6%
Tribal	329	<0.1%
County/Other Public	3,528	0.1%
Federal	37,334	1.4%
Totals	2,649,848	100%

Table 1.4: DNR-administered acres in the PP Section from the DNR’s forest inventory data (2017 FIM)

State administration	Non-School Trust Land	School Trust Land	Total
Division of Forestry	46,264	807	47,071
Division of FAW – Section of Wildlife	41,200	7	41,207
Scientific and Natural Areas	1,326	0	1,326
State Parks	9,510	0	9,510
Division of FAW – Section of Fisheries	611	0	611
Trails and Waterways	255	0	255
DNR	7	0	7
Mean Water	8	0	8
Grand Total	99,182	814	99,995

Table 1.5: Acreages of DNR-administered lands in the PP by school trust status. Managed acres are those in the management pool (2017 FIM).

School Trust Status	DNR Land in FIM	Percent land in FIM	Timberland	Percent Timberland	Managed Acres	Percent Managed Acres	Managed Timberland	Percent Managed Timberland
Trust	814	0.8%	670	0.9%	760	0.9%	616	1.0%
Non-Trust	99,181	99.2%	69,854	99.1%	83,996	99.1%	58,635	99.0%

A Note on Data Limitations

Due to updates to the forest inventory and other data sources during the planning process, there may be slight differences in acreages between various tables and figures in this planning document. These differences do not affect the recommendations in this plan. For this reason, acreage goals in this plan should be viewed as desired trends, not exact targets. FIM data used in this plan is from the same dataset used for the Sustainable Timber Harvest and is from 2017.

¹ SFRMP only covers DNR Division of Forestry and Division Fish and Wildlife, Wildlife section – administered lands.

Chapter 2: Issues Considered During SFRMP Planning

Issue Definition

In this plan, “issues” refers to natural resource-related concerns that are directly affected by, or that directly affect, vegetation management decisions on lands administered by the Minnesota Department of Natural Resources (DNR) Divisions of Forestry and Fish and Wildlife. Relevant issues are defined by current, anticipated, or desired forest vegetation conditions and vegetation management trends, threats, and opportunities. The issues described in this chapter are broad, complex, and often interacting. Future direction in Chapter 3 of this document seeks to balance addressing these issues while following Department policies and direction and state and federal laws.

Some issues relevant to DNR-administered forest lands are outside the scope of the SFRMP process. For example, SFRMPs do not address recreation trail system issues or planning. However, aesthetic concerns along existing recreational trail corridors can be considered when determining forest stand management guidance in SFRMPs. As another example, the plan establishes vegetation goals associated with wildlife habitat but not goals for wildlife population levels.

All of the issues listed in this chapter are important to the management of DNR-administered land. However, the extent to which issues can be addressed through the SFRMP varies. Some issues raised in this chapter are primarily addressed through other planning processes but are included here due to their influence on the desired future conditions, general direction, and strategies given in this plan. For example, several decisions about forest management on DNR-administered land related to the issues listed below were addressed or determined through the development of the strategic direction and 10-year stand exam list components of our plan system, including:

- amount, type, and distribution of old and young forest
- desired age class distributions
- timber harvest levels
- landscape patterns of harvested stands

Although still important, some issues in this plan can only be addressed opportunistically given a variety of factors, including current natural resource conditions, managing to address various forest values, state and federal statutes, and department direction and policy.

The guidance for future direction in Chapter 3 was developed to address the issues in this chapter. [Appendix B](#) contains a table showing the relationship between the general direction statements in Chapter 3 and the issues that they are intended to address in Chapter 2. Each section in Chapter 3 references the issues related to that section.

How Issues Were Identified

The SFRMP issues were developed using assessment information, DNR policies and guidelines, local knowledge, existing plans, and external input through past planning processes. Each SFRMP contains a

common set of issues developed from previous SFRMPs. These common issues are refined and supplemented based on section-specific conditions and considerations.

Issues

A. Forest Age and Growth Stages

Some aspects of this issue category, including the distribution of forest ages across DNR-administered lands, are addressed through the forest plan system's strategic direction and 10-year stand exam list. They are still included here because they are also relevant to implementing the forest plan system's strategic direction and 10-year stand exam list through SFRMP guidance.

A1. Representing growth stages and forest types across the landscape, given age class distribution goals.

DNR forest resource planning has long sought to balance acres between age classes up to standard rotation ages for even-aged cover types. Balanced age class distributions ensure a sustainable supply of timber and other forest values, including older forest, across the landscape over time from state-administered land. At the same time, DNR-administered lands represent a broad range of growth stages and age classes on the landscape in various ways, including within-stand characteristics associated with older growth stages and stands representing older growth stages.

Why is this issue important? Adequate representation of all age classes and growth stages provides:

- a supply of vegetation conditions that supports many species, including species with age-specific habitat requirements
- greater potential to provide a sustainable yield of timber
- ecological values, including healthier diverse forests that are more resilient to insect and disease outbreaks and negative effects of climate change
- increase in forest-wide diversity
- greater ability to manage forest lands sustainably into the future

A2. Managing for older forest and old forest qualities on the landscape.

Mature to old forest is represented on DNR-administered land in a variety of ways. Examples include stands that exceed the normal rotation age for their cover type, old forest characteristics like large old trees and snags within younger stands, and designated old-growth stands.

Why is this issue important? Old forest provides the following benefits:

- vegetation conditions of later successional growth stages associated with animal, plant, and fungi species' habitats
 - Old, large-diameter hardwood trees are important to woodpeckers, fishers, and bats
 - Older hardwood forests with diverse vertical forest structures are important to warblers, woodpeckers, squirrels, and wild turkeys
- development of late-successional native plant community (NPC) growth stages
- stable hydrology and groundwater in relatively undisturbed older forests, especially lowland forests

- overall structural and species diversity on the forest landscape
- within-stand and landscape diversity and complexity
- ecological services associated with old forest conditions, such as maintaining water quality, natural disturbance regimes, and biodiversity
- traditional use, recreational, and economic opportunities associated with old forest conditions

Tradeoffs include the potential for an old forest to have reduced timber quantity and quality for some types of forest products compared to forests at or below normal rotation age and forest health and wildfire risks.

A3. Managing for young, early successional forest.

Young, early successional forest is defined as the 0-30 age class of aspen, balm-of-Gilead, birch, and jack pine cover types across the state. In the Paleozoic Plateau, young oak stands in the 0-30 age class, which is a common early successional stage in southern floristic plant communities and is included as a young early successional forest. Currently, an estimated 5.3% of DNR-administered timberland-managed acres in the PP Section are young forests.

Why is this issue important? Young, early successional forest provides:

- vegetation conditions that support associated animal (game and non-game) species
 - Examples of species within PP associated with young or early successional forest for at least part of their life cycle include ruffed grouse, American woodcock, golden-winged warbler, chestnut-sided warbler, mourning warbler, white-throated sparrow, and white-tailed deer.
- cover from predation and/or food supply for species that depend on dense young forest
- edges between young and more mature forests that some species depend on
- traditional use of the natural resources associated with young forests (e.g., berry picking)

B. Forest Composition, Structure, Spatial Arrangement, Growth Stages, and Native Plant Communities

Some aspects of this issue category, including the distribution of growth stages and landscape spatial arrangement, were addressed or determined through the strategic direction and 10-year stand exam list plan system components. They are still included here because they are also relevant to implementing the plan system's strategic direction and 10-year stand exam list through SFRMP guidance.

B1. Addressing biodiversity, forest health, and productivity of native plant communities through management of forest composition, structure, representation of growth stages, within-stand diversity, and spatial arrangement of vegetative types.

Why is this issue important?

- The composition and structure within individual stands and across the forest landscape provide habitat for plant and wildlife species.
- Forests with greater species and structural diversity support a greater diversity of plant and animal life and, subsequently, a greater capacity to cope with changing environmental conditions.
- A variety of patch sizes on the landscape provide a range of habitat and economic opportunities.

- Connectivity among patches of vegetation is important for plant pollination and migration and allows wildlife to access different habitat components required for their annual life cycles.
- Healthy, productive, and diverse forests have increased resilience to the effects of climate change and invasive species and support forest economies.
- Protecting native biodiversity and forest health and ensuring sustained forest productivity helps support the public's trust in DNR managing these lands.

B2. Determining which tree species to increase or manage within forest communities in the Section with respect to various natural resource objectives and projected environmental change.

Why is this issue important?

- The distribution of specific tree species in the Section provides for different social, economic, and ecological values.
- Tree species diversity supports ecological function (including genetic diversity) within native plant communities.
- Natural regeneration capacity within stands depends on tree species diversity (for example, whether the species present will be capable of suckering, layering, producing stump sprouts, or providing seed) and insect and disease susceptibility.
- Artificial regeneration (seeding and planting) provides opportunities to maintain, change, or diversify species composition within stands.
- Different tree species support a range of mycorrhizal relationships necessary for healthy soils and trees.
- Climate change is expected to impact which cover types will grow well on sites and will inform decisions on which cover types are most appropriate for future vegetation management decisions.

B3. Maintaining or enhancing highly imperiled, imperiled, and vulnerable to extirpation native plant communities in the Section.

Certain rare native plant communities are of particular concern in the Section because of one or more of the following factors:

- global or statewide rarity
- limited geographic range or extent
- significant changes in composition (short- and long-term trends) as compared to historical conditions
- scope and severity of major threats

Examples of these types of communities in the Section include FDs27 (S1S2, G3G4), FFs59 (S1-S3, G2G3), MHc38a (S1, G2), MHs38 (S3, G2G3) UPn13 (S1 S2, G2), UPs13 (S1S2, G3), UPs14 (S1S2, G2G3), UPs24 (S1, G1G2), and WFs57 (S1S2). See the [DNR NPC website](#) and DNR field guides to native plant communities for more information.

Why is this issue important?

- Rare plant communities can provide unique and important habitats for specialist plant and animal species, some of which can also be rare or uncommon.
- The Minnesota Forest Resource Council’s Voluntary Site-Level Forest Management Guidelines for Landowners, Loggers and Resource Managers (MFRC site-level guidelines) and the DNR’s third-party forest certification programs recognize rare plant communities as considerations during forest management planning.
- These plant communities contribute to overall forest biodiversity and reflect the unique conditions created by interactions between biotic and abiotic factors within this Section.
- As the climate continues to change, it is important to maintain these sites and communities as refugia for species, biodiversity, and genetics.

B4. Retaining characteristics of natural stand-replacement disturbance events while applying intensive management of forest communities.

Why is this issue important?

- Intensive management can include activities such as rock-raking and herbicide application. Intensive management may be essential for successfully regenerating certain species, controlling insect or disease problems, and managing wildlife habitats.
- Although intensive management is a valuable tool, these activities also have the potential to:
 - reduce plant species and structural diversity, disrupt the soil profile, compact the soil, reduce native herbaceous species diversity, and increase non-native invasive plants or aggressive native plants
 - simplify and fragment native plant communities at the stand and landscape scale
 - alter hydrology to a greater extent than less intensive management
- Even in fire-dependent systems, where natural disturbance events (e.g., wind and fire) are relatively frequent, the resulting forest mosaic includes undisturbed vegetation and many legacies or refugia for species in the regenerating stand.

B5. Using management to better reflect natural landscape patterns (the size and configuration of growth stages and types resulting from broad-scale natural disturbances) in the Section.

Large blocks of forest provide an opportunity to create contiguous habitats of uniform age and structure in patches of various sizes and ages. Due to the dispersed nature of DNR-administered lands within PP, the number and presence of large old patches greater than 250 acres in size and over rotation age are limited. Approximately 12,617 acres, or about 12% of all DNR-administered lands within the forest inventory in PP, are within large old patches. Most of these acres are within upland hardwoods, including northern hardwoods and oak.

Why is this issue important? Large patches and older growth stages are rarer on the landscape than smaller patches and younger growth stages. This results in the following:

- simplification of forest ecosystems at the landscape scale
- change in the spatial arrangement of vegetation patches used by plants and animals
- increased isolation of wildlife and plant populations

- potential decline of species
- reduced resilience of forest ecosystems to disturbance events and climate change
- potential increases of certain populations to undesirable levels, resulting in negative impacts to forest communities

B6. Reducing forest fragmentation to maintain connectivity among habitat types.

Why is this issue important? In this Section, forest fragmentation is greatly affected by the small amount of state-administered lands compared to other ownerships. Land use, such as the conversion of forest to agriculture, residential development, and ongoing sales of large tracts of land by private corporations, have the greatest impact on forest fragmentation. Together with forest management and harvesting across ownerships, these impacts can result in the following:

- reduced forest patch size
- altered forest composition, structure, and age
- increased forest fragmentation and simplification
- fragmentation of wildlife habitat cover types by suburban and urban sprawl
- reduced interior forest habitat, and increased edge disturbance, which can promote invasive species
- reduced biodiversity and the ability of the forest to produce a range of forest products
- reduced habitat connectivity and ecologically intact landscapes

C. Harvest Levels for Timber and Non-Timber Forest Products

Decisions concerning the amount of timber volume to offer for sale to accomplish the disturbance needed to develop the DNR's desired forest age class distributions and species mixes over time, consistent with the specific management objectives of different forest lands administered by the DNR, are part of the strategic direction for this planning period. Other aspects of management related to harvest levels, such as providing guidance related to annual plan additions or habitat, are within the scope of the SFRMP.

C1. Contributing to sustainable forest management that meets the Department's direction to continue to develop the desired forest age class distributions and species mixes over time by offering timber volume for sale, considering all forest resources and the objectives of the different forest lands administered by the DNR.

Why is this issue important?

- Some cover types in the Section have pronounced age class imbalances (Appendix C), which, if not corrected, decreases our opportunity to provide a consistent supply of other forest resource benefits over time.
- Timber harvest sustainably provides forest products from a renewable resource that Minnesotans use every day, including:
 - building materials for homes, businesses, and other buildings, including lumber, cabin logs, flooring, paneling, building timbers, and engineered wood products
 - pulp, paper, and paper products used for printing documents, packaging, and numerous other applications

- dissolved wood products used to create clothing and other products
- utility poles that facilitate the transmission of the electricity our society depends on
- Sustainable timber harvest supports the state’s economy.
 - Forest management directly produces thousands of jobs, billions of dollars in revenue, and millions of dollars in state and local taxes.
 - Forest management supports healthy forests that promote recreation, a \$10 billion dollar industry in Minnesota.
 - Forest management that sustains healthy forests promotes ecosystem benefits, such as clean water, that support the state’s economy overall.
- School trust land is mandated to benefit the Permanent School Fund economically through sustainable management.
- Forest management in Wildlife Management Areas maintains or enhances habitat objectives.
- Managing forests in a sustainable manner is a requirement for maintaining the DNR’s Forest Stewardship Council (FSC) and Sustainable Forestry Initiative (SFI) certifications (forest certification).
Sustainably managed forests can:
 - support a healthy and competitive timber industry
 - provide a diversity of vegetation types associated with plant and animal species
 - maintain water quality and quantity
 - maintain soil health, structure, and biodiversity
 - sequester and store carbon in forests and timber products and support climate adaptation
 - provide a wide array of recreational opportunities

C2. Managing non-timber forest products.

Demand for non-timber forest products (e.g., decorative trees, berries, ginseng, firewood, and mushrooms) is increasing within this Section.

Why is this issue important?

Non-timber forest products:

- diversify local economies and support traditional harvest activities (e.g., maple syrup tapping)
- are particularly important in areas where employment opportunities are limited
- support local individuals, families, and cottage industries in an expanding worldwide market
- maintain a sustainable harvest of these resources

C3. Marketability and utilization of forest products

Marketability and good utilization of forest products help to ensure that state forests are managed sustainably and that goals of creating and maintaining wildlife habitat and forest composition and structure are achieved.

Why is this issue important?

Marketability and good utilization provide the ability to:

- achieve silvicultural goals through harvesting timber
- achieve cover type change/maintenance goals
- create structure and conditions beneficial to wildlife

D. Biological Diversity

D1. Maintaining or enhancing biodiversity and native plant community composition, structure, and function through stand management within larger areas of biodiversity significance.

Why is this issue important?

Larger areas with biodiversity significance provide:

- reference areas to improve our understanding of ecosystems and help us evaluate the effects of vegetation management
- opportunities for large patch management and the maintenance, enhancement, or restoration of native plant communities at landscape scales
- potential for addressing biodiversity-related goals of the DNR and other landowners
- habitat for various native species across the landscape
- ecosystem services that support human health, safety, and welfare

D2. Retaining or restoring within-stand structural complexity (e.g., vertical structure, stem size and density, coarse woody debris, and pit and mound micro-topography) when stands are harvested before reaching older growth stages in which these characteristics would normally develop.

Why is this issue important?

- Within-stand structural complexity supports a variety of plant and animal species and soil health and promotes the regeneration of some tree species.
- Some forest management practices can reduce within-stand structural complexity and diversity.

E. Rare Features

E1. Protecting rare plants and animals (including endangered, threatened, special concern, and Species in Greatest Conservation Need), their habitats, and other rare features in the Section.

Rare features and species exist across the PP Section, resulting in one of the most diverse Sections within Minnesota. The Section's rare natural features and the habitats they support are an important component of managing for rare species. Areas within the Section that provide valuable habitat for rare features include but are not limited to high conservation value forests (HCVF), high biodiversity site management opportunity areas, and the Whitewater WMA.

Why is this issue important?

- Protecting rare features on state lands is a key component of ensuring species, community, and forest-level biodiversity in the Section.

- There are many different factors that may influence rare species and features, many beyond the control of forest managers. DNR Department-wide direction acknowledges the effects of habitat loss and degradation on rare species and the DNR's role in advocating for the maintenance and protection of habitat for rare species throughout the state, regardless of ownership.
- The DNR is obligated to follow federal laws and rules concerning the protection of endangered and threatened species and associated habitats, as well as state laws, rules, and policies concerning the protection of state endangered and threatened species.
- The DNR is required by third-party certification to ensure that any management within high conservation value forest (HCVF) sites enhances or maintains the high conservation value(s) associated with the site.

F. Wildlife

F1. Addressing the needs of game and nongame species through vegetation management.

Why is this issue important?

- Forest change affects forest wildlife; populations of some species have increased while others have decreased in the Section.
- Several species listed by the state as endangered, threatened, or of special concern live in habitats managed through forest resource planning and management, including forested, non-forested, and transitional habitat types within the Section.
- Forest wildlife is important to society and depends on healthy forest ecosystems.
- Legal mandates, stakeholders' expectations, and DNR internal policies require the ecological integrity of the forest to be maintained and enhanced.
- Practical reasons to maintain ecological integrity related to wildlife habitat include:
 - the economic vitality of forest and tourism industries
 - maintenance of recreation opportunities for the public
 - the health of wildlife species and populations
 - control of forest insects and disease
- Not managing for the habitat needs of wildlife may result in the following:
 - decreases in wildlife population abundance in the Section
 - decreased habitat for all wildlife species, especially rare species
- In the PP Section, historical and more recent changes have affected wildlife species and their habitats, including:
 - reduced number of larger patches of older forest and connections between such patches
 - increased habitat fragmentation from agriculture and development
 - alteration of natural fire disturbance events
- The location of public forest land in the PP Section near the most populated areas in Minnesota draws thousands of people every year to observe, photograph, hunt, and trap the wide variety of wildlife in the area, supporting long-standing traditions and income to local economies.

- Hunters throughout the Section seek game species. Ruffed grouse, turkey, American woodcock, and white-tailed deer are found though out the Section.
- The Section provides unique wildlife viewing and photography opportunities for sought-after species, including Blanding’s turtle, Acadian flycatcher, Louisiana waterthrush, cerulean warbler, red-headed woodpecker, and a large number of warbler species.
- There is a significant risk of up-listing and additional protections being applied to rare species with declining populations.

G. Watersheds, including Riparian and Aquatic Areas

G1. Addressing the impacts of vegetation management on surface waters (wetlands, streams, and lakes).

Why is this issue important?

- Management of riparian areas can influence water quality, water temperature, erosion rates, and deposition of woody debris in lakes and streams.
 - Well-managed riparian areas are critical to protecting, maintaining, or enhancing aquatic habitat types, corridors, connectivity for plant and animal species, aesthetics, recreation, water quality, reducing the threat and impact of invasive species, and forest products.
 - Rare species are affected by changes to these factors.
 - Tree species growing in riparian areas affect erosion potential; the presence of streamside grass and brush species can help minimize erosion and encourage better fish habitat.
- Infrastructure such as roads, culverts, and stream crossings can influence water quality and stream connectivity.
- Management activities may affect permanent wetlands adjacent to upland stands. For example, young forests in the adjacent landscape may lead to faster and increased water runoff.
- Seasonal ponds and wetlands can influence water quality and wildlife populations.
 - They retain snowpack later in the spring for an even melt and contribute to adjacent water bodies.
 - They are important for maintaining wildlife populations such as amphibians, which have limited ability to disperse long distances.
- Many wildlife species and plants are associated with forested wetlands or the riparian forest interface. These areas also serve as movement corridors for additional species.
- Increased species diversity within riparian forests will help them be more resistant and resilient to forest diseases and climate change.
- Applying Minnesota Forest Resource Council site-level guidelines without considering site-specific conditions may not be adequate to protect surface waters.

G2. Addressing cumulative impacts of vegetation management on aquatic resources on a watershed or sub-watershed level.

Why is this issue important?

- The PP Section contains all or parts of 8 major watersheds in Minnesota.

- Vegetation management activities and the amount of forest cover on the landscape can significantly affect watershed or sub-watershed hydrology and overall water quality.
- Land use significantly impacts the type of vegetation and vegetation management and the health of a watershed.

Note: This document includes a description of this issue here because of its relevance to forest management. However, SFRMPs are specific to vegetation management on a portion of State-administered lands and do not apply to all lands within the ecological Section. [Comprehensive watershed management plans](#) are developed through a separate program. Because we do not currently have the data or methodology to fully evaluate the effects of different forest cover types and conditions on watersheds, this plan does not include specific future direction related to cumulative impacts on aquatic resources. Instead, this plan and DNR forest management focus on addressing water quality issues and impacts on aquatic resources by applying MFRC site-level guidelines and guidance for site-level decisions (see [Chapter 3, Section 3.5](#)).

H. Timber Productivity

H1. Maintaining or increasing timber productivity on state lands.

Why is this issue important?

- Minnesota’s forests provide a range of environmental and economic services. Healthy trees provide many ecosystem benefits, from habitat to carbon sequestration.
- The DNR accomplishes many of the vegetation management activities covered under this SFRMP through timber harvesting.
- The state's forest industry and economy benefit from increased productivity and quality of timber. A robust forest industry is a critical component of our ability to manage forests and sustainably provide forest products over time.
- Increasing forest productivity will help the DNR meet its fiduciary obligation on trust lands.

I. Disturbance Impacts on Forest Ecosystems

I1. Addressing disturbances, such as harmful forest insects, disease, and herbivory, on forest ecosystems.

Why is this issue important?

- Insects and diseases can alter and negatively affect forests and functioning forest ecosystems.
 - Widespread pest outbreaks outside their natural range cause high levels of tree mortality and can have significant ecological and economic consequences.
 - Insects and diseases can reduce timber production and quality and increase fire hazards.
 - Aggressive control can impact non-target and/or native species, ecosystem function, and overall species diversity and still may not solve the problem.
 - Inadequate control may negatively affect the forest's timber volume, aesthetics, and recreational enjoyment.

- Natural disturbances can promote a diversity of tree species and forest structure and generate dead wood, which provides important habitat components and soil nutrients.
- Wildlife can have adverse impacts, including browsing, girdling, and grazing (herbivory).

12. Addressing non-native invasive species threats and invasions.

Why is this issue important?

- Non-native invasive species can displace native species, carry or cause diseases, or disrupt natural community functions. They can change ecosystem function, simplify natural processes and plant communities, reduce resiliency, and cause reductions in sensitive and rare species and communities. Examples of non-native invasives that affect the forests within the Paleozoic Plateau include reed canary grass (native and non-native strains), round leaf bittersweet, Japanese barberry, Japanese knotweed, spongy moth, garlic mustard, oak wilt, spotted knapweed, buckthorn, non-native honeysuckle, black locust, wild parsnip, earthworms, and emerald ash borer.
- Through the Invasive Species Operational Order, the DNR's policy is to prevent or limit the introduction of invasive species onto DNR-administered lands and waters and limit their spread and impact on high-value resources.
- Invasive species can result in economic loss, including loss of timber through increased competition and increased damage and control costs, and they can impact the ability to achieve silvicultural goals across the section.
- Invasive species can have a negative impact on species diversity, fish and wildlife habitat, and the recreational use of forests.
- Effective or practical methods to control most non-native and invasive species at a landscape scale do not exist.
- Increased use of public lands results in a greater risk of transporting invasive species.

13. Considering catastrophic natural disturbances in vegetation management decisions.

Why is this issue important?

- Catastrophic natural disturbance events such as wind, precipitation, erosion, and fire may destroy or damage forest resources, reducing opportunities for commercial timber harvest.
- They may affect this plan's short-term goals and long-term desired future condition (DFC) goals.
- The timing and location of catastrophic events are difficult to predict.

J. Climate Change

J1. Managing vegetation to prepare for and respond to the effects of climate change.

Changes to climate will have various effects on the state's forests over time. Descriptions of these effects can also be found within the other issues described in this chapter and within the strategies found in Chapter 3.

Why is this issue important?

- Minnesota is becoming warmer and wetter on average, and temperatures and precipitation are projected to continue increasing through the end of this century.
- Effects of climate change include:
 - changes in frequency and intensity of precipitation events
 - increased potential of soil erosion and the creation of gullies within the bluffs due to the intensity of rain events
 - changes in the distribution and survival of plant and animal species
 - increased reproductive capability and survival of some insect pests, pathogens, and non-native invasive species that affect forests and wildlife
 - negative effects on tree species, such as quaking aspen, birch, and eastern white pine
 - expansion of habitat for some tree species, such as black walnut, sugar maple, eastern red cedar, and bur oak
 - reduced timber production and more limited access to winter management sites
 - negative effects on populations of rare species
- Forests with lower species and structural diversity are projected to be less resilient to climate change impacts.
- Stand regeneration decisions have the potential to introduce and assist in the migration of species projected to fare better as climate changes.
- Ecological communities thought to be most vulnerable to changing climate include cool and cold-water streams, and lowland conifer forests.
- Climate change will affect future management options and decisions on site-appropriate cover types.
- Carbon sequestration by forests and wetlands, including soils, will be affected.

K. Visual Quality

K1. Minimizing the effects of vegetation management activities on visual quality.

Why is this issue important?

- Scenic beauty, or visual quality, is a primary reason people spend their recreation and vacation time in or near forested areas.
- Visual quality is an important consideration for vegetation management activities adjacent to recreational trails, campgrounds, day-use areas, lakes, waterways, or public roads and highways.
- Visual quality affects public perceptions of vegetation management and thus is important to maintain public support for forest resource management.

L. Access to State Land

L1. Providing access to stands identified for management.

Access to DNR-administered lands for vegetation management can be very challenging in the Paleozoic Plateau for various reasons. Steep topography, flood plains, high sensitivity areas, rare species and features,

the dispersed nature of DNR-administered lands, and the need to secure access across adjacent land can limit the timing and ability to access forests to conduct management.

Why is this issue important?

- Access routes are necessary for vegetation management activities, insect and disease control, fire response, and recreation.
- A large amount of forest sites require access across other ownerships to conduct management.
- Properly designed and managed access will result in the following:
 - less land disturbance
 - less forest fragmentation
 - decreased spread of non-native invasive species and undesirable native plants and animals
 - decreased conflicts with adjacent landowners
 - fewer impacts to water quality, changes to hydrology, rare species, and destruction of fish habitat

M. Cultural Resources

M1. Protecting cultural resources during vegetation management activities on state-administered lands.

A cultural resource is an archaeological site, cemetery, historic structure, historic area, or traditional use area of spiritual, traditional, scientific, or educational value. Examples include the archaeological remains of American Indian villages and use areas, an abandoned logging camp, a portage trail, a cemetery, food-gathering sites such as wild rice harvesting and maple sugaring camps, or a pioneer homestead.

Why is this issue important?

- Cultural resources are scarce, nonrenewable features that provide physical links to our past or the ability to continue to practice cultural traditions.
- They often possess spiritual, traditional, scientific, or educational values and should be treated as assets.
- In addition to federal and state laws that protect certain types of cultural resources, the MFRC site-level guidelines provide information and recommendations to assist private and public land managers in taking responsible actions when cultural resources are encountered.

N. Balancing Vegetation Management Needs with Legal Requirements

N1. Including various state and federal legal requirements in the SFRMP planning process.

Why is this issue important? Vegetation management is directed by administrative land status and relevant statutes and laws. Some examples include:

- The Minnesota state constitution and state statute require the DNR to manage school trust lands for the maximum long-term economic benefit of the permanent school fund, using sound natural resource conservation and management principles.

- Acquired WMA lands are managed primarily for wildlife habitat.
- The DNR must comply with federal and state endangered species laws.
- Not meeting these legal requirements could cause a loss in funding or revenue, corrective actions through third-party forest certification, and loss of authority to manage these lands.
- Following federal and state legal requirements upholds the public trust in the DNR managing these resources sustainably.

Chapter 3: Forest Types and Management Direction

Introduction

Managing sustainability requires addressing the issues identified in Chapter 2 to balance multiple forest benefits. Sustainably managed forests support wildlife habitat, biodiversity, wood supply and healthy natural resource economies, carbon storage, forest health, recreation, and water quality and quantity. The “optimal balance” of these forest benefits varies across the different lands managed by the DNR. This chapter provides future direction to forest managers that aims to balance the issues identified in this plan while adhering to Minnesota Department of Natural Resources (DNR) policy.

Interdisciplinary DNR staff members helped refine general direction statement (GDS) strategies in response to the list of issues in Chapter 2 and defined desired future condition (DFC) goals where appropriate (see below for definitions of GDSs and DFCs). An issue may be addressed through one or more GDSs, and some GDSs address multiple issues ([Appendix B](#)). Broadly, strategies are designed to maintain or increase a site's and landscape's adaptive capacity to meet the challenges and opportunities identified within the issues with the goal of maintaining and increasing diversity across the landscape. Goals and strategies for state-administered forest lands in this plan are consistent with the MFRC landscape desired outcomes, long-term goals, and strategies for forest lands and ecosystem types within the southeast MFRC landscape region.

As part of the process of developing this plan, management opportunity areas (MOAs) were reviewed and adopted. Management opportunity areas provide opportunities to address values such as biodiversity, rare features, diversity of native plant community growth stages, and wildlife needs through vegetation management at a scale smaller than the landscape but larger than individual stands. See [Section 3.13](#) and [Appendix E](#) for more information on MOAs.

General Direction Statements (GDS)

- follow directions provided in federal and state statutes, laws, and rules, as well as all DNR policies, guidelines, and management direction
- incorporate DNR specialists' expert knowledge in their fields when designing management prescriptions
- make recommendations such as increasing, decreasing, maintaining, or protecting a forest condition, output, or quality
- are grouped under 13 forest resource management categories; some categories have several GDSs to address the associated issues, while others have only one
- include strategies to achieve the general direction

Desired Future Conditions (DFC)

- are short-term (10-year) and long-term (50+ years) trends for the desired condition of DNR forest lands in the Section
- were identified where we can measure and quantify progress toward meeting the DFCs

Role of Statutes, laws, Department Guidance Documents, Policy, and Management Recommendations

In addition to DFCs, GDSs, and strategies identified in this SFRMP, a vast array of laws, rules, planning documents, guidelines, policies, objectives, and initiatives direct vegetation management on state-administered land. DNR employees must consider these directives when making individual site-level decisions. The DNR's internal policy system, which uses a variety of directional documents to communicate expectations to DNR staff on a range of land management issues, provides clarification and guidance to staff on how to interpret and implement these directives.

Questions that should always be considered when implementing this plan include:

- Does the treatment meet the requirements of federal and state laws and rules?
- Does the treatment meet current DNR policies and apply guidelines as appropriate?
- Does the treatment align with the management objectives and requirements associated with the land status (e.g., if the treatment is on acquired WMA acres, is it primarily for habitat improvement? If the treatment is on school trust lands, does the prescription adhere to the DNR School Trust Lands policy?)?
- Is the site within an area with a WMA plan? If yes, have you considered and implemented applicable direction from those plans? Have the management objectives been documented prior to treatment?
- Does the planned management meet MFRC site-level guidelines?
- Is the management activity appropriate for the NPC? Is it consistent with the ECS silvicultural interpretation?
- Is the planned management activity within an area of high biodiversity (MBS sites, HCVF, High Biodiversity MOA, etc.)? If yes, have you considered and incorporated relevant direction?
- Does the stand present a good opportunity to contribute to SFRMP conversion goals?
- Do planned actions account for endangered and threatened species?
- Have you considered and incorporated information on rare species (special concern and Species in Greatest Conservation Need) and associated habitats?
- Have climate change adaptation strategies been implemented?
- Have current guidelines or forest health specialists been consulted if a forest health issue is present?
- Is the site in a MOA? If yes, have the MOA guidance documents been considered?
- Do management decisions align with local annual goals that are derived from the strategic direction and 10-year stand exam list?
- Have forest coordination processes and agreements been documented and followed?

The strategies for achieving GDSs throughout the rest of this chapter provide guidance beyond these overarching considerations to achieve SFRMP landscape goals.

3.1 Forest Composition and Within-stand Diversity

Broadly, goals for forest composition and within-stand diversity in this section of the plan are to 1) maintain or increase where appropriate, cover type diversity, and 2) increase within-stand diversity where

appropriate. This section begins with a description and guidance for each cover type and concludes with broader general direction statements and strategies for the PP Section.

The GDSs and Strategies in this section address Issues: [A1, A2, A3, B1, B2, C1, F1, J1](#)

Cover Type Direction

The following cover type management guidance summarizes current conditions and future management direction for each of the major cover types within the PP Section, including Section-specific cover type issues that field staff should focus on while planning and executing on-the-ground management activities. However, this section is not a comprehensive discussion of these cover types, and field staff should rely on current management direction provided on the DNR's internal interdisciplinary forest direction documents page and WMA unit plans where applicable. Those directions are updated to reflect current management guidance and policy.

Some cover types include desired cover type conversion trends or goals. The numbers and percentages provided are not exact targets and are provided to give an idea of the amount of desired change. These conversion goals are not identified for specific stands or areas within a Section but across the Section as a whole. Individual stands may convert to or away from a specific cover type based on site-specific conditions, while, as a whole, the cover type may increase across the Section. Conversion goals were developed considering the following:

- documented and modeled native plant communities
- historical forest composition, disturbance regimes, and range of natural variation
- wildlife habitat associations
- forest insects and diseases
- projected tree suitability under projected long-term climate change conditions
- societal values

Cover type conversions will be done on appropriate sites based on site-specific conditions and NPC.

Broadly, management strategies for cover types fall into two categories: even-aged management and uneven-aged management (Table 3.1). Even-aged managed cover types are managed with the goal of moving toward balanced age class distributions, with relatively equal acres in each 10-year age class through normal rotation age (NRA) for a cover type. Some stands within these cover types are thinned periodically to enhance individual tree growth, forest health, and within-stand diversity. Uneven-aged managed cover types are not managed for balanced age class distributions but to enhance within-stand diversity and composition and improve wood quality.

These broad management strategies were used during modeling to develop the DNR's 10-year stand exam list. It is important to remember that the model assumptions, including standard types of management by cover type, are simplified assumptions for average management on the average stand in the average year. These simplified assumptions are necessary for the model, which cannot work with the nuance of site-level variation. In reality, sites may differ in their objectives and characteristics. For more information, see the DNR's [Development of the 10-year Stand Exam List](#) report.

Within a cover type, there can be a large variety of native plant communities and conditions, each of which might need distinct or different management strategies implemented. The DNR will determine site-level prescriptions and strategies based on field examinations and interdisciplinary coordination to meet management objectives.

Table 3.6: General management strategies by cover type. Actual prescriptions may vary depending on the results of field examinations and stand management objectives. For example, on lands administered by the Division of Fish and Wildlife, alternative strategies may be used to support fish or wildlife habitat values.

Cover Type	Thin	Even-Aged	Uneven-Aged	Cover Type	Thin	Even-Aged	Uneven-Aged
Ash/lowland hardwoods			✓	Jack pine		✓	
Aspen/balm of Gilead		✓		Norway (red) pine	✓	✓	
Birch		✓		Tamarack		✓	
Northern hardwoods / Central Hardwoods	✓	✓ (CH)	✓	White cedar			✓
Oak	✓	✓	✓	White spruce natural			✓
Balsam fir		✓		White spruce planted	✓	✓	
Black spruce-lowland		✓		White pine natural			✓
Black spruce-upland		✓		White pine planted	✓	✓	✓ (FAW)

Oak (O)

The oak cover type includes oak forest, oak woodland, and oak savanna structures and native plant communities. Mature oak stands range from nearly pure oak to mixed stands and may contain northern pin, red, white, black, and bur oak. Oak species are also commonly found as a component of other cover types, such as aspen, birch, northern hardwoods, central hardwoods, and lowland hardwoods.

Oak species are found within various native plant communities within PP, including UPs14a, FDs27, FDs38, MHs37, MHs38, MHs39, MHs49, and FFs59.

The oak acres in the PP Section are distributed unevenly across all age classes ([Appendix C](#)). Most oak acres are over 71 years old, with very few in the younger and middle age classes. Oak can be managed as both even and uneven-aged strategies; because of this, a more balanced age class distribution is desired within the oak cover type.

Current Acres: 35,471 acres in the PP Section (approximately 41.8% of state-managed acres in the PP Section)

Future Direction and Goals

- 10-year DFC: 35,800 acres (0.9% increase)
- 50-year DFC: 36,000 acres (1.5%)
- Maintain age and species composition within stands
- Create and maintain a more balanced age-class distribution of oak stands
- Minimize the conversion of oak cover types to northern hardwoods and central hardwoods
- Consider strategies to increase the oak component in northern hardwood sites with a high oak component.

Strategies

- Convert approximately 330 acres to the oak cover type to promote climate adaptation, increase cover type diversity across the landscape, and provide wildlife value by increasing the acres that produce oak mast.
- When regenerating oak, target management to forest stands young enough to increase the success of regeneration.
- Consider the amount of advanced regeneration when planning regeneration methods and potential competition from shade-tolerant species.
- Increase the mixture of oak species, such as bur and white oak, within oak stands as appropriate to the NPC.
- Evaluate each stand to determine the best prescription when regenerating oak. Utilize even-aged or uneven-aged strategies (including clear-cuts and gap creation) as appropriate based on site-specific characteristics (e.g., stand condition, NPC) and desired future condition.
- Increase the use of prescribed fire to maintain or create oak stands.
- Consider converting old agriculture fields through planting or direct seeding to a mix of oak species appropriate to the site and NPC.

- Oak and hickory trees are important habitat and food-producing trees for many species of wildlife. Consider reserving poorly formed oak and hickory trees at the break of slopes and scattered throughout the stand for roost trees and for future mast (acorn and nut) producing trees.
- White oak is an important tree for wildlife. Incorporate white oak into reserve trees and plant within oak stands when possible.
- Deer browse and other animal damage can significantly affect the success of regenerating oak seedlings. Consider protecting regenerating seedlings where there is the risk of damage from animals.
- Management to maintain or increase oak may require an aggressive management regime. This may include clear-cutting, invasive species control, multiple-step harvests, prescribed burning, timber stand improvement, protection, and planting to regenerate oak stands adequately. Based upon site-level conditions, plans and strategies to regenerate oak should consider and implement both pre- and or post-timber harvest strategies as appropriate.
- Non-native invasive species such as buckthorn are of particular concern when managing and regenerating oak. When present, efforts should be made to control buckthorn when regenerating oak. See strategies GDS-7A for more information on invasive species.
- Insect and disease concerns – see current management guidelines or consult a Forest Health Specialist:
 - Oak wilt is a common problem within oak stands within this Section. When possible, management should be designed to suppress oak wilt infections within stands and increase oak species diversity. See [Minnesota DNR Oak Wilt Guide](#) for additional information on oak wilt and recommendations for sale design when oak wilt is present within the site.

Special Considerations

- Shade-tolerant species such as maple and basswood can outcompete shade-intolerant species such as oak, resulting in stands converting to northern hardwood-dominated stands.
- Some oak stands may gradually convert to more NH-dominated stands, considering climate change and natural selection forces.
- Oak forests are found on several native plant communities of conservation concern (see [GDS-3F](#)), including:
 - MHs39 (Southern Mesic Maple-Basswood Forest)
 - MHs49 (Southern Wet-Mesic Hardwood Forest)
 - MHc38 (Central Mesic Cold-Slope Hardwood-Conifer Forest)
 - UPs14 (southern Dry Savanna)

Northern Hardwoods (NH)

Northern hardwood-dominated plant communities in the PP Section usually occur on upland sites with moist soils in settings protected from fire. Natural, mature northern hardwood stands are comprised of a mix of species, including oak, birch, sugar maple, basswood, ash, red maple, aspen, white pine, and bitternut hickory. Many of the northern hardwood stands within the PP Section are experiencing natural succession, transitioning from oak-dominated stands to sugar maple basswood stands.

Northern hardwood stands can be found on several native plant communities, including MHc38, MHs37, MHs38, MHs39, and MHs49.

Northern hardwoods have a relatively even distribution across all age classes, with the majority of stands between the ages of 51 and 110 years old ([Appendix C](#)). Northern hardwoods are typically, but not always, managed as an uneven-aged cover type and were modeled as uneven-aged, so balancing age class distributions is not a goal for this cover type. Some northern hardwoods stands may have a higher oak component and are managed using an even-aged regime.

Current Acres: 8,890 acres in the PP Section (approximately 10.4% of state-managed acres)

Future Direction and Goals

- 10-year DFC: 8,890 acres (Maintain)
- 50-year DFC: 8,890 acres (Maintain)
- Improve timber quality
- Enhance or maintain wildlife habitat
- Enhance or maintain aesthetic values

Strategies

- Use uneven-aged and gap management to regenerate northern hardwoods and manage species composition.
- Allow some upland forest sites to transition to northern hardwoods based on site-specific characteristics and NPC.
- Manage some stands with a higher oak component with even-aged regimes to maintain the oak component within the stand.

Special Considerations

- Some aspen and oak stands may gradually convert to more northern hardwood-dominated stands, considering climate change and natural succession. See the oak and aspen cover types for additional strategies to minimize the conversion of these types to northern hardwoods.
- Northern hardwood forests are found on several native plant communities of conservation concern (see [GDS-3F](#)):
 - MHs39 (Southern Mesic Maple-Basswood Forest)
 - MHs49 (Southern Wet-Mesic Hardwood Forest)
 - MHc38 (Central Mesic Cold-Slope Hardwood-Conifer Forest)

Lowland Hardwoods (Ash/LH/CT)

The ash, lowland hardwoods, and cottonwood cover types are combined into one management category because they are commonly associated with each other and managed under similar management prescriptions. Lowland hardwoods are typically found within wet forest and floodplain forest native plant communities, along water features, or in depressions where the water table is generally within reach of plant roots. They may include silver maple, cottonwood, green ash, willow, box elder, and other lowland hardwood species. Ash, LH, and CT cover types can be found on many different native plant communities within the PP, including MHs38, MHs49, FFs59, and FFs68.

These cover types are typically managed using uneven-aged treatments. In the current age class distribution of these cover types in the PP Section, most of the acres are between the ages of 41 and 110 years old ([Appendix C](#)).

There is projected to be a loss of ash within these cover types within PP due to natural processes, invasive species, and impacts due to climate change. This may result in a shift from ash-dominated stands to mixed lowland hardwood stands and the conversion of some of these stands to a different cover type.

Emerald ash borer and reed canary grass are two invasive species that may considerably affect the health of Ash/LH cover types and contribute to the loss of these cover types over time.

While cottonwood was modeled within the central hardwood cover type across the state, it is typically found mixed with other lowland hardwood species within the Paleozoic Plateau. It is included with the lowland hardwood cover type in this SFRMP because management strategies for this cover type are similar to mixed lowland hardwood stands.

Current Acres: 9,755 managed acres in the PP Section (approximately 12.8% of state-managed acres in the PP Section)

Future Direction and Goals

- Transition some ash stands to lowland hardwoods and increase within-stand diversity, especially in ash stands, to increase the resilience of lowland hardwood forests to emerald ash borer.
- 10-year DFC: 9,675 acres (0.8% decrease)
- 50-year DFC: 9,514 acres (2.4% decrease)
- Increase within-stand diversity with species appropriate to the NPC
- Increase the resilience of sites to emerald ash borer (EAB)
- Maintain forested conditions of ash and lowland hardwood sites in the wake of EAB and reed canary grass

Strategies

- Follow Division guidelines on managing ash to address the threat of emerald ash borer, including:
 - Maintain an ash component in all stands but reduce the overall number of ash.
 - Promote non-ash species appropriate to NPC, including American elm, yellow birch, bur oak, swamp white oak, silver maple, and Kentucky coffee tree.

- When present, retain non-ash species within the reserve trees. See the corresponding division direction on ash management for maintaining and regenerating non-ash species within ash stands.
- Design prescriptions to protect forest hydrology and maintain water regulation while maintaining forest cover. Minimize the loss of forest cover to shrubs, grass, sedges, and invasive species.
- See the [Division of Forestry ash management guidelines](#) and [Division of Fish and Wildlife ash management guidelines](#) for additional information on managing ash.

Special Considerations

- Emerald ash borer (EAB)
- Reed canary grass can enter forested stands and outcompete forest regeneration. See GDS-7A for additional information on reed canary grass.
- Climate change and invasive species may reduce habitat for the ash-dominated stands and cover type.
- Periodic flooding and animal damage can limit the success of regenerating trees within lowland hardwood forests.

Central Hardwoods (CH)

The central hardwood cover types occur on plant communities on upland sites with moist soils in settings protected from fire. These stands are generally located in the southern portion of the PP Section on central and southern mesic native plant communities. They are a mix of hardwood species, including oak, hickory, cherry, maple, and butternut.

Central hardwoods can be managed as both even and uneven-aged strategies; because of this, a more balanced age class distribution is desired within the central hardwoods cover type. In the current age class distribution of these cover types in the PP Section, the majority of acres are between the ages of 21-30 and 50-80 years old ([Appendix C](#)).

While cottonwood was modeled within the central hardwood cover type across the state, it is typically found mixed with other lowland hardwood species within the Paleozoic Plateau. Strategies for the cottonwood cover type are described with the lowland hardwood cover type, as management strategies for this cover type are similar to mixed lowland hardwood stands.

Current Acres: 2,589 acres in the PP Section (approximately 4% of state-managed forest acres in the PP Section)

Future Direction and Goals

- 10-year DFC: 2,589 acres (Maintain)
- 50-year DFC: 2,589 acres (Maintain)
- Improve timber quality
- Enhance or maintain aesthetic values

Strategies

- Evaluate each stand to determine the best prescription when regenerating central hardwoods. Utilize even-aged or uneven-aged strategies (including clear-cuts and gap creation) as appropriate based on site-specific characteristics (i.e., stand condition, NPC) and desired future condition.
- Increase the diversity of oak species within stands and maintain a mix of central hardwood species within mixed stands.
- Oak and hickory trees are important habitat and food-producing trees for many wildlife species. Consider reserving poorly formed oak and hickory trees at the break of slopes and scattered throughout the stand for roost trees and future mast (acorn and nut) producing trees.

Special Considerations

- Considering climate change, some oak, northern hardwoods, or aspen stands may gradually convert to more central hardwood-dominated stands.

Black Walnut (WAL)

Black walnut is the second most important cover type in terms of economic impact in the Section. It can be found growing in a variety of locations and plant communities within the Section. It can also be found as a component in northern hardwood, central hardwood, and oak cover types. Pure stands of walnut usually have been planted and can be found on river terraces and benches.

Walnut prefers well-drained soils and may be found on various native plant communities within PP, including FDs38, MHs37, and MHs38.

Most acres in the walnut age class distribution are in the 31-50 and 61-70 age classes, with relatively even acres in the other age classes ([Appendix C](#)). WAL stands generally receive uneven-aged management, so balancing age class distributions is not a goal for this cover type.

Current Acres: 2,384 acres in the PP Section (2.81% of state-managed acres in the PP Section)

Future Direction and Goals

- 10-year DFC: 2,384 acres (Maintain)
- 50-year DFC: 2,384 acres (Maintain)
- Maintain age and species composition within stands

Strategies

- Use selective thinning, uneven-aged, and gap management to regenerate WAL and manage species composition.
- Increase the diversity of other hardwood species within WAL stands.
- Black walnut should be maintained within forests wherever it occurs and as a component within other cover types.
- Consider adding walnut as a component to direct seeding projects on suitable NPCs.

Special Considerations

- None

White Pine (WP)

White pine occurs as pure stands and as a component of many other upland cover types in the PP Section. A stand can belong to the WP cover type if it contains greater than 33% white pine by volume or basal area.

White pine may be found on various native plant communities within PP, including FDs27, MHC38, and MHs38.

Natural origin WP stands generally receive uneven-aged management, so balancing age class distributions is not a goal for this cover type. Most acres in the current age class distribution are younger than 60 years, with the largest amounts in the 01-10 and 61-70 age classes ([Appendix C](#)).

Current Acres: 2,049 acres in the PP Section (2.42% of state-managed timberland acres in the PP Section)

Future Direction and Goals

- 10-year DFC: 2,049 acres (Maintain)
- 50-year DFC: 2,049 acres (Maintain)
- Maintain age and species composition within stands

Strategies

- Manage white pine stands to maximize the potential for white pine regeneration in the understory.
 - White pine abundance can be encouraged by selective thinning in stands.
- Mature white pine stands typically contain a mix of species. Manage stands to increase species diversity, allowing other species, including hardwoods, to develop over time. Favor removing red pine when thinning white pine stands. Increase the amount of white pine as a component in mixed stands appropriate to NPC.
- Convert planted sites to hardwoods when appropriate to the site conditions and NPC.
 - Maintain a component of white pine within converted sites as appropriate to the NPC and site conditions.
- Consider the potential for deer herbivory when regenerating white pine. Implement tree protection strategies when needed to accomplish regeneration goals.
- Consider legacy tree direction and value as roost and nest trees for mature white pine in harvest decisions.

Special Considerations

- Insect and disease concerns – see current management guidelines or consult a Forest Health Specialist concerning white pine blister rust
- Some white pine stands occur on native plant communities of conservation concern, including (see [GDS-3F](#)):
 - FDs27 (Southern Dry Pine-Oak Woodland)
 - MHC38 (Central Mesic Cold-Slope Hardwood-Conifer Forest)

Aspen/Balm-of-Gilead (A/BG)

Aspen (trembling and bigtooth) and balm-of-Gilead cover types are combined because they are commonly associated with each other and managed similarly. These stands are identified with aspen/balm-of-Gilead being the major component as measured by volume.

Aspen/BG-dominated native plant communities in the PP Section are typically fire-dependent, mesic, to wet-mesic forests with a mixture of hardwood species and some conifers in the canopy and understory. Native plant communities in PP in which A/BG cover types can be found include FDs38 and MHs37.

The A/BG cover types are uncommon within the PP Section. These stands can easily convert through natural processes to oak and northern hardwood cover types if the stands are not managed to retain aspen as a primary component of stands.

The current A/BG age class distribution does not reflect a desired age class distribution for even-aged managed cover types ([Appendix C](#)). The goal within this planning period is to maintain the number of A/BG acres as a cover type while continuing to move aspen within this Section to a more balanced age-class distribution.

Current Acres: 941 managed acres in the PP Section (approximately 1.5% of state-managed in the PP Section)

Future Direction and Goals

- 10-year DFC: 941 acres (Maintain)
- 50-year DFC: 941 acres (Maintain)
- Maintain a balanced age-class distribution
- Maintain aspen as the main species within stands while increasing within-stand species diversity.

Strategies

- Use clearcut with reserves method to regenerate aspen.
- Avoid conversion of aspen stands while maintaining the composition of northern hardwood species appropriate to NPC.

Special Considerations

- Insect and disease concerns – see current management guidelines or consult a Forest Health Specialist:
 - stem decay and butt rot in wounded trees
 - white trunk rot as aspen ages
 - decline following tent caterpillar defoliation in over-mature stands
 - *Hypoxylon* cankers and *Saperda* stem borer mortality in low-density stands or stand edges.
- Long distances to market may make harvesting and regenerating aspen stands challenging, especially in low-density, over-mature stands.
- Climate change effects may limit the ability to achieve goals for this cover type.

Red (Norway) Pine (RP)

Red pine is not normally found as a cover type on the native plant communities within the Paleozoic Plateau. Most stands identified as red pine originated when the DNR purchased old farmlands in the 1960s and 1970s and planted the pine to stabilize the fields and pastures.

DNR-administered red pine timberlands are treated as two distinct cover types for management. Natural origin stands (NORP) are managed to reflect a more natural age class distribution, with a final harvest followed by a regeneration strategy mimicking the creation of a natural origin stand. Planted stands are managed using an economic rotation age.

Red pine is managed as an even-aged cover type, with the final harvest determined by whether it was from natural origin or if it was planted. The current age class distribution for planted red pine is unbalanced, with most of the acres within the 31-40 and 51-60 age classes. Due to the very small number of acres of natural origin red pine, managing for a balanced age class is not desired within this section. Currently, the majority of acres are within the 91-100 age class.

The desired future condition is to reduce the number of acres of red pine cover type by about 43 acres when the stands are ready for the final harvest. Regeneration of red pine stands back to red pine will be determined site-by-site when the stand is visited.

Current Acres: 543 acres in the PP Section, 524 planted and 19 natural origin (0.64 % of state-managed acres in the PP Section)

Future Direction and Goals

- 10-year DFC: 500 acres (7% decrease)
- 50-year DFC: 500 acres (7% decrease)
- Manage for high-value forest products, biological diversity, riparian buffers, recreation, aesthetics, and wildlife habitat where possible or appropriate.
- Increase species diversity within stands as they age
- Increase within-stand structure to maintain or improve site productivity, wildlife habitat, and biodiversity
- Within natural origin stands, allow species native to the NPC to increase within the stand

Strategies

Thinning of red pine stands:

- In planted stands, thinning is used to reduce stand density, increase future tree growth, quality, and vigor, and obtain the stand's desired composition. Recommendations are:
 - Conduct normal rotation stand thinning in merchantable stands at approximately 10-year intervals, depending on site quality.
 - Older stands may have longer intervals between thinning to compensate for slower growth rates and facilitate desirable understory species' growth.
- Thin stands to maintain a mix of species.
 - Consider incorporating variable density thinning or other techniques to meet biodiversity or habitat objectives.

- Manage some stands for large-diameter, high-quality products (e.g., the size of poles needed to support the electrical grid has increased to 40' tall poles that are 14" in diameter).
- Thinning in natural origin stands should maintain or increase within-stand diversity, retaining red pine as the main cover type, by the following methods:
 - Reserve individual trees or patches of other species appropriate to the site, where possible.
 - Consider creating or maintaining variable densities within stands when thinning.
 - Thin stands to maintain a mix of species.
 - Protect advanced regeneration of desirable understory species, where possible.
 - Higher stand densities (basal area) are recommended along stand edges exposed to wind and along high-visual-quality corridors, such as major roads and lakes.
 - Consider underplanting shade-tolerant species appropriate for the site and NPC, where seed sources or advanced regeneration for these are lacking. For suggestions on species, refer to the *Field Guide to Native Plant Communities of Minnesota* and [NPC silviculture strategies](#).

Final harvests of red pine stands:

- On planted red pine sites, consider conversion to a mix of hardwoods appropriate to the NPC and site.
- To regenerate both planted and natural origin red pine back to red pine, use clearcut or clearcut with reserves. Use the following considerations:
 - When appropriate to site conditions, consider summer harvest to allow for scarification of soil in preparation for regenerating the stand.
 - Maintain or enhance within-stand diversity during site preparation and release treatments, considering the desired future condition and NPC.
 - Evaluate and prepare an adequate seedbed or planting site for red pine regeneration while retaining areas of undisturbed ground layer.
 - Prescribed surface fire in mature red pine stands can be an effective management tool for eliminating shrub competition, reducing thick duff layers, and preparing mineral seedbeds. Summer fires conducted over several growing seasons are most effective at controlling dense shrub competition and exposing mineral soil. This may be done before harvesting to prepare seedbeds unless charred bark on harvested trees poses a problem (["Red Pine Handbook"](#)).
 - Consider the risk of *Diplodia* tip blight and canker (*Sphaeropsis sapinea*) and shoot blight (*Sirococcus conigenus*) infection on sites where taller infected red pine or jack pine are left on or next to sites being regenerated to red pine.
 - Retain cavity trees or snags as recommended in the MFRC site-level guidelines.
 - For final harvests, consider using a regeneration strategy that mimics the creation of a natural origin stand (i.e., with associated species, especially jack and white pine, and structural diversity).
 - Reserve biological legacies such as large, healthy, live trees, decadent trees, snags, logs, and other coarse woody debris.

Special Considerations

- Insect and disease concerns – see current management guidelines or consult a Forest Health Specialist:
 - Diplodia tip blight and canker (*Sphaeropsis sapinea*)
 - shoot blight (*Sirococcus conigenus*)
 - bark beetles (*Ips* and *Dendroctonus* spp.)
- Red pine is not within its normal range within this Section. Climate change effects may increase the negative impacts of deer browse, drought, *Diplodia*, and bark beetles.

Red Cedar

Red cedar is found as a component in upland plant communities, including oak woodland, oak savanna, upland prairie, and cliff and rock outcrop communities. Red cedar can dominate bluff prairie and oak savanna communities, significantly altering the composition and function of the native plant community.

Due to the small number of acres within the section, there is not a desire for a balanced age class distribution.

The goal during this planning period is to decrease the amount of red cedar within the Section.

Current Acres: 318 managed acres in the PP Section (approximately 0.37% of state-managed acres in the PP Section)

Future Direction and Goals

- 10-year DFC: 200 acres (37% decrease)
- 50-year DFC: 200 acres (37% decrease)

Strategies

- Use clear-cutting or thinning to decrease the amount of red cedar within stands.
- Convert approximately 118 acres of red cedar cover type utilizing NPC-suitable species.
 - Convert red cedar to oak woodland, oak savanna, and bluff prairie characteristics depending on the NPC.
 - Determine sites and species appropriate for conversion by field visits and NPC.
- Increase northern hardwood species composition within red cedar stands as appropriate to NPC.
- Utilize prescribed fire to control the regeneration of red cedar and favor other northern hardwood species within stands.
- Red cedar can easily encroach, convert, and degrade naturally occurring oak savannas, upland prairies, and bluff prairie native plant communities. See [GDS-3F](#).
 - Reduce the occurrence of brush and red cedar from encroaching on these NPCs
 - Implement prescribed fire in order to limit woody encroachment, community succession, and invasive species establishment/spread within these plant communities
 - Consider variable density thinning more heavily within these areas to create more open canopy characteristics
- Review and incorporate MOA guidance documents in management activities.

Birch (Bi)

The birch cover type includes paper birch in PP. Birch-dominated NPCs in the PP Section are typically mesic to wet-mesic forests with a mixture of hardwood species and some conifers in the canopy and understory. They may also be found on dryer sites including native plant communities such as FDs27 and FDs38.

The Bi age class distribution does not reflect the desired balanced structure for even-aged managed cover types ([Appendix C](#)). Due to the small number of acres of this cover type in the PP Section, attaining a balanced age class distribution is unlikely. However, improving the age-class balance remains a goal for Bi.

Current Acres: 304 managed acres in the PP Section (approximately 0.35% of state-managed acres in the PP Section)

Future Direction and Goals

- 10-year DFC: 304 acres (maintain)
- 50-year DFC: 304 acres (maintain)
- Move toward balanced age class distribution to the extent possible
- Increase within stand diversity

Strategies

- Use clearcut with reserves method to regenerate paper birch.

Special Considerations

- Balancing Bi age classes may not be attainable due to the small number of cover type acres.
- Live birch is an important wildlife component for grouse, turkey, and squirrels and a food source for the yellow-bellied sapsucker.
- Dead birch is important for chickadee and nuthatch nest sites.
- Birch is also used for non-timber forest products, including chaga, birch bark, and poles.

Cover types with small acre totals

The following cover types have very small acreages within the section: Scotch pine, white spruce, Norway spruce, stagnant cedar, tamarack, and jack pine. Some of these cover types may contain species not native to the PP Section, such as European larch.

Future direction, goals, and basic strategies are shown in Table 3.2. Future direction is represented as a general trend and not with specific acreage goals. Due to the small number of acres present within the PP section, management activities may or may not occur within these cover types during this planning period.

Table 3.2- Small acreage cover type desired future condition

Cover Type	Managed acres	Future Direction and Goals
Scotch Pine	106	Decrease
White Spruce	105	Decrease
Norway spruce	30	Decrease
Stagnant Cedar	26	Maintain if from natural origin
Tamarack	7	Maintain if from natural origin
Jack pine	6	Maintain if from natural origin

Strategies

- Increase species diversity within stands as they age.
- Allow species native to the NPC to increase within the stand.
- Regenerate stands after the final harvest to cover types appropriate to the NPC.
- Maintain number of acres if it is of natural origin.

GDS 1A: Maintain diversity of cover types.

GDS-1A Strategies

- Retain cover types appropriate to native plant communities.
 - For more information on species appropriate to NPCs in the PP Section, including habitat suitability projections for those species affected by climate change, refer to the [NPC *Silviculture Strategies for Forest Stand prescriptions* webpage](#).
 - Strive to maintain areas of ash and lowland hardwood cover types as forested cover types within this section. These cover types are projected to decline due to invasive species and climate change.
- Convert cover types where appropriate (Table 3.2; see Figure 3.1 for an example and the Cover Type accounts for more detail).
 - Increase the acreage of oak cover type within the Section. This cover type has declined compared to historical conditions and is projected to do well under climate change scenarios.
 - Determine sites and species appropriate for conversion after evaluating site-specific conditions and identifying the native plant community. Options available include:
 - Artificially convert some stands using a variety of tools such as mechanical site preparation, prescribed burning, planting, or seeding.
 - Selectively harvest some stands to facilitate movement toward the desired cover type and within-stand composition.
 - Restore some northern hardwood, oak woodlands, and upland brush to oak savanna on sites with appropriate NPCs.
 - Restore some red cedar, oak, northern hardwoods, and upland brush to bluff prairie on appropriate NPCs.
 - Allow some stands to convert through succession with or without harvest (e.g., oak to northern hardwoods). The applicability of this option depends on land administration and status, the ability to offer the annual planned volume, and operability and marketability, among other considerations.

Figure 3.1: Example of converting a mixed northern hardwood stand to an oak-dominated stand, resulting in increased oak cover type acres. Cover type conversions such as this attempt to move a cover type to a different growth stage and species mixture. True conversions are realized after years of effort and maintenance.

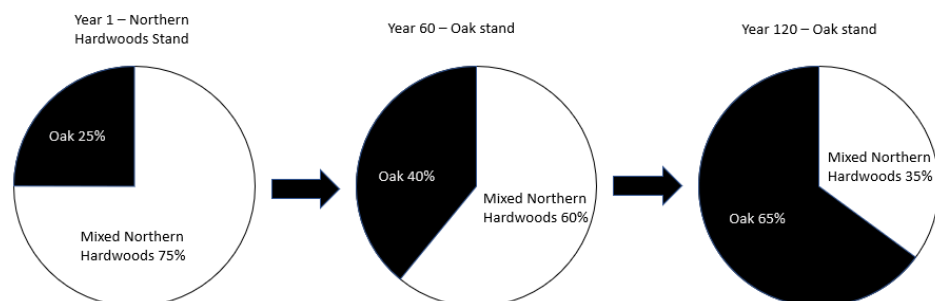


Table 3.7: Managed cover type acres in the PP Section from the DNR’s forest inventory and desired trends and future conditions for the first decade and 50-year planning period (see [Cover Types](#) for more information). DFCs and percent change are relative to current acres. DFCs for cover type change represent general trends to work toward, not exact targets. As such, the DFCs for cover-type reductions and increases do not necessarily balance to zero.

Cover Type	Current Cover Type Acres	The Estimated Trend in Acres (first plan decade)	The Estimated Trend in Acres (50-year DFC)	Final Cover Type Acres (current + 50-year DFC)
Oak	35,471	Increase 329 acres	Increase 529 acres	36,000
Northern hardwoods	8,890	Maintain	Maintain	8,890
Ash/lowland hardwoods	9,755	Decrease 80 acres	Decrease 241 acres	8,140
Central hardwoods	3,454	Maintain	Maintain	9,514
Walnut	2,384	Maintain	Maintain	2,384
White pine	2,049	Maintain	Maintain	2,049
Aspen/balm-of-Gilead/birch	941	Maintain	Maintain	941
Red (Norway) pine	543	Decrease 43 acres	Decrease 43 acres	500
Red Cedar	318	Decrease 118 acres	Decrease 118 acres	200
Birch	304	Maintain	Maintain	304
Scotch Pine	106	Decrease	Decrease	Less than 106
White spruce	105	Decrease	Decrease	Less than 105
Norway spruce	30	Decrease	Decrease	Less than 30
Stagnant Cedar	26	Maintain	Maintain	26
Tamarack	7	Maintain	Maintain	7
Jack pine	6	Maintain	Maintain	6

GDS-1B: Manage within stands to reflect the composition, structure, and function of native plant communities.

GDS-1B Strategies

- Use the Field Guide to the Native Plant Communities of Minnesota: the Eastern Broadleaf Forest Province and associated ECS silvicultural strategies to classify stands to NPC type and subtype and inform silvicultural prescriptions.
- Retain or incorporate components, such as species and structure, characteristic of various NPC growth stages in stands.
- Use the most up-to-date available climate change projections when choosing species to reserve, regenerate, or introduce in stands.
 - Consider the projected increase or decline of species and habitats as climate change progresses (e.g., [MN Forest Ecosystem Vulnerability Assessment and Synthesis](#) and [Climate Change Field Guide for Northern Minnesota Forests: Site-level considerations and adaptation](#)).
 - Apply best-available information, such as the Native plant community silvicultural strategies, including information on species affinity for warmer and/or dryer site conditions.
- Retain biological legacies through the incorporation of MFRC site-level guidelines and other department direction such as leave tree, HCVF, and management opportunity area direction (e.g., high biodiversity site MOA strategies).

GDS-1C: Maintain or increase the diversity of species, ages, and structures within stands.

GDS-1C Strategies

- Provide structural diversity characteristics, including:
 - sizes (diameter and height), abundance, and distribution of overstory trees
 - understory vegetation
 - arrangement (scattered or clumped) of vegetation in the stand
 - distribution, size, and decay class of snags and coarse woody debris
- Use harvest systems and strategies that encourage diversity of species, ages, and stand structures. (e.g., selective harvest, variable density thinning, retaining trees of various diameters, and reserve area placement)
- Meet or exceed the MFRC site-level guidelines to maintain tree species diversity within a stand.
- Retain tree species, stand structure, and ground layer diversity within stands when prescribing release and timber stand improvement rather than managing for one species.
- Take advantage of opportunities to diversify stands when prescribing intermediate treatments.
- Use harvest systems or methods that protect advanced regeneration. Retain conditions that favor regeneration and understory initiation.
 - When it is desirable to protect the existing seedlings, saplings, or other high-value trees (timber quality and/or wildlife habitat) in a stand, harvest design and permit specifications

should specify outcomes to protect these trees. In some cases, portions of the stand may be delineated to protect regeneration by restricting harvest activity in those areas. A partial canopy may be needed to retain the moisture and light requirements needed for regenerating seedlings.

- Identify some stands where succession is allowed to occur to encourage the development of within-stand diversity. The movement to the next successional stage may be achieved with or without harvest.
- Increase and/or maintain target species, including oak species and black walnut, as components within appropriate cover types. Silvicultural practices that may increase the presence of these target species include planting, inter-planting, artificial or natural seeding, and leave tree selection.
- Manage planted and seeded stands to represent the array of NPCs, growth stages, and variations within NPCs. This may be accomplished by:
 - accepting lower stocking levels of planted species in younger planted stands if other desirable species are present to create a fully stocked stand
 - planting or seeding mixed species appropriate to the site and desired growth stage
 - using intermediate harvests to enhance age, species, and structural diversity
 - using the least intensive site preparation necessary to successfully regenerate the site while favoring retention of the existing ground layer plant species
 - When using intensive site prep methods, consider leaving legacy patches of the existing ground layer to assist in the recolonization of the site.
- Encourage fruit and mast-producing species (e.g., trees and shrubs that produce acorns and nuts) for wildlife benefits as well as to encourage natural regeneration.
- Recognize that some plant communities naturally have low species diversity due to site conditions and regular disturbance events.
- Recognize some rare/declining communities that naturally had scattered or no forest cover due to natural disturbances are no longer common, and manage some sites for that condition (e.g., bluff prairies, oak savanna)

3.2 Harvest Levels

The GDSs and Strategies in this section address Issues: [C1](#), [C2](#), [C3](#), [N1](#)

GDS-2A: Manage stands to provide a sustainable supply of timber.

Providing a sustainable supply of timber is one of the forest benefits for which state forests are managed, and an ancillary benefit of habitat management on acquired DNR WMA and Aquatic Management Area (AMA) lands. The DNR uses timber harvest to create the disturbance needed to develop or maintain a mix of forest age classes that provide broad social, economic, and environmental benefits in perpetuity. The DNR uses timber volume to track that disturbance because it is the most efficient and effective metric currently available to evaluate our progress. The amount of timber volume the DNR plans to offer annually in this plan period was determined considering the results of STHA modeling and the following factors, among others:

- statutory requirements for specific land statuses (e.g., school trust lands, WMAs, state forests)
- age class imbalances for even-aged managed cover types
- acres over rotation age
- representation of young and old forest
- varying goals based on administration or land status
- wildlife habitat and biodiversity
- supply of timber
- criteria for uneven-aged management and thinning
- forest growth and sustainability
- forest health concerns
- expected future market and stand conditions
- incorporating intermediate treatments to achieve goals in conjunction with harvests

Considering these factors, the DNR determined how much timber volume to offer on average annually to achieve the disturbance needed to sustain a balance of multiple values and forest benefits over time and to meet the objectives for different forest lands administered by the DNR.

The statewide 10-year stand exam list was developed to implement the DNR's strategic direction for this plan period. See [the DNR 10-year stand exam list report](#) for more information. See Tables 3.4-3.5, Fig. 3.2, and [Appendix D](#) for acre and volume summaries for the 10-year stand exam list in PP. Note that the DNR plans to visit more stand acres that contain more volume than necessary, based on model estimates, to ensure that the DNR will offer as much volume annually as planned. Thus, the estimated volume from planned stand exam acres is not equivalent to the volume that is harvested and removed from the landscape.

After site visits and interdisciplinary coordination, DNR staff develop the management prescription and treatment for each forest stand on the stand exam list. This could result in the stand being appraised and offered for sale, having its inventory corrected, having a non-harvest treatment, or having a planned treatment deferred to later in the planning period or to another planning period.

GDS-2A Strategies

In addition to the statewide 10-year stand exam list, the following strategies aim to contribute to providing a sustainable timber supply over time:

- Emphasize visiting stands older than normal rotation age and visiting the oldest stands first to evaluate for appropriate management. While evaluating older stands, consider SFRMP goals within GDS-3A.
- Consider SFRMP goals when proposing annual plan additions (APAs) and follow APA and joint coordination policies when adding APAs.
 - Annual plan additions are stands or portions of stands that make sense to treat immediately (e.g., to address insects and diseases, operational considerations, or to adhere to policy) and are not on the annual stand exam list.
- Consider potential biomass harvest consistent with MFRC guidelines.

- Biomass could be available as tops and limbs from timber harvests.
- Non-commercial forests and brushlands may have the potential for biomass harvest.

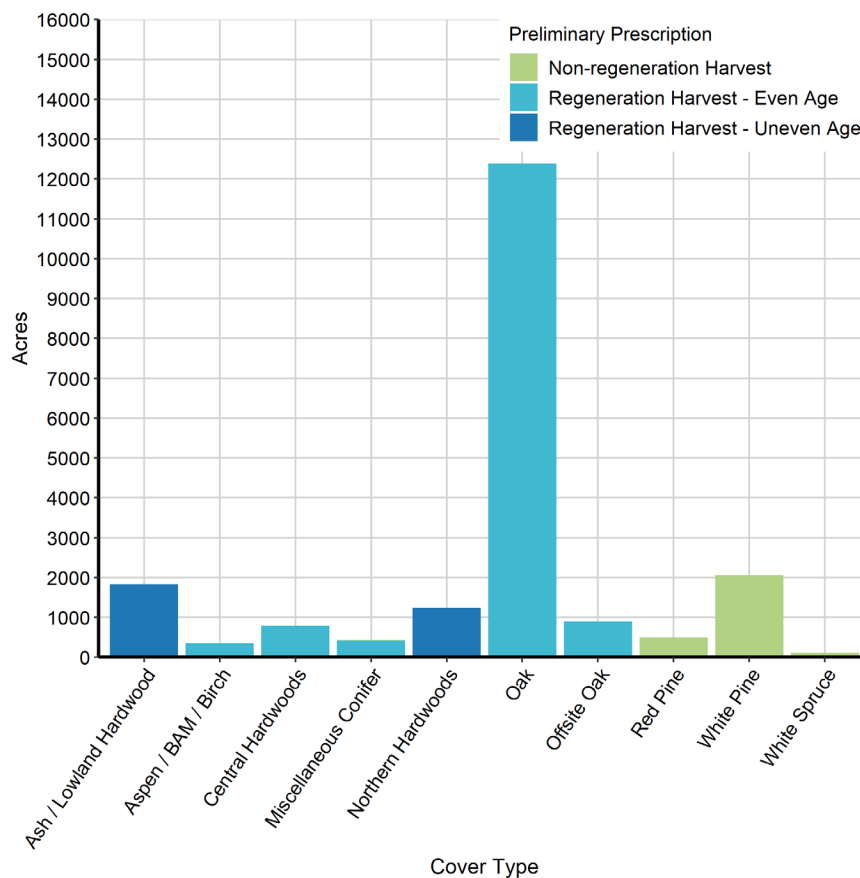
Table 3.8: Planned stand exam list acres by cover type and land administrator on the 10-year stand exam list for the PP Section (FY 2021-2030).

Modeled Cover Type	Forestry Acres Planned	Fish and Wildlife Acres Planned	Total Acres Planned
Oak	7,886	4,587	12,473
White pine	1890	144	2034
Ash/ lowland hardwoods	1,141	694	1,835
Northern hardwoods	921	317	1,238
Offsite oak	525	345	870
Central hardwoods	725	129	854
Red pine	408	88	496
Red cedar	206	97	303
Aspen	235	30	265
Scotch pine	53	53	106
White spruce	58	47	105
Birch	91	0	91
Walnut	17	23	40
Stagnant cedar	26	0	26
Tam	7	0	7
Jack pine	3	2	5
Norway Spruce	22	0	22
Non-forest (grass, brush, rock outcrops)	9	39	48
Total	14,223	6,595	20,818

Table 3.9: Model estimated volume (cords) for acres on the FY 2021-2030 stand exam list by land administering DNR Division and treatment groups in the PP Section. The model estimated volume using yield estimates and assumptions about how DNR lands are managed to address multiple values. Volume offered for sale depends on the annual planned volume needed to advance DFFCs. As staff implement this plan, conduct stand exams, and make management decisions, monitoring will inform the accuracy of the model assumptions.

Treatment Group	Forestry Volume (cords)	Fish and Wildlife Volume (cords)	Total Volume (cords)
Even-aged harvest	174,058	85,938	259,996
Thinning	22,178	2,842	25,020
Uneven-aged harvest	13,243	7,599	20,842
Total	209,479	96,379	305,858

Figure 3.2: Acres on the 10-year stand exam list by cover types and preliminary prescription in the PP Section (for cover types with at least 50 acres planned).



GDS-2B: Manage the availability of non-timber forest products.

[Non-timber forest products](#) include decorative materials, foods, herbs, medicinal materials, fuelwood, and specialty items.

Foresters issue special product permits or informal timber sales for a number of non-timber forest products, which may be restricted depending on the land administrator.

The following strategies will be used to protect the long-term availability of these forest resources.

GDS-2B Strategies

- Maintain or enhance known traditional gathering areas of non-timber forest products when managing forest resources.
- Supervise and enforce special product permit regulations to ensure resource sustainability.
- Consider managing or using some forest stands for non-timber forest products.
- Coordinate with DNR specialists before issuing special product permits in known locations of important wildlife habitats, rare native plant communities, or rare species.
- Maintain non-timber forest products projected to be negatively impacted by climate change.

GDS-2C Improve Marketability and utilization of wood products in this planning area.

Non-existent or weak markets for conifers and small diameter hardwoods in this planning area hinder the ability to achieve silvicultural, cover type change/maintenance, and fish and wildlife habitat goals.

GDS-2C Strategies

- Look for ways to design timber harvests to increase marketability or reduce the costs of operations.
- Look for ways to connect resource availability to existing markets for species and products not currently in demand.
- Communicate resource availability to stimulate new markets.
- Design prescriptions and site-specific actions to achieve site and landscape-level goals. Utilize harvesting, planting, or other vegetation management strategies to do this. If standard timber sale and harvest procedures are not effective in achieving vegetation and habitat goals, alternative strategies may be considered.

3.3 Biological Diversity, Young and Old Forest, and Spatial Distribution

The GDSs and strategies in this section address Issues: [A1, A2, A3, B1, B3, B5, B6, D1, D2, E1, F1, J1, N1](#)

Many factors influence biological diversity, forest composition, and spatial distribution of forest patches, including:

Soils and hydrology: Nutrient and water availability are fundamental to determining species making up a native plant community. Demand for these resources and the ability of each tree species to compete alters the forest's makeup.

Natural disturbance: In conjunction with insects and disease, weather and wildfire events were once the primary natural disturbance factors affecting forest stands. Alteration of the landscape after European settlement and the subsequent types and frequencies of other disturbance events have helped to shape the current forest.

Past and current timber harvesting and land management practices: From the mid-19th century to the early 20th century, agriculture and timber harvesting expanded across central and southern Minnesota. This caused much of the forest within this Section to be harvested or converted to agriculture. This has had profound and long-lasting effects on seed sources, soil fertility, and subsequent re-vegetation. Current land ownership patterns, land use, forest resource management goals, and different ownership constraints influence the distribution of forest species, age classes, and NPC growth stages across the landscape. In this Section, the amount of land converted to agriculture continues to impact hydrology, forest connectivity and productivity, and overall access to forests.

Natural succession: As some 20th-century forests have matured beyond the maximum age for early successional tree species, there have been moderate declines in acres of quaking aspen, balm-of-Gilead, and paper birch cover type and corresponding increases in cover types dominated by mid- and late-successional tree species such as oak, northern hardwoods, and long-lived conifers.

Wildlife browse: Browsing effects on vegetation vary with herbivore densities, including deer, and the availability and selection of browse material. In many areas today, it can be extremely difficult to grow several tree species that are preferred by deer. White pine, oaks, and many other forest plants often fail to survive without protection from browsing.

Invasive species: Invasive plants, animals, and diseases have established their presence and continue to emerge as significant factors affecting forest vegetation and biological processes. Among other effects, invasive species can disrupt natural succession, hinder regeneration, change soil structure and chemistry, or displace native trees and plants.

Climate Change: The [2014 Minnesota Forest Ecosystem Vulnerability Assessment and Synthesis](#) report from the Northwoods Climate Change Response Framework project predicts that over the next 150 years, habitat for many common species will decline (e.g., quaking aspen, paper birch, tamarack, black spruce). However, habitat for some species is projected to increase (e.g., American basswood, black cherry, northern red oak,). Forests with lower species and structural diversity are predicted to be less resilient to climate change impacts. In addition, fragmented landscapes will provide less opportunity for desired native species to migrate in response to climate change.

GDS-3A: Ensure older forest stands and older forest characteristics within stands are distributed across the landscape.

Conditions ranging from stands over standard DNR rotation age for a cover type (“older forest”) to stands designated as old growth represent mature to old forest on the landscape. These conditions exist on other ownerships in the PP landscape and are created or maintained in many ways on DNR-administered lands, including:

- Designation of old-growth forests. managed forest lands is 60 years old or older statewide.
- Incorporating older forest values in sustainable timber harvest analysis and stand exam list development:
 - Older forest across ownerships is accounted for during DNR planning (see below).
 - Model results show that, at the current level of volume offered, older forest will be retained, and for many forest types, will continue to accumulate.
 - Management regimes on the Division of Fish and Wildlife-administered lands and in some management opportunity areas allow for older rotation ages and forest.
 - Modeling to ensure at least 2.5% of the aspen cover type on DNR-
- Some forest stands on DNR-administered lands (e.g., state parks and SNAs), inoperable stands, most representative sample areas (RSAs), and stagnant conifers are not in the management pool.
- On average, approximately 75% of acres within PP on DNR annual stand exam lists don’t result in timber sales. A portion of these acres represents or will become older forests.
- Application of leave trees and reserve areas within stands and riparian management zones.
- Management for High Conservation Values and federal and state-listed species.
- Conversions from shorter to longer-lived species (e.g., aspen to pine or oak).

In addition, the DNR uses an adaptive approach to monitor and manage forest age classes, including older forest, across ownerships at a landscape level:

1. The SFRMP original desired age class distribution is applied as a benchmark across all ownerships.
2. Forest age class distributions across all ownerships and on DNR-administered timberlands are periodically monitored.
3. DNR forest age class management may be adjusted in response to changing conditions across all ownerships.

GDS-3A Strategies

- Allow some stands, especially those with old forest characteristics, to succeed to longer-lived cover types or under-represented NPC growth stages (e.g., FDn32c, d).
- Manage designated old-growth stands (Table 3.6) and SMZs according to DNR policy and OFMCs according to old growth policy and MOA guidance documents (Appendix D).

- Use silvicultural treatments that retain old forest components in some stands, such as OFMCs, FAW-administered lands, riparian areas, relevant MOAs, HCVF sites, and natural origin red pine stands.
 - When making decisions to add and offer unplanned wood for harvest, consider the habitat value of old forest in the area and the age-class structure of the surrounding local landscape.
- Use silvicultural prescriptions or reserves to create corridors that connect older stands.
- Apply DNR legacy tree direction to identify and reserve existing legacy trees from harvest.

Table 3.10: Old growth acres within PP by cover type.

Old growth type	Designated	Future Old Growth	Candidate Old Growth	Grand Total
Aspen	0	0	11.6	11.6
Lowland hardwoods	98.3	0	0	98.3
Northern hardwoods	605.7	0	18.7	624.4
Oak	544.6	0	436.1	980.7
White pine	107.7	33.5	17.2	158.4
Grand Total	1,356.3	33.5	483.6	1,873.4

GDS-3B: Maintain or enhance vegetation conditions associated with known occurrences of Species in Greatest Conservation Need.

Species in Greatest Conservation Need (SGCN) are native animals whose populations are rare, declining, or vulnerable to decline and below levels necessary to ensure long-term health and stability. For more information, refer to Minnesota’s [Wildlife Action Plan](#) and the [Rare Species Guide](#) on the DNR website.

GDS-3B Strategies

- Use the interdisciplinary forest management processes to apply SGCN data, conservation focus area, and Wildlife Action Plan guidance to maintain or enhance habitat when conditions and opportunities are suitable.
- Manage MOAs in a consistent manner with their association with SGCNs.
 - MOAs identified in this plan address specific SGCNs (either directly or indirectly through habitat enhancement and maintenance), including American woodcock, cerulean warbler, Acadian flycatcher, and Connecticut warbler.
- Consider climate change adaptation strategies in the [Wildlife Action Plan](#).

GDS-3C: Maintain existing large patches and increase average patch size on state lands over time, with consideration of natural spatial patterns. Identify ways to increase average patch size over time.

Patches are made up of one or more adjoining stands that are relatively homogenous in structure, primarily in height and density, and are similar in vegetation cover and age. Patches may be formally recognized as patch management opportunity areas (MOAs). Patches of forest vegetation can also be created, maintained, or enhanced outside of MOAs through stand exam list development and decisions made during stand management. Due to the non-contiguous nature of DNR-administered lands within this Section, most patches are small to medium sized.

In this plan, patches:

- are categorized as old, intermediate, and young within cover types or groups of cover types
- range in size from small (less than 40 acres) to large (greater than 640 acres)
- may have smaller areas within them that are not in the same patch category as the main patch, such as inclusions, residual islands, legacy patches, corridors, and buffers

The strategies below provide general guidance for working toward maintaining medium to large patches.

GDS-3C Strategies

- Review and incorporate MOA guidance documents in management activities.
- Maintain existing medium to large patches.
- Group harvest activities to maintain or create new large patches.
- Lump stands of similar age, cover type, and density while performing forest stand inventory.
- Increase the “age window” for harvesting adjacent stands to maintain or create new large patches (harvesting at younger or older ages than normal).
- Increase the size of clear-cuts while retaining adequate residuals.
- When possible, cooperate with other landowners in patch management to maintain existing large patches and increase the average patch size across forest land of multiple ownerships.

GDS-3D: Maintain or enhance vegetation conditions associated with existing biodiversity significance factors within MBS sites of high and outstanding biodiversity significance to the maximum extent possible.

Minnesota Biological Survey (MBS) sites of biodiversity significance may contain intact native plant communities and populations and concentrations of rare species, critical animal habitat, and functional landscapes (Table 3.7).

MBS sites are ranked as having outstanding (O), high (H), or moderate (M) biodiversity significance or as being below (B) the MBS minimum biodiversity threshold for statewide significance based on the following factors:

- rare species occurrences (element occurrences)
- native plant community quality, rarity, and size

- landscape context and presence/absence of landscape-level functions

More information about MBS, including background, definitions, and maps of sites of biodiversity significance, is available on the [DNR website](#).

Table 3.11: Sites of biodiversity significance acres in the PP Section summarized by ranking as of June 2020.

Rank	Number of Sites	Total Acres	Total state stand acres	Total state-managed acres
Outstanding	89	63,833	24,141	14,640
High	137	77,009	17,258	15,502
Moderate	420	200,504	30,278	28,049
Below	386	81,087	3,438	3,333

GDS-3D Strategies

Forest management activities such as timber harvesting, site preparation, access route construction and maintenance, and tree planting will occur on Forestry- and Fish and Wildlife-administered lands within MBS sites. MBS information should be used in conjunction with other available information and management direction to inform site-level management. The following strategies will help to minimize the loss of the factors on which the MBS sites of outstanding and high biodiversity significance were ranked.

- Follow interdisciplinary coordination direction when working within MBS sites of outstanding or high significance.
- Consider the broader context and significance of the MBS site as a whole when assigning management objectives and designing silvicultural prescriptions. For example:
 - Emulate the within-stand composition, structure, and function of NPC growth stages when managing stands in MBS sites.
 - Apply variable density thinning or variable retention during harvest or reforestation where appropriate.
 - Increase the use of prescribed fire as a silvicultural technique in managing fire-dependent NPCs.
 - Locate roads and trails to minimize fragmentation of high and outstanding MBS sites.
- Manage stands identified as having high conservation values consistent with DNR policy. Refer to specific directions on managing for high conservation values for additional information.
- As opportunities arise, inform other landowners of the significance of shared MBS sites, their biodiversity objectives, and the management options for addressing them.

Special considerations

- The Paleozoic Plateau Section contains many unique areas of high to outstanding biodiversity. These areas may be identified as MBS sites of biodiversity, high conservation value forests, or high biodiversity site MOAs.

- Individual stands within these areas exist within the larger context of the whole area of higher biodiversity. When managing stands in these areas, consider the placement of the stand and the effects of proposed management within the larger area of higher biodiversity.
- Incorporate direction identified within HCVF policy and strategies identified within management opportunity area documents into proposed management within these areas.
- These areas will also likely have rare NPCs, plants, and animals. Incorporate strategies from [GDS-3B, GDS-3E, GDS-3F, and GDS-3G](#) to the stand and area as appropriate.

GDS-3E: Protect, maintain, or enhance endangered, threatened, and special concern species and their habitats in the Section.

Minnesota’s List of Endangered, Threatened, and Special Concern Species (ETS list) highlights plants and animals at risk of disappearing from Minnesota. Special regulations apply to endangered and threatened species. Species listed as special concern are not statutorily protected but are considered in management decisions. Up-to-date information on the state ETS list can be found on the DNR’s [ETS website](#). Vegetation management decisions will comply with federal laws, including the Endangered Species Act, state laws, and department listed species direction.

The DNR has a leadership role in the administration and application of MN rare species statutes and associated rules. Information on rare species in MN is available on the [Rare Species Guide website](#).

GDS-3E Strategies

- Provide DNR staff access to the Natural Heritage Information System (NHIS).
- Incorporate new rare features inventory information as it becomes available.
- Consult the rare features database (NHIS) prior to all management activities (e.g., appraisal, harvesting, stand development work, etc.).
- When ETS species are present, follow joint coordination processes to coordinate with DNR specialists to design management to prevent the take of federally and state-listed species.
- Refer to Department ETS list species guidelines as they become available.
- Consult the [Rare Species Guide](#) when appropriate.
- Protect and enhance rare features during management activities.
- Use management to mitigate the effects of climate change on ETS list species.
 - Maintain or enhance habitat needed for ETS listed species.
 - Maintain connectivity of islands of habitat that allows the migration of plants and animals.

Special considerations

- Rusty patched bumble bee (federally endangered species) and its associated habitat are commonly found in central and southeast Minnesota, including within the Paleozoic Plateau ecological section. Apply rusty patched bumblebee direction before engaging in work (harvesting timber, prescribed burning, trail maintenance, invasive species management, etc.) within high-probability zones.
- Long-eared bats (federally endangered species), Little brown bats, tri-colored bats, and associated habitats are commonly found in central and southeast Minnesota, including within the Paleozoic Plateau ecological section. The Minnesota DNR has worked with the US Fish and Wildlife Service to

develop a [Bat Habitat Conservation Plan \(HCP\)](#) to protect these species while conducting forest management activities. Foresters and resource managers will follow the Bat HCP Implementation Policy, which provides direction to staff when conducting covered activities on how to comply with and implement the Bat HCP on DNR-administered lands (e.g., forest management, road and trail construction maintenance and use, prescribed fire, protecting and maintaining hibernacula).

GDS-3F: Protect, maintain, or enhance rare native plant communities in the Section.

Minnesota's NPCs are ranked based on NatureServe's Conservation Status Rank system (S-Rank), indicating the relative rarity or endangerment of the NPC statewide. These ranks are:

- S1 – critically imperiled
- S2 – imperiled
- S3 – vulnerable to extirpation
- S4 – apparently secure; uncommon but not rare
- S5 – secure, common, widespread, and abundant

Some NPCs ranked S1, S2, or S3 are also considered globally imperiled, as indicated by corresponding "G-Ranks". More information on status ranks, including a complete list of S-Ranks and G-Ranks by NPC, is available on the [DNR native plant community classification webpage](#).

In addition to status ranks, NPC condition ranks indicate the quality of NPC occurrences. NPC condition is ranked on a continuum from A through D, with an A rank indicating an excellent-quality NPC and a D rank indicating a poor-quality NPC. Consult the appropriate regional ecologist for more information on condition rank definitions.

GDS-3F Strategies

- Maintain or enhance the characteristics that contribute to areas identified as G1 and G2 ranked plant communities, following the current direction for managing these sites. DNR staff should consult the Ecological and Water Resources Division's regional ecologist(s) when developing site prescriptions within these communities.
- Maintain or enhance the characteristics that contribute to a C or greater condition rank for S1 through S3 NPCs.
- Apply special management to stands identified as the highest quality examples of rare NPCs (rank B or above, depending on NPC).
 - Coordination between Divisions of Forestry, Fish and Wildlife, and Ecological and Water Resources staff will determine treatments needed to protect, maintain, or enhance the ecological integrity of rare NPCs.
 - Consider swapping stands, when possible, to protect, maintain, or enhance high-quality examples of rare NPCs.
- Utilize existing access routes and landings and avoid creating new access routes and landings in rare NPCs to the extent possible.

Special considerations

- Certain native plant communities are of conservation concern within the PP Section due to their global and statewide rarity, limited occurrence, and known association with rare species. Those that support forests include:

MHs 37 (Southern Dry-Mesic Oak Forest), MHs38 (Southern Mesic Oak-Basswood Forest), MHs39 (Southern Mesic Maple-Basswood Forest), MHw36 (Northwestern Wet-Mesic Hardwood Forest), MHs49 (Southern Wet-Mesic Hardwood Forest), MHc38 (Central Mesic Cold-Slope Hardwood-Conifer Forest), FDs27 (Southern Dry-Mesic Pine-Oak Woodland), FDs36 (Southern Dry-Mesic Oak-Aspen Forest), FDs37 (Southern Dry-Mesic oak (maple) Woodlands), FDs38 (Southern Dry-Mesic Oak-Hickory Woodland), FFs59 (Southern Terrace Forest), WFs57 (Southern Wet Ash Swamp), UPs14 (Southern dry savanna), and UPs24 (Southern Mesic Oak Savanna).

 - The goal of maintaining or enhancing the composition and structure of these native plant communities should be considered when conducting active management.
 - Coordination between the Divisions of Forestry, Fish and Wildlife, and Ecological and Water Resources staff is important to design management within these sites to protect, maintain, and enhance the characteristics found within these NPC.
- Upland savanna and bluff prairies were once more widespread in southeast Minnesota. They can be found on small inclusions of UPs14 and UPs13 plant communities within larger areas of upland deciduous forests on ridgetops and south-facing slopes. Many of these areas are being degraded by the encroachment of brush and have slowly converted to forest cover such as oak, northern hardwoods, and red cedar. Due to their small size, they may be found as inclusions within various cover types, including rock outcrops, oak, upland brush, upland grass, northern hardwoods, red cedar, and aspen. Some, but not all, bluff prairie locations have been identified and can be found within the Bluff Prairie MOA. When upland savanna and bluff prairies are found within an existing cover type:
 - Manage inclusions towards no or limited canopy cover.
 - Increase harvest efforts in these areas where feasible; retain wolf trees as leave trees.
 - Consider variable density thinning more heavily in these areas to create more open canopy characteristics.
 - Expand existing sites where feasible using Rx Fire, mechanical tree/shrub removal, and/or chemical treatment as needed.
 - Retain and enhance rare plant and animal species associated with these communities.
 - Monitor for and remove invasion of invasive species as needed to maintain native vegetation on the sites.

GDS-3G: Represent all native plant community class growth stages on state lands.

Growth stages are successional stages within a native plant community class that develop over time following an initial stand-establishing disturbance. Plant and animal species utilize various growth stages in different ways. Information on native plant community stand dynamics and growth stages can be found within the [native plant community descriptions](#).

This SFRMP document does not establish acreage goals for growth stages by ecosystem type or native plant community. Young and mature growth stages are represented on a variety of DNR-administered lands. Older forest stages are represented in designated old-growth forests and in some protected areas such as state parks and SNAs.

GDS-3G Strategies

- Look for opportunities to maintain or develop characteristics of under-represented growth stages.
- Consider the contribution of inoperable stands and reserved areas (e.g., old growth, SNAs, state parks) in providing representations of growth stages when developing prescriptions.

GDS-3H: Ensure young, early successional forest is distributed across the landscape over time.

The 0-30 year age group of aspen, balm-of-Gilead, birch, oak, and jack pine cover types represents young, early successional forest in this plan. Young oak forests are the largest contributor to young forest characteristics within this section. The goal of balancing age class distributions in even-aged managed cover types determines the amount of young forest sustained over time. Young, early successional tree species are also present in other cover types.

In this planning period, sufficient young forest is being created and maintained in the PP Section through the implementation of the strategic direction and the 10-year stand exam list. Management opportunity areas that are a part of this plan provide further direction for the management of some young, early successional forests for wildlife species (e.g., turkey and ruffed grouse management areas, bluff prairie management areas). Management opportunity areas are summarized, with links for their management guidance documents, in [Appendix D](#). Additional direction on bluff prairies can be found in [GDS-3F](#).

3.4 Wildlife Habitat

The GDS and Strategies in this section address Issues: [A2, B1, B2, D2, E1, F1, G1, N1](#)

GDS-4: Provide a variety of vegetation conditions and habitat components at multiple scales simultaneously to support wildlife species found in the Section.

Game and nongame wildlife populations reflect the biological health of the forest and are important to society for their inherent values. Both natural events and forest vegetation management have the potential to affect wildlife species positively or negatively, as well as provide a variety of habitats for short-distance and long-distance migrants. A range of vegetation conditions and components of species' habitats are provided in the PP Section through a variety of mechanisms:

- **Some species associated with older forest** are provided for through statutory preserves, old-growth stands and old forest complexes, inoperable or unmerchantable stands, management regimes that allow older rotation ages and greater reserve amounts on Fish and Wildlife administered land, stands that are not harvested at rotation age for a variety of reasons, and on other ownerships (see GDS-3A for additional examples).
- **Species associated with younger forest** are provided for on state lands and other ownerships in timberlands that are regenerating after harvest.

- **Structural elements within stands that many species depend on** are provided through the application of MFRC site-level guidelines and strategies in this plan.
- **Some individual species' needs** are addressed through state and federal laws and Department policies and guidelines.
- **Wildlife management areas (WMA)** are managed with the primary objective of providing habitat maintenance, habitat enhancement, and values for various wildlife species.

Overall, providing a diversity of forest characteristics and forest stand age classes will help support wildlife species with different habitat requirements. Strategies in this section provide additional, specific guidance related to wildlife habitat in the PP Section.

Through this planning process, management opportunity areas (MOAs) focused on providing wildlife habitat at landscape spatial scales were adopted. These include interior forest management areas and turkey and ruffed grouse management areas. Summary information for all MOAs and links to their guidance documents are in [Appendix D](#).

GDS-4 Strategies

- Prioritize wildlife habitat values when conducting management and timber harvests within WMAs.
- Follow forest management coordination direction on managing forests within WMAs.
- Provide for the needs of species that depend on perches, cavity trees, bark foraging sites, and downed-woody debris through the application of MFRC site-level guidelines, leave tree and snag guidelines, and DNR legacy tree direction.
 - Where appropriate, retain some storm-damaged large-diameter trees for the development of cavities for wildlife.
- Consult WMA plan guidance on WMA lands
- Follow leave tree guidelines on documenting leave tree and snag retention so they are not selected for future harvest before their time.
- Provide for the needs of species associated with native plant communities of conservation concern and have some association of dependence on specific tree species and habitat structure characteristics. Examples include savanna, oak woodlands, and grasslands. Opportunities include:
 - Increasing mixed forest conditions in some stands through selection harvesting.
 - Managing oak woodlands by retaining the oak component (fire or harvest, emulating natural disturbances)
 - Retaining mast (acorn and nut-producing trees) such as oak, hickory, and walnut within forests.
 - Using prescribed burning
 - Restoring oak savanna, bluff prairie, and grassland sites
 - Converting non-native cover types to native species
- Provide site-specific benefits for game and nongame species through management opportunity areas.

3.5 Riparian and Aquatic Areas

The GDSs and Strategies in this section address Issues: [A2](#), [B1](#), [F1](#), [G1](#)

Riparian areas encompass the transition zone between the terrestrial and aquatic habitats that occur along lakes, streams, and open-water wetlands. A riparian management zone (RMZ) is a portion of the riparian area where site conditions and landowner objectives are used to determine management activities that address riparian resource needs.

GDS-5A: Manage riparian areas to provide vegetation conditions associated with habitat for fish, wildlife, and plant species.

GDS-5A Strategies

- Retain a relatively continuous forest cover for the protection and maintenance of aquatic habitat types, aesthetics, recreation, and forest products.
- Manage to maintain or increase old forest characteristics in riparian areas.
- Emphasize longer-lived, uneven-aged, mixed species stands to maintain shade in the riparian management zone (RMZ) of designated trout streams.
- Favor reserves in locations around wetland habitats, seasonal ponds, and riparian areas to maintain ecosystem functions.
- Refer to Minnesota's [Wildlife Action Plan](#), the MFRC's Riparian Science Technical Committee's [Analysis of Current Science Behind Riparian Issues](#), and other applicable research for information on managing riparian areas for wildlife and other ecological considerations.

Special considerations

- Riparian areas and transition zones between upland forests and wetlands/lowland hardwood forests are at risk of conversion to non-forest types and loss of ecological function due to Invasive species. Address the risks of invasive species to riparian areas through:
 - identification of invasive species in/adjacent to a stand proposed for treatment
 - applying buffers to decrease the potential for invasives moving from adjacent wetlands into the forested stand as needed
 - use of treatment prescriptions and implementation of leave tree requirements that aid in the establishment or maintenance of non-ash tree species to mitigate potential impacts of the emerald ash borer
 - see [GDS-7A](#) for additional strategies to decrease the negative impacts of invasive species

GDS-5B: Protect wetlands and seasonal ponds during forest management.

Wetland areas include lowland forested areas, lowland brush and grass cover types, seasonal ponds, seeps, springs, springsheds, and karst features. These areas are protected using different MFRC site-level guidelines than those required for riparian areas adjacent to lakes, streams, and rivers or permanent open-water ponds.

GDS-5B Strategies

- Meet or exceed MFRC site-level guidelines to emphasize the protection of water quality and wetland health.
 - Verify that landing locations are appropriate (e.g., avoid wetlands) based on the cover type.
- Check the application of wetlands and seasonal pond guidelines as a part of the stand exam review, timber sales supervision, and inspections.
- Maintain canopy cover around seasonal ponds.
- Favor reserves in locations around wetland habitats, springs, spring sheds, and karst features to maintain ecosystem functions.
- Design forest access routes and landings to avoid wetlands, seeps, springs, springsheds, and karst features. [See springs, springsheds, and karst inventories.](#)

Special considerations

- Calcareous fens are statutorily protected wetlands that are present within the Paleozoic plateau. Calcareous fens must not be impacted or otherwise altered or degraded. Follow joint coordination processes for management guidance near calcareous fens.

3.6 Timber Productivity

The GDS and Strategies in this section address Issues: [B1, B4, H1](#)

GDS-6: Increase timber productivity and quality on state timberlands.

GDS-6 Strategies

- Move toward harvesting stands in even-aged managed cover types at their rotation ages (Appendix E).
- Use site preparation, inter-planting, release from competition (e.g., herbicide application or mechanical/hand release), and tree protection.
- Consider alternative approaches to minimize the use of pesticides (herbicides, insecticides, etc.).
 - Consider mechanical site prep (e.g., roller chopping) and release (e.g., brush saw) to control competition where feasible.
 - Follow operational standards to control competing vegetation or forest insects and diseases on state lands.
- Apply selection harvest treatments and thinning to increase tree quality and forest health.
- Continue to improve, implement, supervise, and enforce current DNR timber sale regulations to protect and minimize damage to sites or residual trees from treatment activities.
- Manage certain stands for large-diameter, high-quality products by retaining adequate stocking and basal area.
- Identify and treat invasive species as needed to prevent their spread. See [GDS-7A](#) for additional strategies to decrease the negative impacts of invasive species.

3.7 Forest Pests, Pathogens, and Non-native Invasive Species

The GDSs and Strategies in this section address Issues: [B1](#), [H1](#), [I1](#), [I2](#)

GDS-7A: Limit damage to forests from insects, disease, and non-native invasive species to acceptable levels where feasible.

Forest management will not attempt to eliminate native insects and diseases or their processes from the landscape but rather limit their impact on individual sites to a level that allows goals for timber production, water quality, aesthetics, recreation, wildlife, and biodiversity to be realized. Addressing native and non-native insects and diseases in forest management planning and activities can significantly reduce or avoid many adverse economic and environmental impacts on Minnesota forests.

GDS-7A Strategies

- Many different invasive species negatively affect forests within the Paleozoic Plateau. Design management activities to prevent or limit the introduction of invasive species onto DNR-administered lands and waters and limit their spread and impact on high-value resources.
 - Examples of invasive species in the PP Section include black locust, garlic mustard, buckthorn, round leaf bittersweet, Japanese barberry, spongy moth, earthworms, and reed canary grass (native and non-native strains). Additional information on invasive species and control methods can be found on the [terrestrial invasive species website](#).
- Identify and monitor insect, disease, and non-native invasive species populations as part of the forest health monitoring program and document their occurrence on state-managed lands.
- Involve private landowners and local units of government in gathering and disseminating information.
- Consider the least intensive site preparation, release, and timber stand improvement methods possible to ensure success.
- Apply recommended strategies from DNR forest health specialists as appropriate.
- Provide information and training to operators and contractors regarding techniques that minimize damage to residual trees (e.g., leave trees or crop trees) and minimize the spread of invasive insects, diseases, and plants consistent with Department policy and direction on the management of invasive species.
- Arrive at sites with clean equipment and remove mud, clumps of soil, and plant parts (leaves, grass, and other vegetative material) from equipment before leaving sites.
- Consider implementing prescribed burning to improve stand health as a tool to prevent or control the effects of insect and disease outbreaks.
- Identify and treat invasive species before, during, or after management as needed to prevent their spread.
- When feasible, identify invasive species present in and adjacent to stands planned for harvest 1-2 years ahead of harvest so:
 - pre-treatment needs can be planned and completed before harvest

- potential harvest buffers may be identified and planned (e.g., utilizing reserves to create buffers) to decrease the potential for invasives to move into a stand or adjacent forests and wetlands
- this information can be used in planning for funding and resources to treat invasives.

Special considerations

- [Buckthorn](#) is a significant concern within the PP Section. Based upon site level conditions, plans and strategies to control buckthorn, pre- and or post-timber harvest, should be considered and implemented as appropriate.
- Reed canary grass has both native and non-native populations within Minnesota. Regardless of origin, reed canary grass is a significant concern within the PP Section in riparian areas, floodplain forests, and wetland forests. Reed canary grass forms thick layers of thatch that suppress other plants, reduce plant and insect diversity, and significantly impact forest regeneration. Extensive infested areas along waterways provide an annual seed source that allows reed canary grass to colonize new areas and adds to the seed bank in shaded areas. Based upon site-level conditions, plans and strategies to control reed canary grass, pre-and/or post-timber harvest, should be considered and implemented as appropriate. Designing prescriptions to maintain shade within forest stands through placing reserve areas, buffers, and reserve trees which can slow and limit the spread of reed canary grass.

GDS-7B: Reduce adverse impacts of wildlife on forest vegetation on state forest lands.

Wildlife species such as deer, rabbits, beaver, pocket gophers, voles, and other rodents impact forests and plant regeneration through browsing, stem damage, and girdling. The management strategies below attempt to minimize adverse impacts.

GDS-7B Strategies

- Before damage occurs, consider the potential for wildlife impacts on planted or naturally regenerating trees.
 - Work with Area wildlife staff to identify sites where significant damage may occur before forest management activities occur. Where necessary, incorporate plans for post-sale damage mitigation into forest regeneration and development plans.
- Use mitigation techniques on sites where damage from wildlife is anticipated.
 - Seed or plant more heavily to account for expected mortality.
 - Seed or plant a mix of species rather than a single species.
 - Plant larger stock that is able to grow above browse height more quickly.
 - Plant less palatable species along site edges and susceptible species away from surrounding vegetation types preferred by herbivores.
 - Use protective measures such as fenced enclosures, bud capping, repellents, tree shelters, vole guards, etc.

3.8 Climate Change

The GDS and Strategies in this section address Issues: [B1, B2, B5, F1, G1, H1, J1](#)

GDS-8: Use best-available science to increase the resilience of forests and help them adapt to climate change.

Minnesota DNR recognizes that climate change is occurring at a rate that exceeds historical levels and will have serious implications for people and the natural world.

Most tree species in Minnesota reach at least one of the limits of their geographic distribution within the boundaries of the forested portion of the state. Projections of future tree distributions can help guide climate change adaptation.

Although the effects of climate change on forest vegetation at the ecological section scale are uncertain, the following strategies will help monitor and adapt to the projected effects of climate change.

GDS-8 Strategies

- Maintain or increase species and structural diversity, using resources including the NPC silviculture strategies for forest stand prescriptions, including information on species affinity for warmer and drier site conditions and [NIACS climate change projections for tree species in PP](#).
 - Favor tree species that are projected to have expanded habitat in PP under future climate conditions.
- Evaluate site conditions with respect to climate change when selecting tree species for regeneration or conversion.
- Maintain refugia and corridors for species that cannot migrate by implementing the strategies throughout this plan that will provide a wide range of conditions and habitat types across the landscape.
- Use silvicultural prescriptions or reserves to create corridors that connect older stands.
- Maintain connectivity of islands of habitat that allows the migration of plants and animals.
- Enhance genetic diversity in planting and seeding. Evaluate site conditions with respect to climate change when selecting tree species for regeneration or conversion appropriate to the NPC (See NPC silviculture strategies for more information on individual NPC tree response to climate change).
- Consider the use of supplemental climate change information when designing site prescriptions, including:
 - [MNDNR watershed health assessment framework](#)
 - US Forest Service Northern Institute of Applied Science [adaptation workbook](#) and [tree species projections](#) for Ecological sections

3.9 Visual Quality

The GDS and Strategies in this section address Issues: [B1, K1](#)

GDS-9: Minimize forest management impacts on visual quality in sensitive areas.

Scenic beauty is a primary reason people choose to spend their recreation and vacation time in or near forested areas. Where forests are near recreational trails, lakes, waterways, public roads, and highways, consider the impacts of forest management activities on the site's visual quality during and after management activities.

GDS-9 Strategies

- Apply MFRC site-level guidelines for visual quality, including:
 - Minimize visibility of harvest areas along travel routes, recreation routes, campgrounds, and day-use areas with moderate or high sensitivity ratings.
 - Avoid management operations whenever possible during periods of peak recreational use.
 - Locate landings, areas of heavy slash, roads, and trails to minimize visibility from nearby vantage points, such as scenic overlooks, streams, and lakes.
 - Consider species, wind firmness, and retention style (e.g., clumped) to maintain long-lasting visual quality along identified high-visual-quality roadways.

3.10 Access to State Land

The GDS and Strategies in this section address Issues: [K1](#)

GDS-10: Plan forest access routes and collaborate with federal, tribal, private, and local units of government to share access and minimize new construction.

GDS-10 Strategies

- When planning access routes:
 - use existing access routes where possible
 - control access to limit conflicts with recreation
 - eliminate unnecessary access routes
 - minimize forest land area lost to road development
- Cooperate with other landowners to retain existing access to State land and coordinate new road access.
- Close access routes at the conclusion of management activities when appropriate.
- Avoid access routes across sensitive areas when practicable.
 - Minimize impacts to sensitive species or areas when the only access route is across sensitive areas.
 - Review the [spring and karst feature](#) inventory and design access to avoid these areas.
- Follow joint coordination policies and procedures where access routes occur in sensitive areas.

- Incorporate seasonal restrictions on road and access route creation as appropriate to meet rare and ETS species needs (e.g., Blanding’s turtle, rusty patch bumblebee, bat species.)

3.11 Cultural Resources

The GDS and Strategies in this section address Issues: [L1](#)

GDS-11: Protect cultural resources on state-administered lands.

A cultural resource could include an archaeological site, cemetery, historic structure, historic area, or other element of cultural heritage, including areas of spiritual, traditional, scientific, or educational value. In addition to federal and state laws that protect certain types of cultural resources, the MFRC site-level guidelines provide information and recommendations to assist private and public land managers in taking responsible actions when cultural resources are encountered.

GDS-11 Strategies

- Annual stand exam lists are reviewed by DNR archeologists. Recommendations for mitigation are implemented as part of the sale design.
- Where known locations of cultural resources exist (e.g., sugar bush, traditional harvest locations, etc.), consider options for minimizing impacts to or enhancing those resources.
- When forest management is planned on sites not on the annual stand exam list (e.g., salvage harvests, site preparation for planting, invasive species treatments), sites are reviewed by DNR archeologists. Recommendations for mitigation are implemented as part of the project design.

3.12 Natural Disturbance Events

The GDS and Strategies in this section address Issues: [M1](#)

GDS-12: Promptly evaluate and determine an appropriate response to natural disturbance events on state land.

By promptly evaluating known disturbance events (e.g., fire, wind, or insects and disease), DNR land managers will be able to quickly recommend what, if any, forest management activities are necessary to mitigate the impacts of the event on DNR-administered lands. Where quick action is needed to salvage harvest timber from damaged stands, the annual plan addition process, including interdisciplinary coordination and public notice, will be used.

GDS-12 Strategies

- The Department will evaluate large-scale (hundreds to thousands of acres) disturbance events to determine appropriate action.
 - Assess the extent and significance of the event on forest lands in the Section.
 - Recommend forest management actions.
 - Analyze effects on how disturbances might interact with how much volume is offered to advance desired future conditions.

- When possible, cooperate in assessing and implementing management actions with other agencies and landowners.
- Local land managers will evaluate and determine appropriate actions for small-scale (tens of acres) disturbance events and take the appropriate action needed to address the situation while following existing APA and interdisciplinary coordination processes.

3.13 Management Opportunity Areas

Management opportunity areas (MOAs) are areas on DNR-administered lands that offer an opportunity to maintain or create spatial patterns to address natural resource values that are difficult to achieve at the stand level or through the normal stand development process. They contribute toward meeting goals in this plan, including providing wildlife habitat for a range of species (e.g., ruffed grouse management areas), providing older forest and older forest characteristics distributed throughout the Section (e.g., old forest management complexes), and considering species of special concern or conservation need in management (e.g., interior forest management areas).

Preliminary MOAs were incorporated in the modeling to create the DNR's 10-year stand exam list for fiscal years 2021-2030. For some MOA types, cover type harvest age and the percent of stand area reserved from harvest differed compared to standard DNR management on non-school trust lands (see [Appendix E](#)). On school trust lands within MOAs, standard DNR management rotation ages and reserve amounts apply unless otherwise specified in the management of school trust lands operational order (see [Appendix E](#)). In practice, MOA reserve amounts can be applied, on average, at the MOA scale to meet MOA objectives.

The preliminary MOAs included in the stand exam list modeling in the PP Section were evaluated by DNR staff and managers in the Divisions of Ecological and Water Resources, Fish and Wildlife, and Forestry. As a result of that review process, MOAs and MOA guidance documents, which guide MOA implementation, were adopted in the PP Section. Management within adopted MOAs will be designed to meet the MOA's intent and strategies as described in the guidance documents to the extent possible while balancing other forest resource goals and adhering to DNR policies. However, it is important to remember that not all MOA objectives are achievable on every stand within a MOA. Rather, objectives are met at the scale of the MOA through a combination of the resource conditions that preceded the current planning period, the spatial and temporal configuration of stands on the 10-year stand exam list, and the design of management activities within the MOA. Therefore, there is flexibility in how to implement MOAs. This is necessary because there are multiple ways to achieve MOA goals, and the degree to which MOA guidance will impact any individual stand will vary based on MOA goals and site conditions.

Management opportunity areas are not "no-harvest" zones. Normal procedures, including annual plan additions (APAs; stands added to the stand exam list in a given year), are allowed within MOAs and may be necessary to manage appropriately. Management opportunity area goals should be considered when determining annual stand exam list transactions, including APAs. As with stands on the annual stand exam list, management within APA stands is expected to follow the MOA intent and strategies to the extent possible.

The full set of MOA management guidance documents for PP is available on the [DNR's PP SFRMP webpage](#). Individual MOA guidance documents can be downloaded from the links in the tables for each MOA type in [Appendix D](#).

Appendix A: DNR Forest Inventory Managed Acres Query

This appendix describes how the DNR's forest inventory data apply to this plan, including the acres that are considered "managed acres," which this SFRMP document applies to, and the acres that are considered timberland acres, which apply to the stand exam list development process (for more information, see the [10-year stand exam list report](#) on the [DNR forest planning webpage](#)).

Total Minnesota Department of Natural Resources (DNR) Administration with inventory data (in Forest Inventory Module) in the PP Section = 99,995 acres

Source: DNR forest inventory (FIM) April 2017

- **Total managed acres = 84,756**

Land administered by the DNR Divisions of Forestry and Fish and Wildlife, excluding state parks, Camp Ripley, the Boundary Waters Canoe Area Wilderness, scientific and natural areas, meandered waters, Metro Greenways, old-growth stands, stands in the Prairie Parkland planning unit, inoperable stands, TMBR_STAT=3 (inoperable flag in FIM), representative sample areas, and Fisheries-administered lands (except in Lake County)

- **Total timberland forested cover types assigned managed acres in PP = 59,252 acres**

Excludes non-forest (lowland brush, marsh, lowland grass, muskeg, upland grass, water, flooded, others). Non-timberland forest cover types assigned managed acres = 22,054 acres, stagnant and off-site forest cover types assigned managed acres = 3,450 acres.

Forest cover type query: "MN_CTYPE" <> 0 AND "MN_CTYPE" < 75 OR "MN_CTYPE" = 81

Non-forest FIM query: "MN_CTYPE" = 0 OR "MN_CTYPE" > 81

Stagnant and offsite cover types FIM query: "MN_CTYPE" >= 75 AND "MN_CTYPE" <= 79

Appendix B: Summary of Issues and General Direction Statements

Table B.1: General direction statements (GDSs) that address each issue. The Cover Types column indicates whether one or more cover type accounts in section 3.1 address an issue. See below for a summary of each Issue and GDS, Chapter 2 for a full description of each issue, and Chapter 3 for a full description of each GDS.

Issue	General Direction Statement																						Cover Types			
	1A	1B	1C	2A	2B	2C	3A	3B	3C	3D	3E	3F	3G	3H	4	5A	5B	6	7A	7B	8	9		10	11	12
A1	X	X	X				X						X	X												X
A2		X	X				X	X		X	X	X			X	X										
A3	X								X					X												X
B1	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X
B2	X	X	X												X							X				X
B3									X		X															
B4																	X									X
B5									X	X											X					
B6									X	X																
C1	X			X																						X
C2					X																					
C3						X																				
D1									X																	
D2		X	X				X								X											X
E1								X		X	X				X											
F1	X	X	X				X	X	X	X	X			X	X	X	X					X				
G1															X	X	X					X				
G2															X	X	X									
H1																		X	X	X	X					X
I1																				X						X
I2																				X						
I3																									X	
J1	X	X	X					X			X											X				X
K1																						X				
L1																							X			
M1																										
N1				X						X				X												

Summary of Issue Statements

A. Forest Age and Growth Stages

- A1. Representing growth stages and forest types across the landscape, given age class distribution goals.
- A2. Managing for older forest and old forest qualities on the landscape.
- A3. Managing for young, early successional forest.

B. Forest Composition, Structure, Spatial Arrangement, Growth Stages, and Native Plant Communities

- B1. Addressing biodiversity, forest health, and productivity of native plant communities through management of forest composition, structure, representation of growth stages, within-stand diversity, and spatial arrangement of vegetative types.
- B2. Determining which tree species to increase or manage within forest communities in the Section with respect to various natural resource objectives and projected environmental change.
- B3. Maintaining or enhancing highly imperiled, imperiled, and vulnerable to extirpation native plant communities in the Section.
- B4. Retaining characteristics of natural stand-replacement disturbance events while applying intensive management of forest communities.
- B5. Using management to better reflect natural landscape patterns (the size and configuration of growth stages and types resulting from broad-scale natural disturbances) in the Section.
- B6. Reducing forest fragmentation to maintain connectivity among habitat types.

C. Harvest Levels for Timber and Non-Timber Forest Products

- C1. Contributing to sustainable forest management that meets the Department's direction to continue to develop the desired forest age class distributions and species mixes over time by offering timber volume for sale, considering all forest resources and the objectives of the different forest lands administered by the DNR.
- C2. Managing non-timber forest products.
- C3. Marketability and utilization of forest products

D. Biological Diversity

- D1. Maintaining or enhancing biodiversity and native plant community composition, structure, and function through stand management within larger areas of biodiversity significance.

D2. Retaining or restoring within-stand structural complexity (e.g., vertical structure, stem size and density, coarse woody debris, and pit and mound micro-topography) when stands are harvested before reaching older growth stages in which these characteristics would normally develop.

E. Rare Features

E1. Protecting rare plants and animals (including endangered, threatened, special concern, and Species in Greatest Conservation Need), their habitats, and other rare features in the Section.

F. Wildlife

F1. Addressing the needs of game and nongame species through vegetation management.

G. Watersheds, including Riparian and Aquatic Areas

G1. Addressing the impacts of vegetation management on surface waters (wetlands, streams, and lakes).

G2. Addressing cumulative impacts of vegetation management on aquatic resources on a watershed or sub-watershed level.

H. Timber Productivity

H1. Maintaining or increasing timber productivity on state lands.

I. Disturbance Impacts on Forest Ecosystems

I1. Addressing disturbances, such as harmful forest insects, disease, and herbivory, on forest ecosystems.

I2. Addressing non-native invasive species threats and invasions.

I3. Considering catastrophic natural disturbances in vegetation management decisions.

J. Climate Change

J1. Managing vegetation to prepare for and respond to the effects of climate change.

K. Visual Quality

K1. Minimizing the effects of vegetation management activities on visual quality.

L. Access to State Land

L1. Providing access to stands identified for management.

M. Cultural Resources

M1. Protecting cultural resources during vegetation management activities on state-administered lands.

N. Balancing Vegetation Management Needs with Legal Requirements

N1. Including various state and federal legal requirements in the SFRMP planning process.

Summary of General Direction Statements

1. Forest Composition and Within-stand Diversity

GDS 1A: Maintain diversity of cover types.

GDS-1B: Manage within stands to reflect the composition, structure, and function of native plant communities.

GDS-1C: Maintain or increase the diversity of species, ages, and structures within stands.

2. Harvest Levels

GDS-2A: Manage stands to provide a sustainable supply of timber.

GDS-2B: Manage the availability of non-timber forest products.

GDS-2C: Improve Marketability and utilization of wood products in this planning area.

3. Biological Diversity, Young and Old Forest, and Spatial Distribution

GDS-3A: Ensure older forest stands and older forest characteristics within stands are distributed across the landscape.

GDS-3B: Maintain or enhance vegetation conditions associated with known occurrences of Species in Greatest Conservation Need.

GDS-3C: Maintain existing large patches and increase average patch size on state lands over time, with consideration of natural spatial patterns. Identify ways to increase average patch size over time.

GDS-3D: Maintain or enhance vegetation conditions associated with existing biodiversity significance factors within MBS sites of high and outstanding biodiversity significance to the maximum extent possible.

GDS-3E: Protect, maintain, or enhance endangered, threatened, and special concern species and their habitats in the Section.

GDS-3F: Protect, maintain, or enhance rare native plant communities in the Section.

GDS-3G: Represent all native plant community class growth stages on state lands.

GDS-3H: Ensure young, early successional forest is distributed across the landscape over time.

4. Wildlife Habitat

GDS-4: Provide a variety of vegetation conditions and habitat components at multiple scales simultaneously to support wildlife species found in the Section.

5. Riparian and Aquatic Areas

GDS-5A: Manage riparian areas to provide vegetation conditions associated with habitat for fish, wildlife, and plant species.

GDS-5B: Protect wetlands and seasonal ponds during forest management.

6. Timber Productivity

GDS-6: Increase timber productivity and quality on state timberlands.

7. Forest Pests, Pathogens, and Non-native Invasive Species

GDS-7A: Limit damage to forests from insects, disease, and non-native invasive species to acceptable levels where feasible.

GDS-7B: Reduce adverse impacts of wildlife on forest vegetation on state forest lands.

8. Climate Change

GDS-8: Use best-available science to increase the resilience of forests and help them adapt to climate change.

9. Visual Quality

GDS-9: Minimize forest management impacts on visual quality in sensitive areas.

10. Access to State Land

GDS-10: Plan forest access routes and collaborate with federal, tribal, private, and local units of government to share access and minimize new construction.

11. Cultural Resources

GDS-11: Protect cultural resources on state-administered lands.

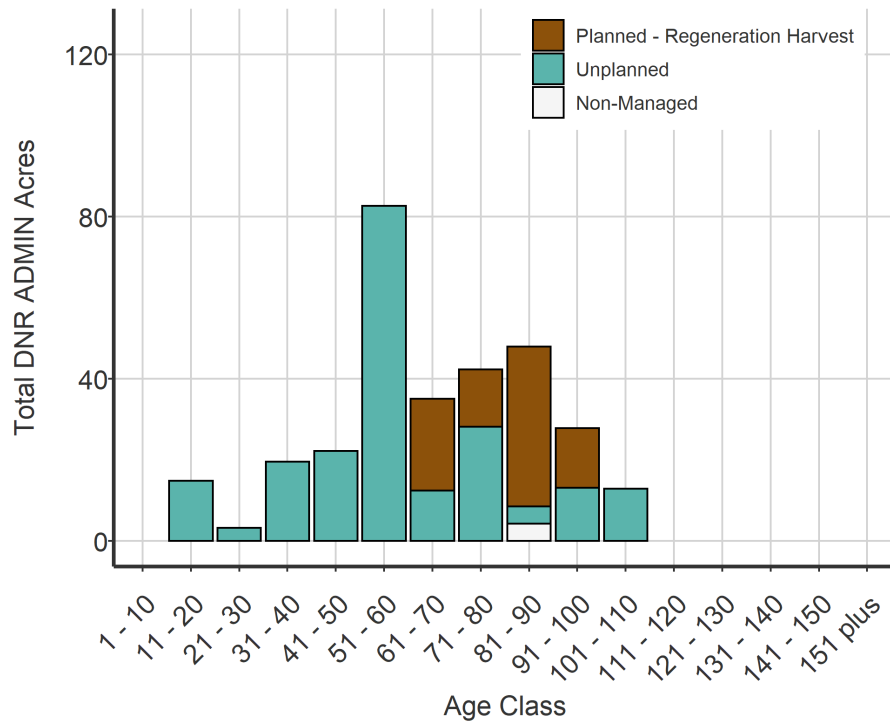
12. Natural Disturbance Events

GDS-12: Promptly evaluate and determine an appropriate response to natural disturbance events on state land.

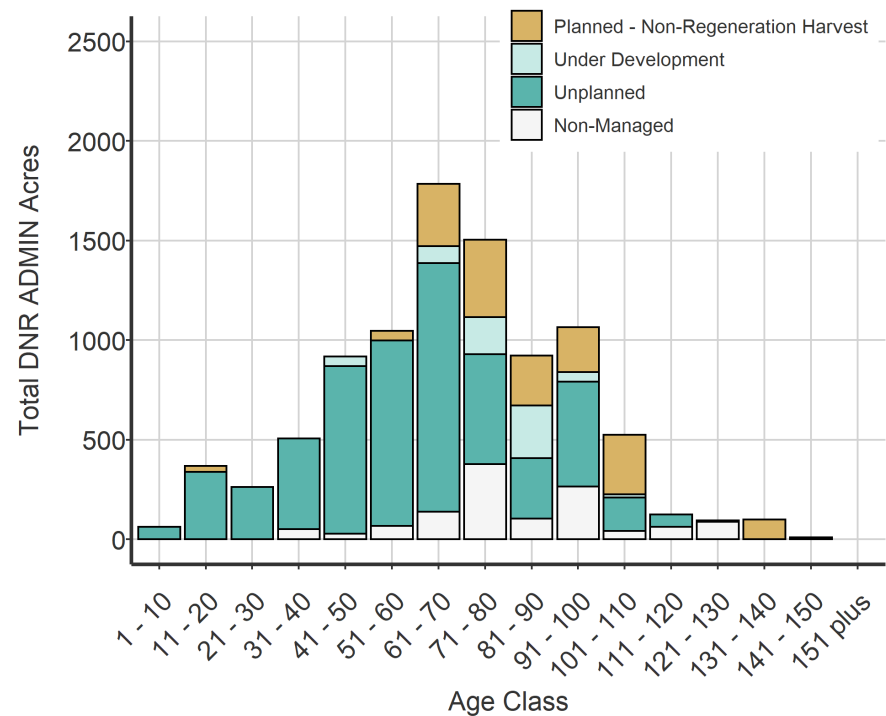
Appendix C: Cover Type Age Class Distributions

The charts in this appendix show the current age class distributions of forested acres as of 2021 for cover types listed in this plan in the Paleozoic Plateau (based on FIM data). Acres under development (in the process of some management action) at the time of plan writing are indicated in each chart, as are stand-exam acres planned to be visited through 2030. Acres planned on the 10-year stand exam list are further broken out by generic preliminary prescriptions of non-regeneration harvest (e.g., thinning) or regeneration harvest (e.g., primarily clearcut with reserves for even-aged managed cover types and selection harvest for uneven-aged managed cover types).

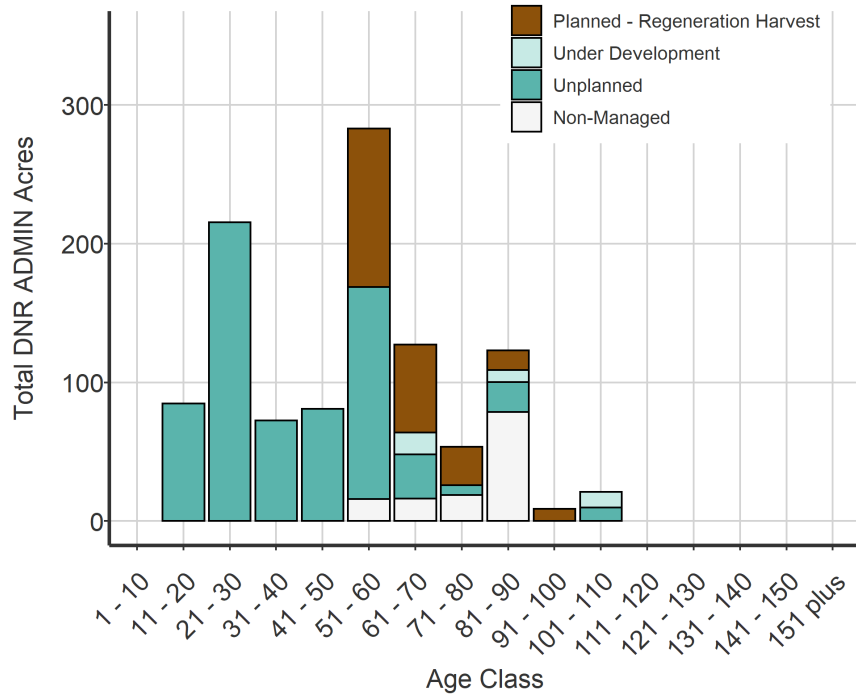
Birch



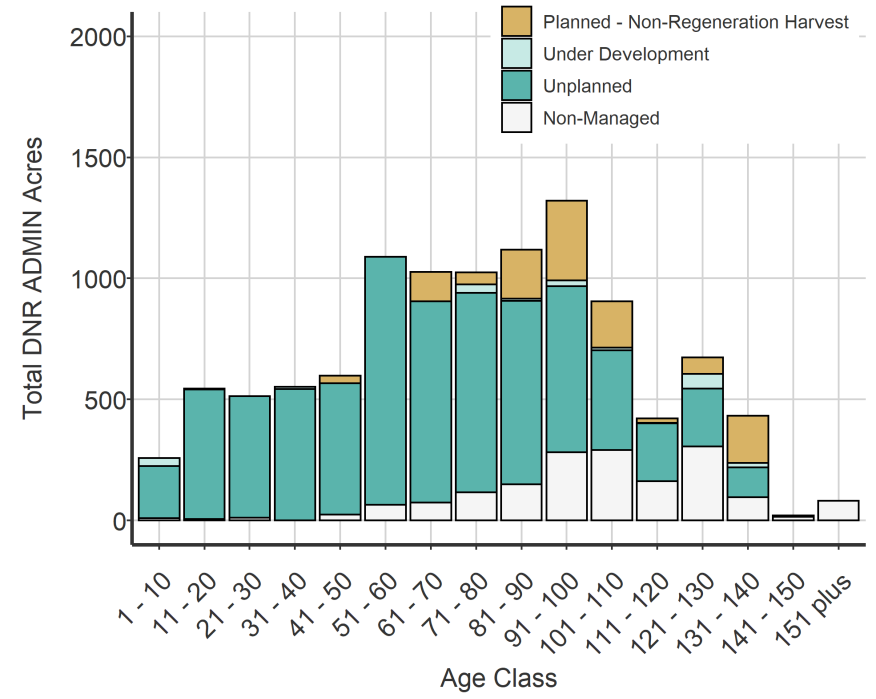
Ash/Lowland Hardwoods



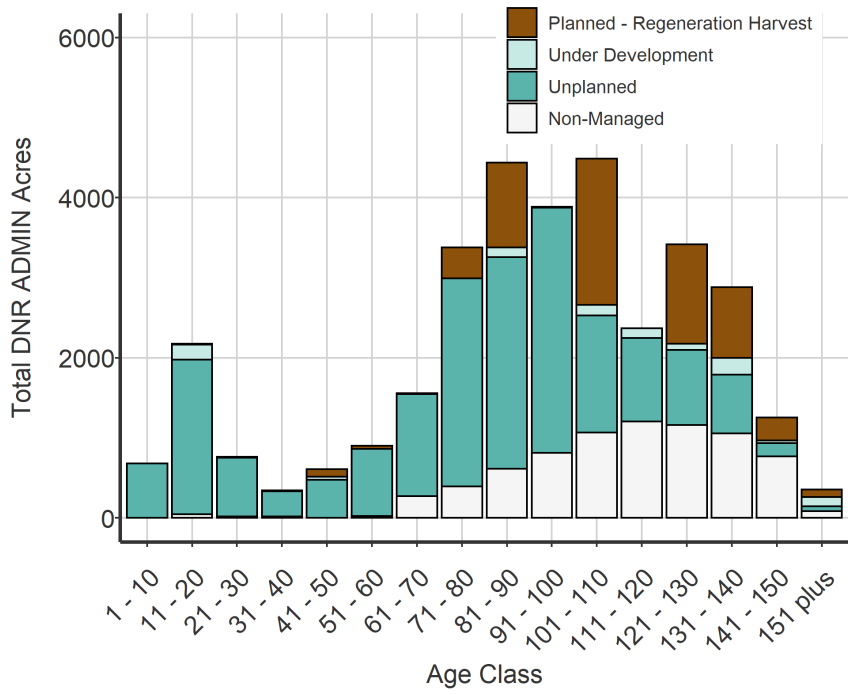
Aspen



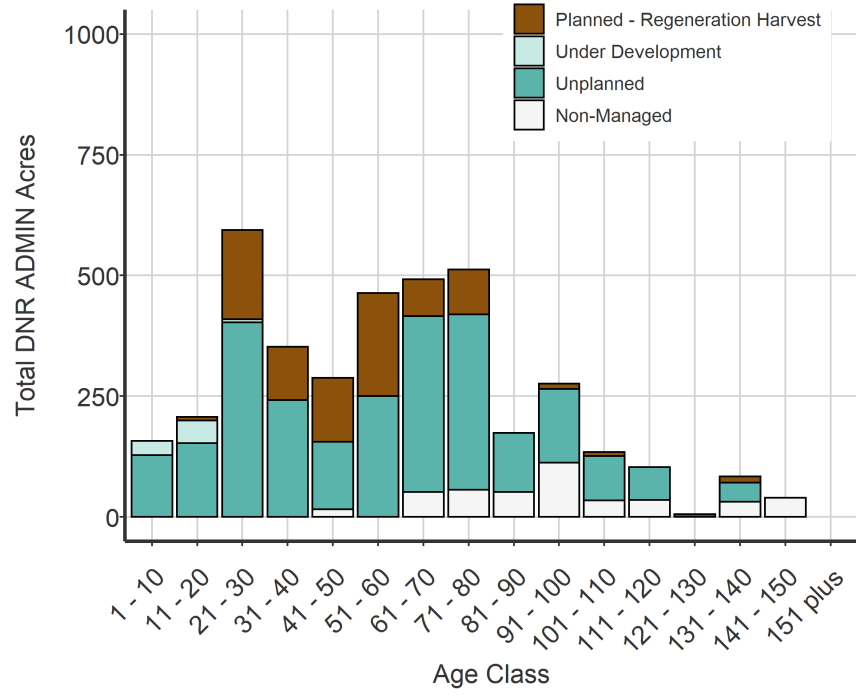
Northern Hardwoods



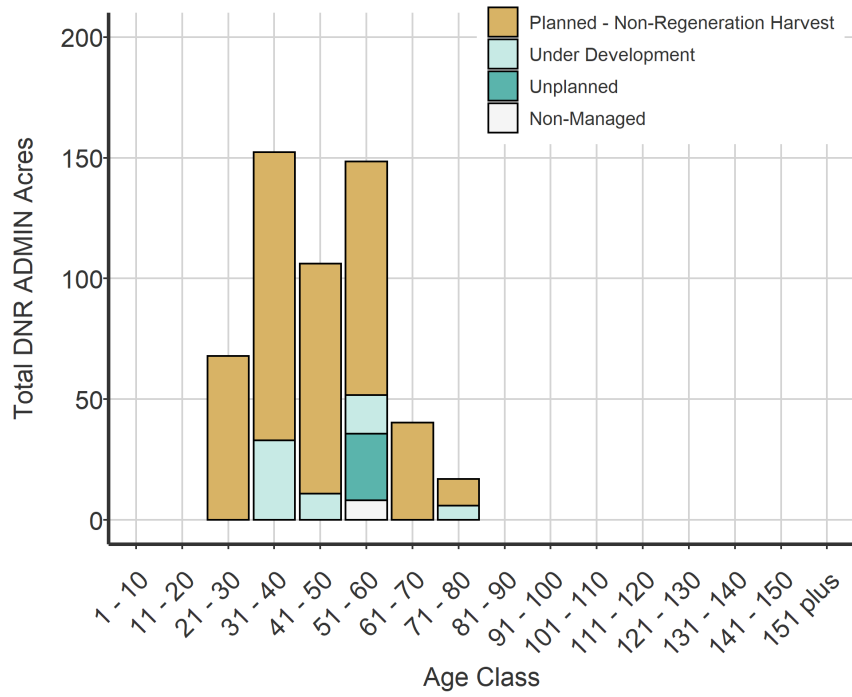
Oak



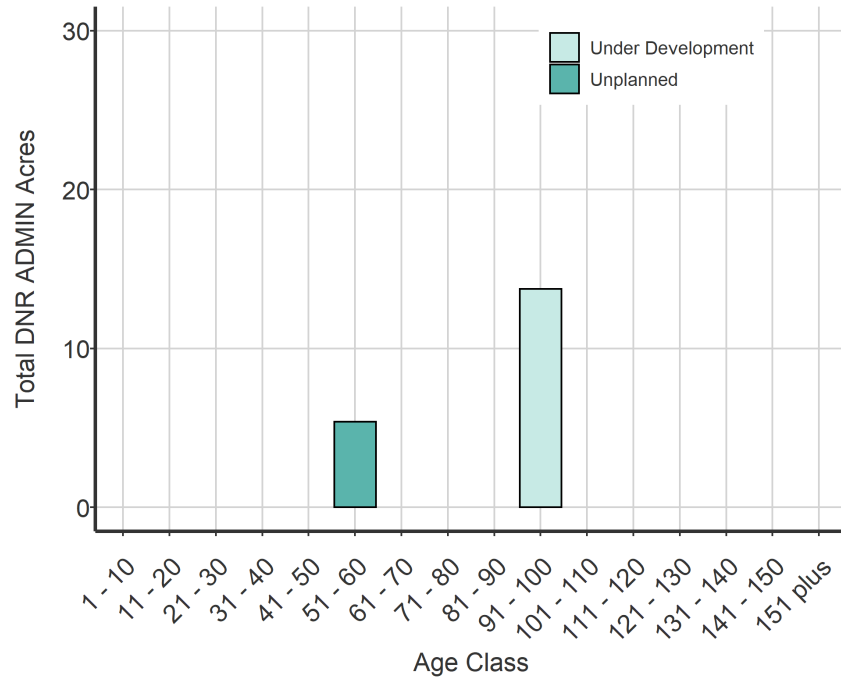
Central Hardwoods



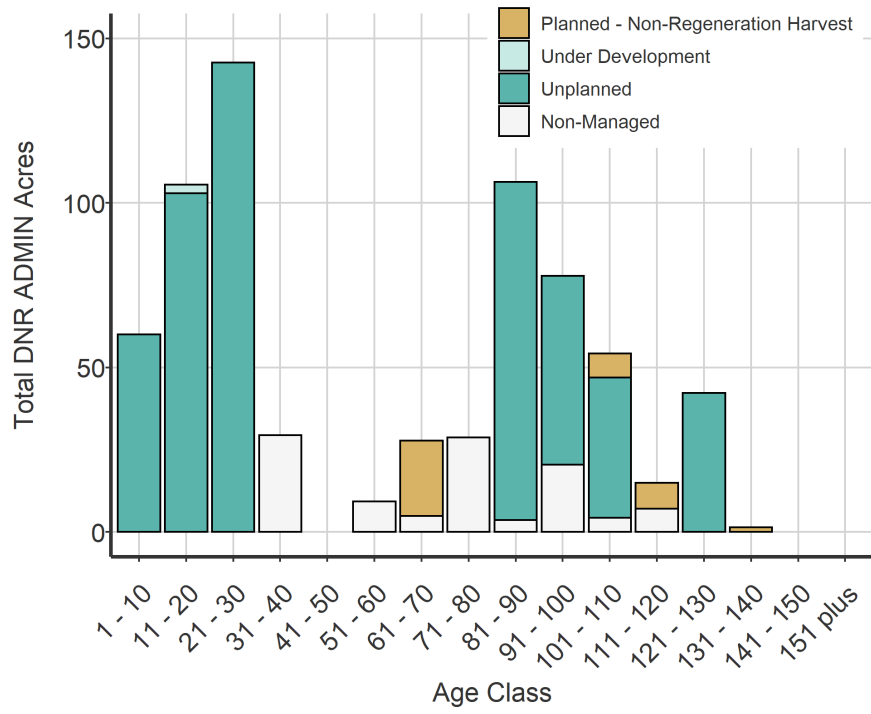
Red Pine Plantation



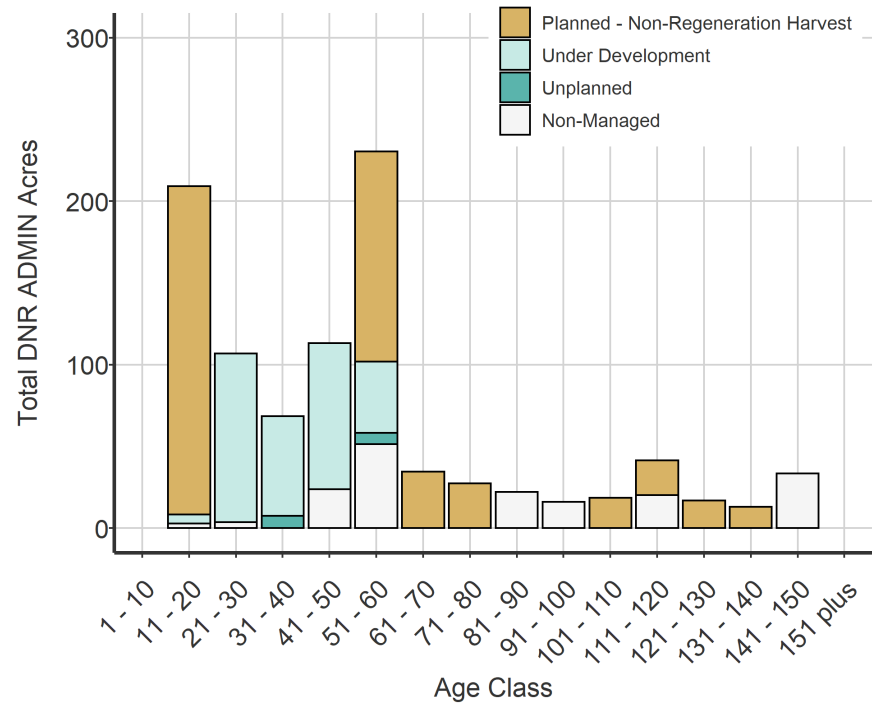
Red Pine Natural Origin



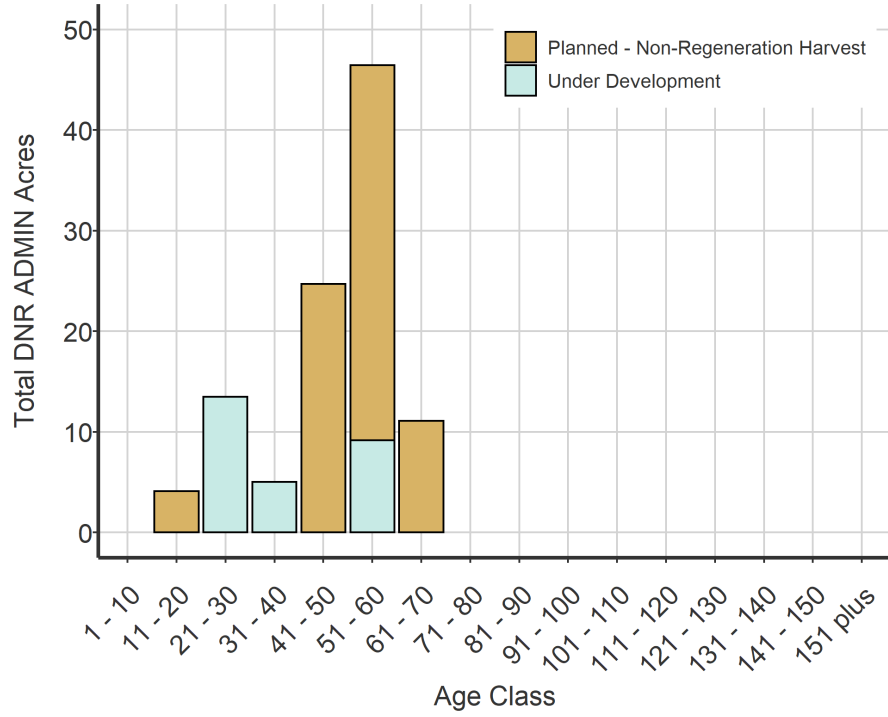
Walnut



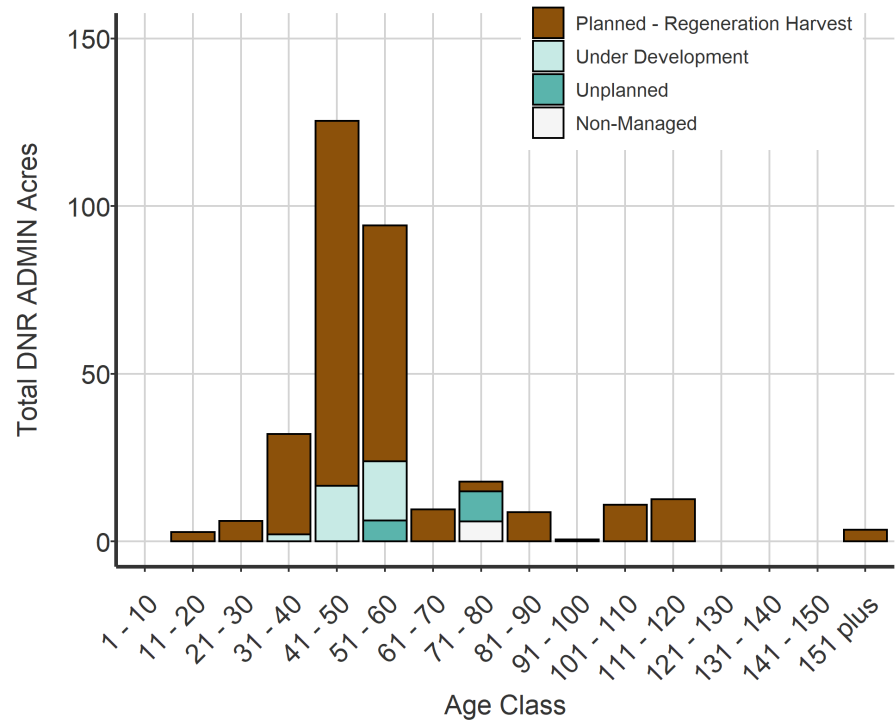
White Pine



White Spruce



Red Cedar



Appendix D: Management Opportunity Areas

Management opportunity areas (MOAs) are areas on Minnesota Department of Natural Resources (DNR)-administered lands that offer an opportunity to maintain or create spatial patterns to address natural resource values that are difficult to achieve at the stand level or through the normal stand development process. They contribute toward meeting goals in this plan, including providing wildlife habitat for a range of species (e.g., ruffed grouse management areas), providing older forest and older forest characteristics distributed throughout the Section (e.g., old forest management complexes), and considering species of special concern or conservation need in management (e.g., northern forest owl MOA).

The full set of MOA management guidance documents for PP is available on the [DNR's PP SFRMP webpage](#). Individual MOA guidance documents can be downloaded from the links in the tables for each MOA type below.

Old forest management complex (OFMC)

The conservation value of designated old growth can be further enhanced by managing additional stands around old-growth stands and their special management zones (SMZs) as OFMCs. Old forest management complexes complement and support values represented in the designated old-growth stands. They serve policy, management, and ecological purposes and include three elements: 1) designated old-growth or future old-growth stands, 2) SMZs around these stands, and 3) additional stands managed for older growth stage characteristics. Refer to the DNR Old Growth Forests policy for more information.

Map D.2: Location of old forest management complexes in the PP Section.

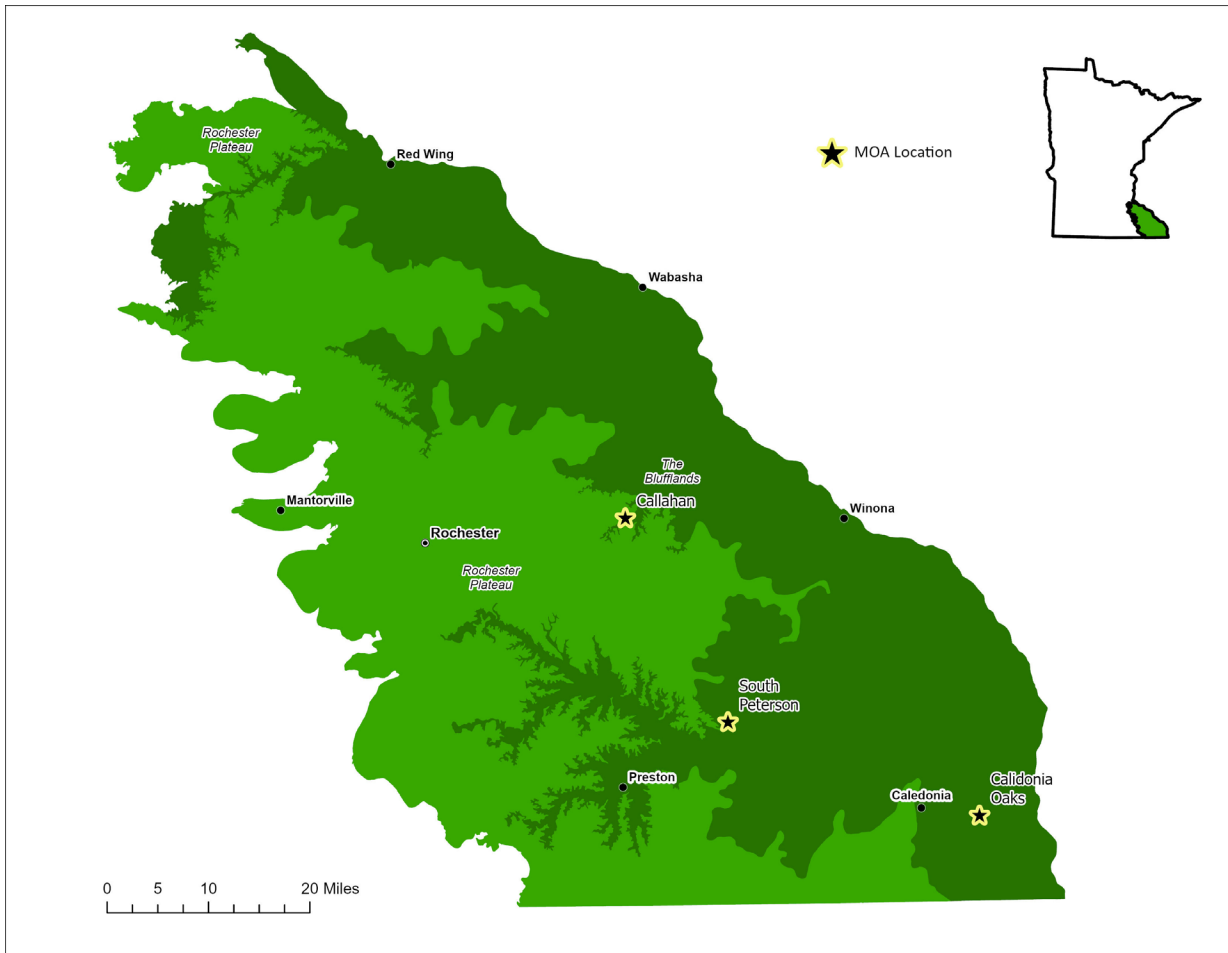


Table D.12: Old Forest management areas in the PP Section. Click on the name of a MOA to view or download its management guidance document.

NAME	FORESTRY AREA	TOTAL STAND ACRES
CALEDONIA OAKS	Lewiston	251
CALLAHAN	Lewiston	244
SOUTH PETERSON	Lewiston	117

Interior Forest MOA (INT)

Interior forests in the PP are managed to retain or create characteristics of mature central and southern hardwood forests to provide habitat for forest bird species and plant species that benefit from closed forest canopies and diverse forest structures while taking into consideration the NPC of the stand.

Map D.3: Location of patch MOAs in the PP Section.

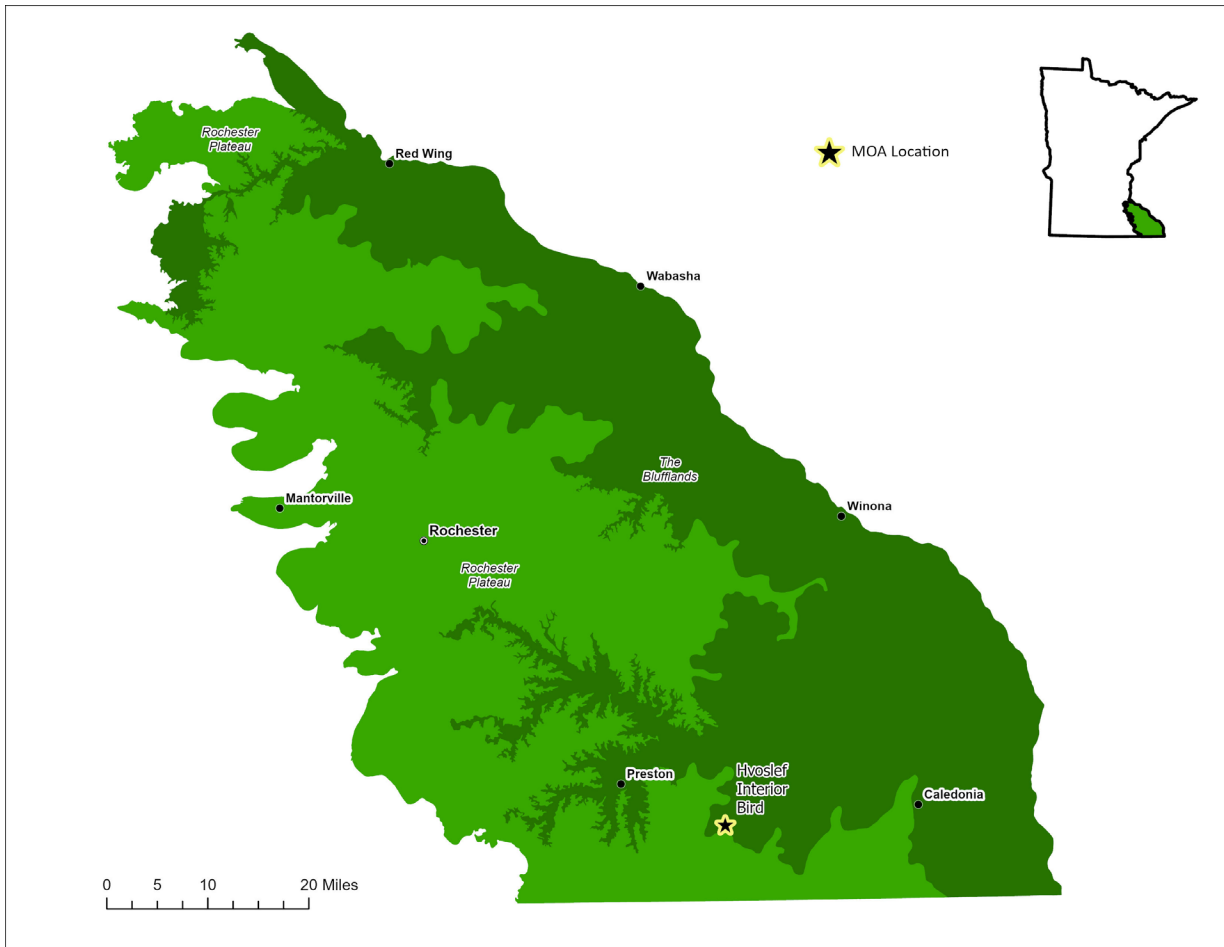


Table D.13: Interior Forest MOAs in the PP Section. Click on the name of a MOA to view or download its management guidance document.

NAME	FORESTRY AREA	TOTAL STAND ACRES
HVOSLEF INTERIOR BIRD	Lewiston	180

Open Landscape Management Area (OLMA)

Forests or patches of trees in these areas are managed to benefit species with open landscape habitat requirements. Forest stands on the edge of open landscapes may be harvested at or before standard DNR harvest ages to create regenerating trees that temporarily mimic brushland habitat.

Map D.4: Location of open landscape MOAs within the PP Section.

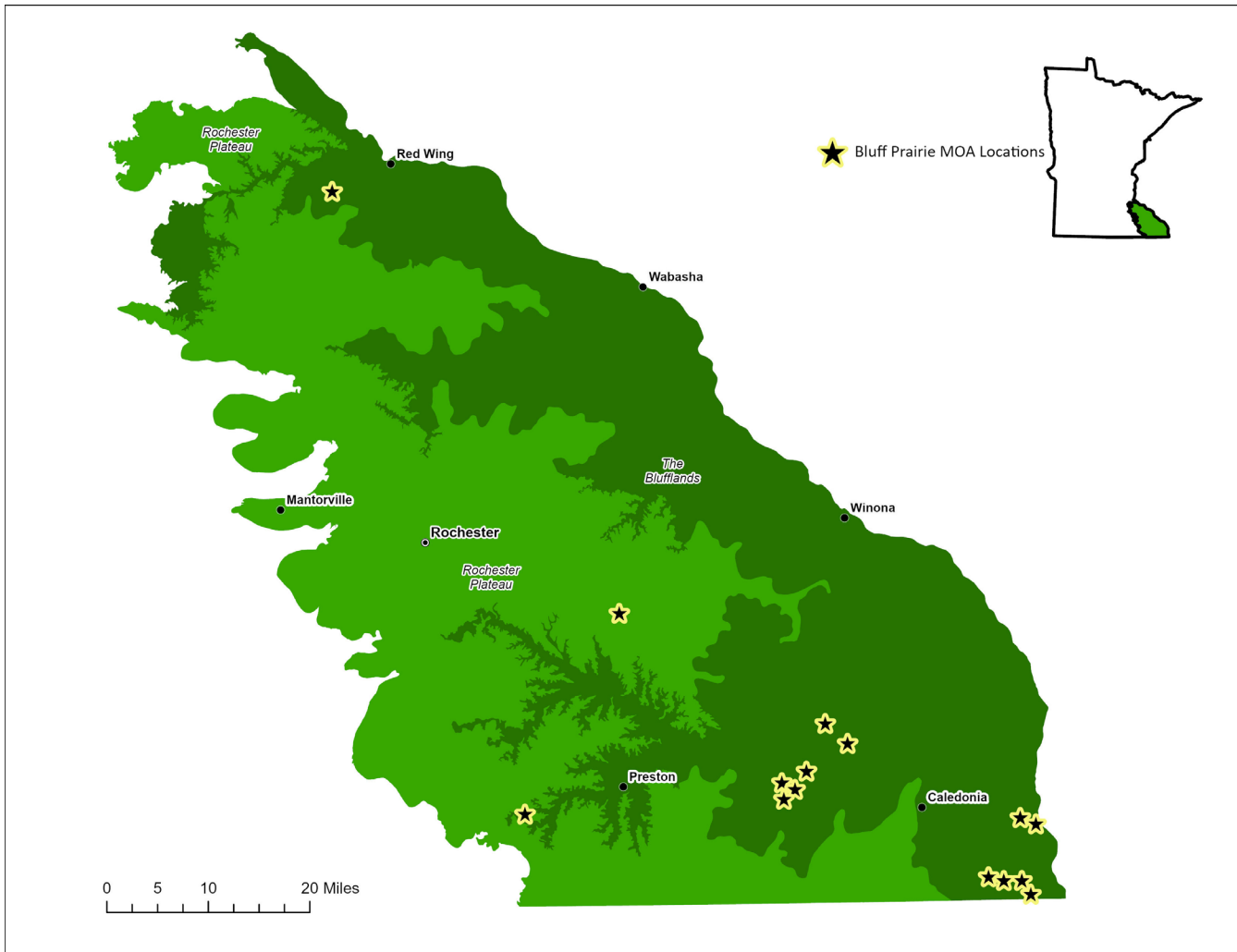


Table D.14: Open landscape MOAs in the PP Section. Click on the name of a MOA to view or download its management guidance document.

NAME	FORESTRY AREA	TOTAL STAND ACRES
BLUFF PRAIRIE (PORTIONS ALSO LOCATED WITHIN MINNESOTA AND NORTHEAST IOWA MORAINAL SECTION)	Lewiston	1,633

Turkey and Ruffed Grouse Management Area (RGMA)

Turkey and ruffed grouse management areas are managed to retain the habitat features and forest structure important to turkey and ruffed grouse by maintaining a mix of forest types, age classes, and growth stages appropriate to the native plant communities present.

Map D.5: Location of turkey and ruffed grouse management areas in the PP Section.

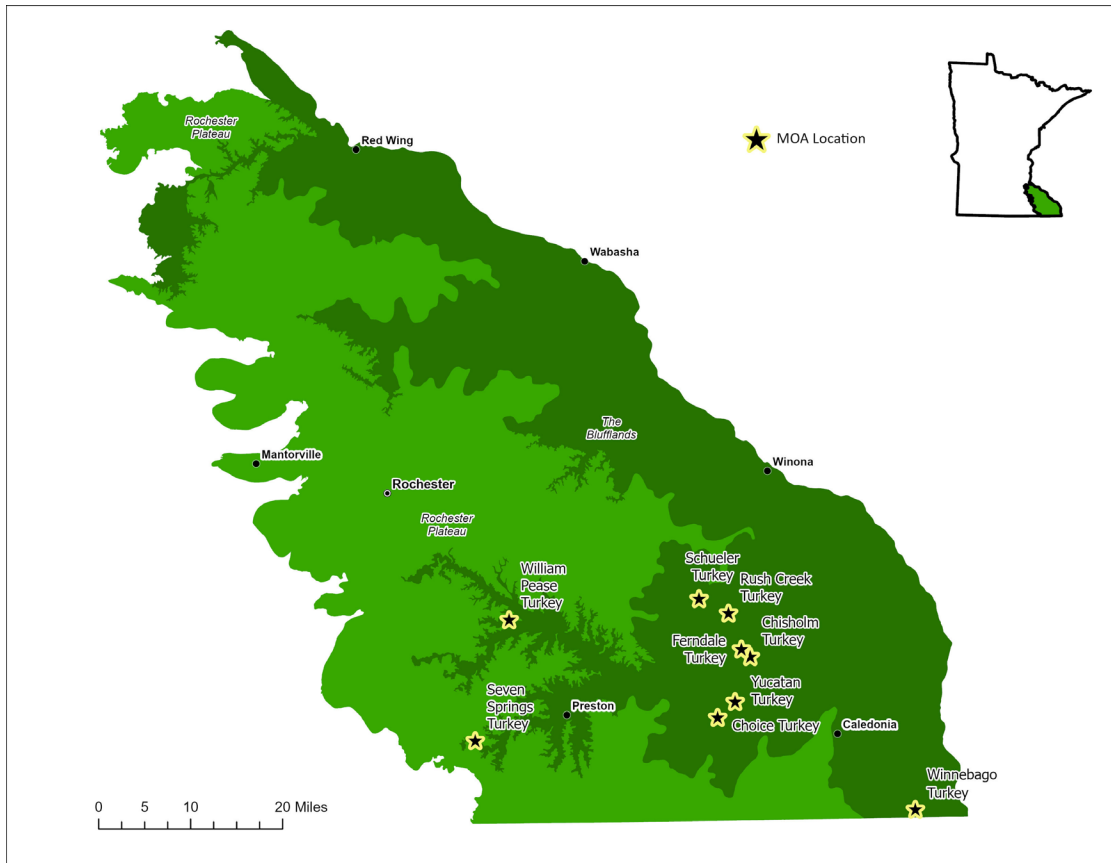


Table D.15: Turkey and Ruffed grouse management areas (RGMA) in the PP Section. Click on the name of a MOA to view or download its management guidance document.

NAME	FORESTRY AREA	TOTAL STAND ACRES
CHISOLM VALLEY TURKEY	Lewiston	76
CHOICE TURKEY	Lewiston	1,523
FERNDALE TURKEY	Lewiston	353
RUSH CREEK TURKEY	Lewiston	220
SCHUELER TURKEY	Lewiston	142
SEVEN SPRINGS TURKEY	Lewiston	172
WILLIAM PEASE TURKEY	Lewiston	65
WINNEBAGO TURKEY	Lewiston	1,114
YUCATAN TURKEY	Lewiston	705

High Biodiversity Sites (LAND)

The Paleozoic plateau contains many unique sites with high-quality forests, a high diversity of rare species, and significant biodiversity. Management within each site should be designed to sustain rare resource values and focus on the site as a whole to achieve goals that may be difficult at the individual forest stand scale.

Map D.6: Location of high biodiversity site MOA in the PP Section.

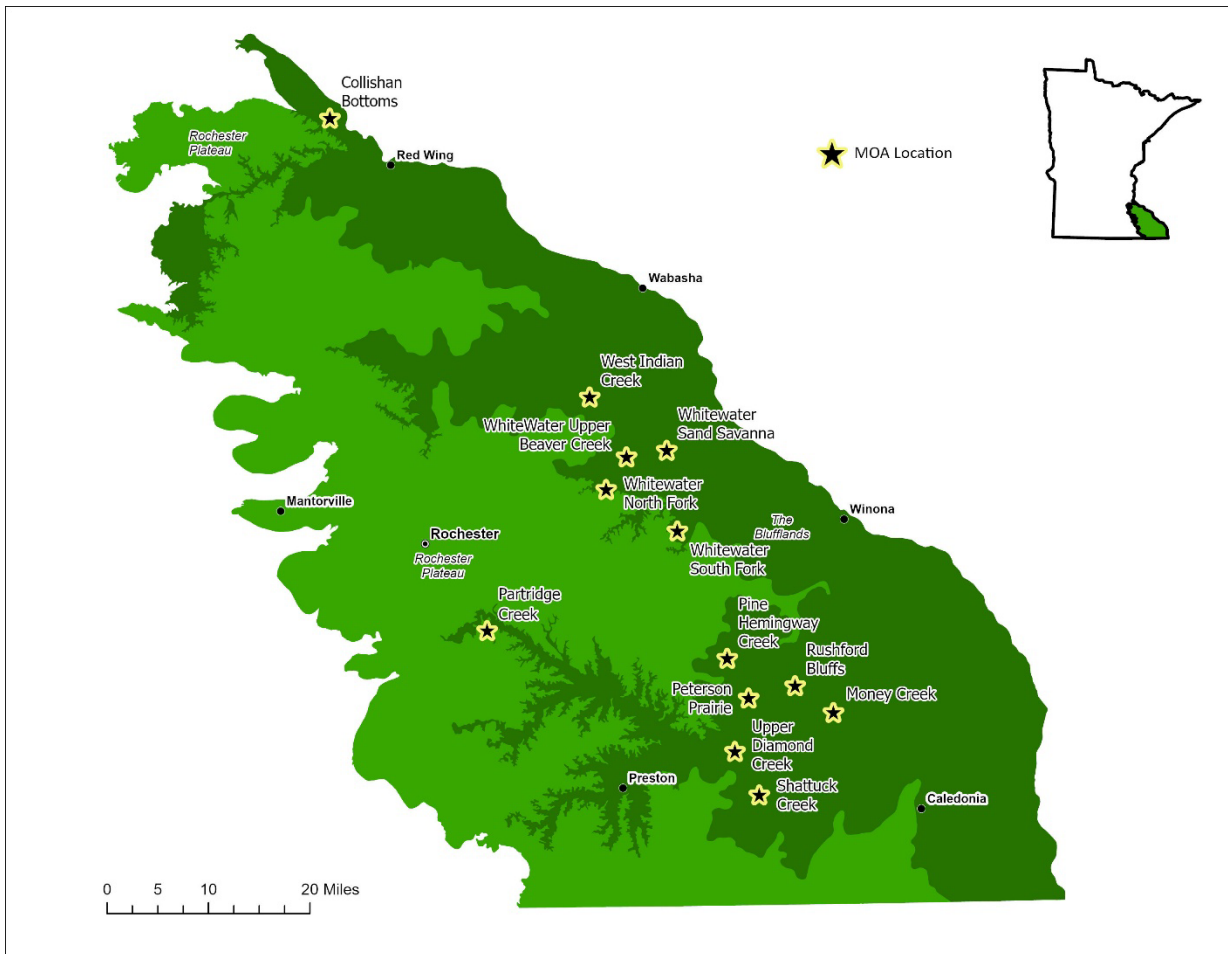


Table D.16: High biodiversity sites in the PP Section. Click on the name of a MOA to view or download its management guidance document.

NAME	FORESTRY AREA	TOTAL STAND ACRES
SOUTHEASTERN MINNESOTA HIGH BIODIVERSITY SITES	Lewiston	27,188

Appendix E: Modeled Management Regimes

During landscape-scale planning, the DNR uses management regimes to develop strategic direction and stand-exam lists that will move forests toward desired conditions. Management regimes for even-aged managed cover types (in which trees within stands are the same age) include rotation ages (the age at which a forest stand is available for final harvest) and reserve amounts. Across the landscape, balancing the acres in each age class up to the rotation age while maintaining some acres over rotation age for habitat is the goal for even-aged managed cover types so that the forest benefits associated with each age class are available in perpetuity. For cover types that are typically managed uneven-aged, the aim is to develop age and structural diversity within stands by developing more than one age class.

In the STH analysis, model parameters that defined management activities (regimes) were necessarily simplified and generic and were meant to represent the average management activity in the average stand. Differences in management were incorporated into the analysis for the Division of Forestry and Division of Fish and Wildlife administered lands. During modeling to develop the 10-year stand exam list for each ecological section, including PP, DNR leadership of the Divisions of Ecological and Water Resources, Fish and Wildlife, and Forestry, with input from project team members and field staff, made decisions on management regimes that further defined the STH model parameters. These included standard prescriptions by cover type, even-aged rotation ages and reserve amounts, and uneven-aged parameters by cover type, DNR administrator, and ecological section. In some cases, management regimes also differed within areas designated as needing management different from the standard regimes to provide particular forest resource benefits. Examples include areas with native plant communities that have global conservation ranks, old growth forest special management zones, and management opportunity areas (MOAs).

The modeled management regimes used to develop the 10-year stand exam list for the PP Section are reported below. It is important to remember that these simplified assumptions were necessary for the model, which cannot work with the nuance of site-level variation; however, in reality, sites may differ in their objectives and characteristics. While achieving the planned level of disturbance depends on generally following these model assumptions, they do not represent rigid rules for site-level management. Some flexibility in the application of those parameters during management activities is necessary, which is purposefully undefined to maintain the ability of professional field staff to make their best judgments based on site-specific conditions.

Even-Aged Management Rotation Age and Reserves Tables

Table Abbreviations:

- RA = rotation age
- SI = site index
- UE = managed uneven-aged (reserve amounts do not apply)
- RES % = percent of stand acres reserved from harvest

Special Management Area/Management Area Type	Abbreviation
Old growth special management zones	OG SMZ
Old forest management complex	OFMC
High conservation value forest modeled assuming low/medium harvest	HCVF Low/HCVF Med
Open landscape management area	OLMA
Ruffed grouse management area	RGMA
Forest Patch	PATCH

Dashes indicate that standard DNR or Division of Fish and Wildlife management regimes apply for even-aged managed cover types or that the cover type is managed uneven-aged.

Note: School trust lands follow standard rotation ages regardless of the land administrator. The Fish and Wildlife regimes are applied to wildlife administered lands identified as managed acres. See Appendix A for a description of lands included as managed acres under this plan.

Cover Type	Standard DNR		Fish and Wildlife		OG SMZ		OFMC		Patch		HCVF Low		OLMA	
	RA	RES%	RA	RES%	RA	RES%	RA	RES%	RA	RES%	RA	RES%	RA	RES%
Ash/Lowland Hardwoods	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-
Aspen/Balm-of-Gilead - SI 65+	40	5	45	10	40	10	50	10	-	-	45	10	-	-
Aspen/ Balm-of-Gilead - SI < 65	50	5	45	10	50	10	55	10	-	-	50	-	-	-
Birch	60	5	45	15	60	10	50	10	-	-	45	10	-	-
Jack Pine	60	5	45	15	60	5	50	5	-	-	45	5	-	-
Black Spruce Upland	60	5	45	15	60	5	50	5	-	-	45	5	-	-
Balsam Fir	45	5	45	15	45	10	50	5	-	-	45	5	-	-
White Spruce Planted	50	5	45	5	-	-	50	5	-	-	45	5	-	-
White Spruce Natural	60	5	UE	UE	-	-	-	-	-	-	-	-	-	-
Black Spruce Lowland - SI 40+	80	5	80	10	80	5	80	10	-	-	80	10	-	-
Black Spruce Lowland - SI 30-39	100	5	100	10	100	5	100	10	-	-	100	10	-	-
Black Spruce Lowland - SI 23-29	120	5	120	10	120	5	120	10	-	-	120	10	-	-
Tamarack - SI 40+	85	5	85	5	85	5	85	5	-	-	80	5	-	-
Tamarack - SI < 40	85	5	85	5	85	5	85	5	-	-	80	5	-	-
Red Pine Planted - SI 65+	60	5	55	5	60	5	60	5	-	-	60	5	-	-
Red Pine Planted - SI 55-64	65	5	60	5	65	5	65	5	-	-	65	5	-	-
Red Pine Planted - SI < 55	70	5	65	5	70	5	70	5	-	-	70	5	-	-
Red Pine Natural	115	5	110	66	115	10	115	10	-	-	110	10	-	-
White Pine Planted - SI 65+	60	5	UE	UE	-	-	60	15	-	-	60	10	-	-
White Pine Planted - SI 55 – 60	65	5	UE	UE	-	-	60	15	-	-	60	10	-	-
White Pine Planted - SI < 50	70	5	UE	UE	-	-	60	15	-	-	60	10	-	-
White Pine Natural	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-
Northern Hardwoods	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-
Central Hardwoods	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-
Oak - SI 75+	80	5	90	15	-	-	-	20	-	-	-	20	-	-
Oak - SI < 75	80	5	90	15	-	-	-	20	-	-	-	20	-	-
Cedar	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-

Cover Type	Standard DNR		Fish and Wildlife		RGMA		HCVF Med		UPLD		INT		DMA		MMA		OWMA	
	RA	RES%	RA	RES%	RA	RES%	RA	RES%	RA	RES%	RA	RES%	RA	RES%	RA	RES%	RA	RES%
Ash/Lowland Hardwoods	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aspen/Balm-of-Gilead - SI 65+	40	5	45	10	-	-	40	5	-	-	-	-	-	-	-	-	-	-
Aspen/ Balm-of-Gilead - SI < 65	50	5	45	10	-	-	50	5	-	-	-	-	-	-	-	-	-	-
Birch	60	5	45	15	-	-	-	5	-	-	-	-	-	-	-	-	-	-
Jack Pine	60	5	45	15	-	-	-	5	-	-	-	-	-	-	-	-	-	-
Black Spruce Upland	60	5	45	15	-	-	-	5	-	-	-	-	-	-	-	-	-	-
Balsam Fir	45	5	45	15	-	-	-	5	-	-	-	-	-	-	-	-	-	-
White Spruce Planted	50	5	45	5	-	-	50	5	-	-	-	-	-	-	-	-	-	-
White Spruce Natural	60	5	UE	UE	-	-	50	-	-	-	-	-	-	-	-	-	-	-
Black Spruce Lowland - SI 40+	80	5	80	10	-	-	80	5	-	-	-	-	-	-	-	-	-	-
Black Spruce Lowland - SI 30-39	100	5	100	10	-	-	100	5	-	-	-	-	-	-	-	-	-	-
Black Spruce Lowland - SI 23-29	120	5	120	10	-	-	120	5	-	-	-	-	-	-	-	-	-	-
Tamarack - SI 40+	85	5	85	5	-	-	85	5	-	-	-	-	-	-	-	-	-	-
Tamarack - SI < 40	85	5	85	5	-	-	85	5	-	-	-	-	-	-	-	-	-	-
Red Pine Planted - SI 65+	60	5	55	5	-	-	60	5	-	-	-	-	-	-	-	-	-	-
Red Pine Planted - SI 55-64	65	5	60	5	-	-	65	5	-	-	-	-	-	-	-	-	-	-
Red Pine Planted - SI < 55	70	5	65	5	-	-	70	5	-	-	-	-	-	-	-	-	-	-
Red Pine Natural	115	5	110	66	-	-	110	5	-	-	-	-	-	-	-	-	-	-
White Pine Planted - SI 65+	60	5	UE	UE	-	-	60	5	-	-	-	-	-	-	-	-	-	-
White Pine Planted - SI 55 – 60	65	5	UE	UE	-	-	65	5	-	-	-	-	-	-	-	-	-	-
White Pine Planted - SI < 50	70	5	UE	UE	-	-	70	5	-	-	-	-	-	-	-	-	-	-
White Pine Natural	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern Hardwoods	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Central Hardwoods	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oak - SI 75+	80	5	90	15	-	-	80	10	-	-	-	-	-	-	-	-	-	-
Oak - SI < 75	80	5	90	15	-	-	80	10	-	-	-	-	-	-	-	-	-	-
Cedar	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Uneven-Aged Management Regimes

The model used to develop the 10-year stand exam list selected stands for uneven-aged management based on criteria including cover type, site index, stand age, stand basal area, and the time since the last treatment. The following tables show uneven-aged management regimes included in the model used to develop the 10-year stand exam list. The “lock” numbers in each table represent the number of years that must pass after treatment before a stand is eligible for subsequent treatment. The treatment BA columns refer to the basal area at which a stand is eligible for treatment in the model. Parameters that do not apply to a given cover type or section are denoted “NA”.

PP DNR Standard Uneven-Aged Regimes

Note: Trust lands were modeled with standard regimes regardless of the type of land administrator or management opportunity area.

Cover Type	Site Index	Treatment Age	Treatment BA	Lock (years)
Ash/Lowland Hardwoods	All	>= 70	NA	20
Northern Hardwoods	> 40	>= 40	NA	20
Oak	<= 55	>= 80	NA	20
Oak	>= 60	>= 50	NA	20
White Pine (natural)	All	>= 45	NA	20
White Spruce (natural)	All	>= 80	NA	20

PP Old Growth Special Management Zone (OG SMZ) Uneven-Aged Regimes

Cover Type	Site Index	Treatment Age	Treatment BA	Lock (years)
Ash/Lowland Hardwoods	All	>= 60	NA	20
Central Hardwoods	All	>=75	NA	20
NH	All	>= 75	NA	20
Oak	All	>= 75	NA	20
White Pine	All	>= 60	NA	25
White Pine Planted	All	>= 30	NA	15
White Spruce	All	>= 55	NA	20
White Spruce Planted	All	>= 55	NA	20

PP Old Forest Management Complex (OFMC), HCVF, and G1/G2* Low Harvest Uneven-Aged Regimes

Cover Type	Site Index	Treatment Age	Treatment BA	Lock (years)
Ash/Lowland Hardwoods	All	>= 40	NA	20
Central Hardwoods	All	>= 75	NA	20
Northern Hardwoods	All	>= 75	NA	20
Oak	All	>= 75	NA	20
White Pine	All	>= 60	NA	20
White Spruce	All	>= 55	NA	20

*G1/G2 are NatureServe global conservation status ranks, indicating a native plant community is critically imperiled or imperiled.

PP HCVF and G1/G2 Medium Harvest Uneven-Aged Regimes

Cover Type	Site Index	Treatment Age	Treatment BA	Lock (years)
Ash/Lowland Hardwoods	>= 45	NA	>= 90	20
Central Hardwoods	All	>= 30	>=110	20
Northern Hardwoods	>= 40	NA	>= 110	20
Oak	>= 60	>= 50	NA	20
Oak	<= 55	>= 80	NA	20
White Pine	All	>= 45	NA	20
White Pine Planted	All	>= 30	NA	20
White Spruce	All	>= 35	NA	20
White Spruce Planted	All	>= 80	NA	20

PP Older Forest Patch MOA Uneven-Aged Regimes

Cover Type	Site Index	Treatment Age	Treatment BA	Lock (years)
Northern Hardwoods	All	>= 30	>= 110	20
Oak	<= 55	>= 80	NA	20
White Pine Planted	All	>= 30	NA	20
Central Hardwoods	<= 55	>= 30	>= 110	20

Thinning Regimes

PP Standard DNR Thinning Regimes

Cover Type	Site Index	Thin Number	Min. Thin Age	Max. Thin Age
Central Hardwoods	>= 60	Un-thinned	30	70
Central Hardwoods	>= 60	Thin1	45	70
Central Hardwoods	>= 60	Thin2	60	70
Northern Hardwoods	<=35	Un-thinned	30	70
Northern Hardwoods	<=35	Thin1	45	70
Northern Hardwoods	<=35	Thin2	60	70
Red Pine	All	Un-thinned	25	90
Red Pine	All	Thin1	35	90
Red Pine	All	Thin2	45	90
Red Pine	All	Thin3	55	90
Red Pine	All	Thin4	65	90
Red Pine	All	Thin5	75	90
Red Pine Planted	All	Un-thinned	25	90
Red Pine Planted	All	Thin1	35	90
Red Pine Planted	All	Thin2	45	90
Red Pine Planted	All	Thin3	55	90
Red Pine Planted	All	Thin4	65	90
Red Pine Planted	All	Thin5	75	90
White Pine Planted	All	Un-thinned	25	90
White Pine Planted	All	Thin1	35	90
White Pine Planted	All	Thin2	45	90
White Pine Planted	All	Thin3	55	90
White Pine Planted	All	Thin4	65	90
White Pine Planted	All	Thin5	75	90
White Spruce Planted	All	Un-thinned	30	60

PP Division of Fish and Wildlife Thinning Regimes

Cover Type	Site Index	Thin Number	Min. Thin Age	Max. Thin Age
Red Pine Planted	All	Un-thinned	30	40
Red Pine Planted	All	Thin1	45	55
White Pine Planted	All	Un-thinned	30	45
White Pine Planted	All	Thin1	50	65
White Spruce Planted	All	Un-thinned	35	50
White Spruce Planted	All	Thin1	55	70

PP HCVF and G1/G2 Medium Harvest Thinning Regimes

Cover Type	Site Index	Thin Number	Min. Thin Age	Max. Thin Age
Red Pine	All	Un-thinned	40	150
Red Pine	All	Thin1	55	150
Red Pine	All	Thin2	70	150
Red Pine	All	Thin3	85	150
Red Pine	All	Thin4	100	150
Red Pine	All	Thin5	115	150

PP Older Forest Patch MOA Thinning Regimes

Cover Type	Site Index	Thin Number	Min. Thin Age	Max. Thin Age
Central Hardwoods	>=60	Un-thinned	30	40
Central Hardwoods	>=60	Thin1	45	55
Central Hardwoods	>=60	Thin2	60	70
Oak	>=60	Un-thinned	30	40
Oak	>=60	Thin1	45	55
Oak	>=60	Thin2	60	70
Red Pine	All	Un-thinned	40	150
Red Pine	All	Thin1	55	150
Red Pine	All	Thin2	70	150
Red Pine	All	Thin3	85	150
Red Pine	All	Thin4	100	150
Red Pine	All	Thin5	115	150
White Pine	All	Un-thinned	40	150
White Pine	All	Thin1	55	150
White Pine	All	Thin2	70	150
White Pine	All	Thin3	85	150
White Pine	All	Thin4	100	150
White Pine	All	Thin5	115	150
White Spruce	All	Un-thinned	25	80
White Spruce	All	Thin1	40	80
White Spruce	All	Thin2	55	80
White Spruce Planted	All	Un-thinned	30	60

Appendix F: Section Forest Resource Management Plan

Monitoring

This appendix describes the DNR's approach to monitoring Section Forest Resource Management Plans (SFRMPs). The SFRMP monitoring approach is updated as needed to reflect current Department policies and processes.

Monitoring Purpose

SFRMP monitoring looks at the following broad questions with respect to the multiple values embedded in DNR forest resources planning and management:

- **Implementation monitoring:** Are management actions and documented management intent consistent with the plan? (Are we doing what we said we would?)
- **Effectiveness monitoring:** Are management actions moving DNR forestlands toward the goals outlined in the plan? (Does our plan have the intended effect?)

Monitoring Approach

The DNR executes implementation and effectiveness monitoring depending on data availability and where we are in the plan period. For example, monitoring plan effectiveness (i.e., on-the-ground effects) is difficult earlier in the plan period. Monitoring metrics or indicators are developed at the beginning of the monitoring process, accounting for these factors. In general, though, the DNR uses several long-standing data sources for monitoring, including:

- forest inventory data, historical and contemporary
- planning datasets, which include planned stand exams and a snapshot of resource conditions at the time of planning
- annual stand exam list and annual plan addition datasets
- stand exam list accomplishments, including whether stands were appraised, altered, or deferred; prescriptions and prescription comments; documented management objectives; etc.
- timber sales data, including volume offered, sold, and scaled
- DNR Geodatabase Data Resource Site (GDRS) data
- Forest Inventory and Analysis (FIA) data

Other data sources may become available over time or may be available for specific geographies. The SFRMP monitoring process is adaptive and evaluates available data and monitoring approaches during each monitoring project.

Communicating Results

Written reports summarizing monitoring results are prepared approximately every five years (i.e., at the plan midpoint and plan end). Final reports are accessible via the DNR website.

Monitoring results are also communicated to internal audiences through a monitoring meeting at the end of each SFRMP monitoring project.

Audience

SFRMP monitoring reports have both internal and external audiences. Internal audiences include DNR field staff, Forest Resource Issue Teams (FRITs), and other DNR decision-makers. External audiences include tribes, forest certification auditors, adjacent landowners, the Minnesota forest resources council, loggers, recreational forest users, the forest products industry, members of environmental organizations, etc.

Glossary

Adaptive Capacity: The capacity of systems to adjust to change, to take advantage of opportunities, or to respond to consequences with minimal disruptions.

Access route: A temporary access or permanent road connecting the most remote parts of the forest to existing public roads. Forest roads provide access to forest lands for timber management, fish and wildlife habitat improvement, fire control, and a variety of recreational activities. Also, see Forest Road.

Acre: An area of land containing 43,560 square feet, roughly the size of a football field, or a square that is 208 feet on a side. A “forty” of land contains 40 acres, and a “section” of land contains 640 acres.

Age class: An interval, commonly ten years, into which the age range of trees or forest stands is divided for classification or use.

Age class distribution: The proportionate amount of various age classes of a forest or forest cover type within a defined geographic area (e.g., ecological classification system subsection). A cover type age class distribution is **balanced** when it has an even number of acres in each age class (usually 5- to 10-year increments) up to the normal rotation age for the cover type.

All-aged: Describes an uneven-aged stand that represents all ages or age classes, from seedlings to mature trees.

Annual plan addition: Stands added to the stand exam list and released for public comment as needed throughout the year. Examples of reasons for APAs include insect, disease, animal, or environmental damage (e.g., storm or fire) that needs to be treated quickly; operational considerations such as harvesting a stand adjacent to a stand on the exam list, avoiding repeated entries to stands with limited or difficult access, and cooperating with adjacent landowners; and incorrect inventory, such as incorrect stand boundaries or cover type classification, for stands that should be harvested.

Annual stand examination list: List of stands to be considered for treatment in a particular year that was selected from the 10-year stand examination list. Treatment may include harvest, thinning, regeneration, prescribed burning, re-inventory, etc.

Artificial regeneration: Renewal of a forest stand by planting seedlings or sowing seeds.

Assessment: A compilation of information about the trends and conditions related to natural and socio-economic resources and factors.

Basal area (BA): The cross-sectional area of a tree taken at the base of the tree (i.e., measured at 4.5 feet above the ground). Basal area is often used to measure and describe the density of trees within a geographic area using an estimate of the sum of the basal area of all trees cross-sectional expressed per unit of land area (e.g., basal area per acre).

Biodiversity (biological diversity): The variety and abundance of species, their genetic composition, and the communities and landscapes in which they occur, including the ecological structures, functions, and processes occurring at all of these levels.

Biodiversity Significance: The relative value, in terms of size, condition, and quality, of native biological diversity for a given area of land or water. (Adapted from Guidelines for MBS Statewide Biodiversity Significance Rank): The Minnesota Biological Survey (MBS) uses a statewide ranking system to evaluate and communicate the biodiversity significance of surveyed areas (MBS sites) to natural resource professionals, state and local government officials, and the public. MBS sites are ranked according to several factors, including the quality and types of Element Occurrences, the size and quality of native plant communities, and the size and condition of the landscape within the Site. Areas are ranked as Outstanding, High, Moderate, or Below the Minimum Threshold for statewide biodiversity significance.

Outstanding Sites: Those containing the best occurrences of the rarest species, the most outstanding examples of the rarest native plant communities, and/or the largest, most intact functional landscapes present in the state.

High Sites: Those containing very good quality occurrences of the rarest species, high-quality examples of the rarest native plant communities, and/or important functional landscapes.

Moderate Sites: Those containing significant occurrences of rare species and/or moderately disturbed native plant communities and landscapes that have a strong potential for recovery.

Sites Below the Minimum Threshold: Those lacking significant populations of rare species and/or natural features that meet MBS minimum standards for size and condition. These include areas of conservation value at the local level, such as habitat for native plants and animals, corridors for animal movements, buffers surrounding higher quality natural areas, and open space areas.

Browse: (n) Portions of woody plants, including twigs, shoots, and leaves used as food by such animals as deer and rabbits. (v) To feed on leaves, young shoots, and other vegetation.

Clearcut: The removal of all or most trees during harvest to permit the re-establishment of an even-aged forest. A harvesting method used to regenerate shade-intolerant species, such as aspen and jack pine.

Coarse woody debris: Stumps and fallen tree trunks or limbs of more than six inches in diameter at the large end.

Competition: The struggle between trees or other vegetation to obtain sunlight, nutrients, water, and growing space.

Connectivity: An element of spatial patterning where patches of vegetation such as forest types, native plant communities, or wildlife habitats are connected to allow the flow of organisms and processes between them.

Conversion: Changing a stand or site from one cover type to another through management actions or without management actions.

Cord: A pile of wood four feet high, four feet wide, and eight feet long, measuring 128 cubic feet, including bark and air space. The actual volume of solid wood may vary from 60 to 100 cubic feet, depending on the size of individual pieces and how tight the wood is stacked. In the Lake States, pulpwood cords are usually four feet x four feet x 100 feet and contain 133 cubic feet. The pulpwood volume of standing trees is estimated in cords. For example, a 10-inch DBH tree, which is 70 feet tall, is about 0.20 cords; or five trees of this size would equal one cord of wood.

Corridor: A defined tract of land connecting two or more areas of similar habitat types through which wildlife species can travel.

Cover Type: Expressed as the tree species having the greatest presence, greater than 40% (i.e., in terms of volume for older stands or number of trees for younger stands), in a forest stand. A stand where the major tree species is aspen would be considered an aspen cover type.

Cultural resource: An archaeological site, cemetery, historic structure, historic area, or traditional use area that is of cultural or scientific value.

Desired Future Condition (DFC): Broad vision of landscape vegetation conditions in the long-term future.

Disturbance: Any event, either natural or human induced, that alters the structure, composition, or functions of an ecosystem. Examples include forest fires, insect infestation, windstorms, and timber harvesting.

Disturbance regime: Natural or human-caused pattern of periodic disturbances, such as fire, wind, insect infestations, or timber harvest.

Dominant trees: Trees that are in the upper layer of the forest canopy, larger than the average trees in the stand.

Early successional forest: The forest community that develops immediately following the removal or destruction of vegetation in an area. Plant succession is the progression of plants from bare ground (e.g., after a forest fire or timber harvest) to mature forest consisting primarily of long-lived species such as sugar maple and white pine. Succession consists of a gradual change of plant and animal communities over time. Early successional forests commonly depend on and develop first following disturbance events (e.g., fire, windstorms, or timber harvest). Examples of early successional forest tree species are aspen, paper birch, and jack pine. Each stage of succession provides different benefits for a variety of species.

Ecological Classification System (ECS): A method to identify, describe, and map units of land with different capabilities to support natural resources. This is done by integrating climatic, geologic, hydrologic, topographic, soil, and vegetation data.

Ecological evaluation: A concise report containing descriptions of the significant natural features of a site, such as the flora, fauna, rare features, geology, soils, and any other factors that provide an interpretation of the site's history, present state and biodiversity significance. Management and protection recommendations are often included in these reports. Evaluations are produced by the Minnesota Biological Survey (MBS) at the completion of MBS work in a given county or ecological classification system (ECS) subsection and are generally reserved for those sites with the highest biodiversity significance in a geographic region, regardless of ownership.

Ecological integrity: In general, ecological integrity refers to the degree to which the elements of biodiversity and the processes that link them together and sustain the entire system are complete and capable of performing desired functions. Exact definitions of integrity are relative and may differ depending on the type of ecosystem being described.

Ecological Section and Subsection: Section and subsection are levels within the DNR's Ecological Classification System (ECS). From largest to smallest in terms of geographic area, the ECS is comprised of the following levels: Province --> Section --> Subsection --> Land Type Association --> Land Type --> Land Type Phase.

Element Occurrence (EO): An area of land and/or water where a rare feature (plant, animal, natural community, geologic feature, animal aggregation) is or was present. An Element Occurrence Rank provides a succinct assessment of the estimated viability or probability of persistence (based on condition, size, and landscape context) of occurrences of a given Element. An Element Occurrence Record is the locational and supporting data associated with a particular Element Occurrence. Element Occurrence Records for the State of Minnesota are managed as part of the rare features database by the Natural Heritage and Nongame Research Program. (Adapted from Biotics EO Standards: Chapter 2)

Endangered species: A plant or animal species that is threatened with extinction throughout all or a significant portion of its range in Minnesota.

Enhance: To modify a vegetative community component for the purpose of favoring a certain function or value. For example, changing the structure of a degraded plant community to bring it closer to a native plant community.

Even-aged: A forest stand composed of trees of primarily the same age or age class. A stand is considered even-aged if the difference in age between the youngest and oldest trees does not exceed 20 percent of the rotation age (e.g., for a stand with a rotation age of 50 years, the difference in age between the youngest and oldest trees should be ten years).

Extirpated: The species is no longer found in this portion of its historical range.

Forest Inventory and Analysis (FIA): A statewide forest survey of timber lands jointly conducted by the Minnesota Department of Natural Resources and the U.S. Department of Agriculture—Forest Service that periodically, through a system of permanent plots, assesses the status of and monitors recent trends in, forest area, volume, growth, and removals.

Forest Inventory Module (FIM): The FIM provides a database and application through which field foresters can maintain an integrated and centralized inventory of the forests on publicly owned lands managed by the Division of Forestry and other DNR Divisions. In the field, foresters collect raw plot and tree data. Those data are summarized in stand-level data that are linked to a spatial representation of stand boundaries.

Forest land: Includes lands in the DNR forest stand inventory (Forest Inventory Module, or FIM), including cover types from aspen to stagnant conifers, muskeg, upland and lowland grass and brush, and other wetlands.

Forest management: The practical application of biological, physical, quantitative, managerial, economic, social, and policy principles to the regeneration, management, utilization, and conservation of forests to

meet specified goals and objectives while maintaining the productivity of the forest. Note: Forest management includes management for aesthetics, fish, recreation, urban values, water, wilderness, wildlife, wood products, and other forest resource values.

From: The Dictionary of Forestry. 1998. The Society of American Foresters. J.A. Helms, ed.

Forest road: A temporary or permanent road connecting the remote parts of the forest to existing public roads. Forest roads provide access to public land for timber management, fish and wildlife habitat improvement, fire control, and a variety of recreational activities. The Division of Forestry has three classifications for roads and access routes:

System roads: These roads are the major roads in the forest that provide forest management and recreational access and may be connected to the state, county, or township public road systems. These roads are used at least on a weekly basis and are often used daily. The roads should be graveled and maintained to allow travel by highway vehicles, and road bonding money can be used to fund the construction and reconstruction of these types of roads. The level and frequency of maintenance will be at the discretion of the Area Forester and as budgets allow.

Minimum maintenance roads: These roads are used for forest management access on an intermittent, as-needed basis. Recreational users may use them, but the roads are not promoted or maintained for recreation. The roads will be open to all motorized vehicles but not maintained to the level where licensed highway vehicles with low clearance can travel routinely on them. The roads will be graded and graveled as needed for forest management purposes. Major damage will be repaired as reported and as budgets allow.

Temporary access: If the access route does not fit into one of the first two options, the access route has to be abandoned and the site reclaimed so that evidence of a travel route is minimized. The level of effort to effectively abandon temporary accesses will vary from site to site depending on the location of the access (e.g., swamp/winter vs. upland route), remoteness, and existing recreational use pressures.

Forest stand: A group of trees occupying a given area and sufficiently uniform in species composition, age, structure, site quality, and condition so as to be distinguishable from the forest in adjoining areas.

Fragmentation: Breaking up contiguous or homogeneous land cover through conversion to different vegetation types, age classes, or uses. Forest fragmentation occurs in landscapes with distinct contrasts between land uses, such as between woodlots and farms. Habitat fragmentation occurs when a contiguous or homogeneous forest area of a similar cover type and age is broken up into smaller dissimilar units.

Free to grow: When seedlings have grown taller than the surrounding competing vegetation.

Game species: In this plan, game species include those terrestrial species that are hunted and trapped.

Gap: The space occurring in forest stands due to the mortality or blowdown of an individual tree or groups of trees. Gap management uses timber harvest methods to emulate this type of spatial forest pattern.

Geographic Information System (GIS): Computer software used to manipulate, analyze, and visually display inventory and other data and prepare maps of the same data.

Growth stage: Growth stages of native plant communities as presented in the Field Guide to the Native Plant Communities of Minnesota: The Eastern Broadleaf Forest Province are periods of stand maturation where the mixture of trees in the canopy is stable. Growth stages are separated by periods of transition where tree mortality is high and different among the species, usually involving the death of early successional species and replacement by shade-tolerant species or longer-lived species.

Habitat: “The resources and conditions present in an area that produce occupancy – including survival and reproduction – by a given organism. Habitat is organism-specific; it relates the presence of a species, population, or individual (animal or plant) to an area’s physical and biological characteristics. Habitat implies more than vegetation or vegetation structure; it is the sum of the specific resources that are needed by organisms.” (Hall et al., 1997)

Herbivory: A plant-animal interaction whereby an organism eats some or all of a plant. Herbivory occurs both above and below ground. Dominant herbivores include beaver, deer, moose, hares, rabbits, small mammals, and forest tent caterpillars.

Intensive management: Intensity of management refers to the degree of disturbance associated with silvicultural treatments. In this plan, references to it range from less intensive to more intensive management. Examples of more intensive management are:

- 1) Site preparation techniques such as rock-raking that disrupts the soil profile and leaves coarse woody debris in piles;
- 2) broadcast herbicide use that eliminates or dramatically reduces herbaceous plant and shrub diversity;
- 3) Conversions of mixed forest stands through clearcutting and/or site preparation that result in the establishment of a more simplified monotypic stand, such as mostly pure aspen regeneration or high-density planted pine stands.

Examples where more intensive management may be needed are: to regenerate a site successfully to a desired species, control insect or disease problems, and wildlife habitat management (e.g., maintenance of wildlife openings).

Landscape: A general term referring to geographic areas that are usually based on some sort of natural feature or combination of natural features. They can range in scale from very large to very small. Examples include watersheds (from large to small), the many levels of the Ecological Classification System (ECS), and Minnesota Forest Resources Council (MFRC) regional landscapes. The issue being addressed usually defines the type and size of the landscape to be used.

Leave trees: Live trees selected to remain on a site to provide present and future benefits, such as shelter, resting sites, cavities, perches, nest sites, foraging sites, mast, and coarse woody debris.

Legacy patch: An area within a harvest unit that is excluded from harvest; this area is representative of the site and is to maintain a source area for recolonization, gene pool maintenance, and establishment of microhabitats for organisms that can persist in small patches of mature forest.

Managed acres: Acres that are available for management purposes.

Management Opportunity Area (MOA): Groups of stands intended to use vegetation management to provide opportunities to address values such as biodiversity, rare features, diversity of native plant community growth stages, and wildlife needs that can't be addressed through site-level management within individual stands.

Mast: Nuts, seeds, catkins, flower buds, and fruits of woody plants that provide food for wildlife.

Mature tree: A tree that has reached the desired size or age for its intended use. Size or age will vary considerably depending on the species and the intended use.

Merchantable timber: Trees or stands having the size, quality, and condition suitable for marketing under a given economic condition, even if not immediately accessible for logging.

Mesic: Moderately moist.

Minnesota Biological Survey (MBS) Sites of Biodiversity Significance: Areas of land identified by Minnesota Biological Survey (MBS) staff, ranging from tens to thousands of acres in size, selected for survey because they are likely to contain relatively undisturbed native plant communities, large populations and/or concentrations of rare species, and/or animal habitat. The MBS site provides a geographic framework for recording and storing data and compiling descriptive summaries.

Minnesota Forest Resources Council (MFRC): The Minnesota Forest Resources Council is a state council established by the Sustainable Forest Resources Act (SFRA) of 1995 to promote long-term sustainable management of Minnesota's forests.

MFRC Voluntary Site-Level Forest Management Guidelines: A set of best management practices for timber harvesting and forest management on forested lands in Minnesota.

Mortality: Death or destruction of forest trees as a result of competition, disease, insect damage, drought, wind, fire, or other factors.

Native Plant Community (NPC): A group of native plants that interact with each other and with their environment in ways not greatly altered by modern human activity or by introduced organisms. These groups of native plants form recognizable units, such as an oak forest, prairie, or marsh, that tend to reoccur over space and time. Native plant communities are classified and described by hydrology, landforms, soils, and natural disturbance regimes (e.g., wildfires, windstorms, and normal flood cycles).

Natural disturbances: Disruption of existing conditions by natural events such as wildfires, windstorms, drought, flooding, insects, and disease. May range in scale from one tree to thousands of acres.

Natural regeneration: The growth of new trees in one of the following ways: (a) from seeds naturally dropped from trees or carried by wind or animals, (b) from seeds stored on the forest floor, or (c) from stumps that sprout or roots that sucker.

Natural spatial patterns: Refer to the size, shape, and arrangement of patches in forested landscapes, which are determined primarily by natural disturbance and physical factors.

Non-forest land: Land that has never supported forests and land formerly forested where use for timber management is precluded by development for other uses such as crops, improved pasture, residential areas, city parks, improved roads, and power line clearings.

Nongame species: In this plan, nongame species include amphibians, reptiles, and those mammal and bird species that are not hunted or trapped.

Non-native invasive species: Any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem and whose introduction does or is likely to cause economic or environmental harm or harm to human health.

Non-timber forest products: Non-timber forest products, also known as special forest products, can be categorized into five general areas: foods, herbs, medicinal, decorative, and specialty items. Special forest products might include berries, mushrooms, boughs, bark, Christmas trees, lycopodium, rose hips and blossoms, diamond willow, birch tops, highbush cranberries, burls, conks, Labrador tea, seedlings, cones, nuts, aromatic oils, extractives.

Normal Rotation Age (NRA): For even-aged managed cover types, normal rotation age is based on the age of trees at which their average annual growth for some metric (height, basal area, diameter) is maximized. Normal rotation age also considers other available data related to forest productivity, wood quality, and local knowledge.

Older forest: A forest stand of any particular forest cover type is considered an older forest whenever its age exceeds the normal rotation age established for that cover type.

Older forest conditions: Forests that have the age and structural conditions typically found in mature to very old forests, such as large diameter trees, large snags, downed logs, mixed-species composition, and greater structural diversity. These older forest conditions typically develop at stand ages greater than the normal rotation ages identified for even-aged managed forest cover types.

Old Forest Management Complex (OFMC): This represents an area of land made up of several to many stands that are managed for old growth, their special management zones (SMZ), and stands in the vicinity of designated old-growth stands.

Old growth forests: Forests defined by age, structural characteristics, and relative lack of human disturbance. These forests are essentially free from catastrophic disturbances and contain old trees (generally over 120 years old), large snags, and downed trees. Additional details on the management of old-growth forests on DNR-administered lands are contained in the DNR's Old Growth Forest Policy and related reference documents.

Overstory: The canopy in a stand of trees.

Patch: An area of forest that is relatively homogenous in structure, primarily in height and stand density, and differs from the surrounding forest. It may be one stand or a group of stands.

Prescribed burn: To deliberately burn wildlands (e.g., forests, prairie, or savanna) in either their natural or modified state and under specified conditions within a predetermined area to meet management objectives for the site. A fire ignited under known conditions of fuel, weather, and topography to achieve specific objectives.

Prescription: A planned treatment (clearcut, selective harvest, thin, reforest, reserve, etc.) designed to change the current stand structure to one that meets management goals. A written statement that specifies the practices to be implemented in a forest stand to meet management objectives. These specifications reflect the desired future condition at the site and landscape level and incorporate knowledge of the special attributes of the site.

Pulpwood: Wood cut or prepared primarily for manufacture into wood pulp or chips for subsequent manufacture into paper, fiberboard, or chipboard. Generally, trees five to 12 inches in diameter at breast height are used.

Range of Natural Variation (RNV): Refers to the expected range of conditions (ecosystem structure and composition) to be found under naturally functioning ecosystem processes (natural climatic fluctuations and disturbance cycles such as fire and windstorms). RNV provides a benchmark (range of reference conditions) to compare with current and potential future ecosystem conditions.

Rare plants: All species that are listed as federally endangered, threatened, or as candidates for federal listing; all species that are state-listed as endangered, threatened, or of special concern. Several rare species are also tracked, which currently have no legal status but need further monitoring to determine their status.

Rare animal: All animal species that are listed as federally endangered or threatened, as well as all birds, small mammals, reptiles, amphibians, mussels, and butterflies that are listed as state endangered, threatened, or of special concern. Several rare species are also tracked, which currently have no legal status but need further monitoring to determine their status. For example, some Species of Greatest Conservation Need (SGCN) have no legal status, but SGCN includes both listed and non-listed species.

Rare species: A plant or animal species that is designated as endangered or threatened at the federal or state level, designated as species of special concern by the state of Minnesota, Species of Greatest Conservation Need, or an uncommon native species that do not (yet) have an official designation, but whose distribution and abundance need to be better understood.

Refuge/refugia: Area(s) where plants and animals can persist through a disturbance event or as climate changes.

Regeneration: The act of renewing tree cover by establishing young trees naturally (e.g., stump sprouts, root suckers, natural seeding) or artificially (e.g., tree planting, seeding).

Release: Freeing seedlings from competition before they are free to grow.

Resilience: The ability of a forest ecosystem to respond and recover from a disturbance or change to maintain ecological function.

Restore: To return a stand, site, or ecosystem to its original structure and species composition through active management actions.

Riparian area: The area of land and water forming a transition from aquatic to terrestrial ecosystems along streams, lakes, and open-water wetlands.

Riparian Management Zone (RMZ): That portion of the riparian area where site conditions and landowner objectives are used to determine management activities that address riparian resource needs. It is the area where riparian MFRC site-level guidelines apply.

Rotation age: The age at which a forest stand (primarily even-aged) receives its final harvest. This is an administrative decision based on economics, site conditions, growth rates, and other facts.

Salvage cut: A harvest made to remove trees killed or damaged by fire, wind, insects, disease, or other injurious agents. The purpose of salvage cuts is to use available wood fiber before further deterioration occurs to recover the value that otherwise would be lost.

Sapling: A tree that is one to five inches in diameter at breast height.

Sawtimber: Trees that yield logs suitable in size and quality for the production of lumber.

Scientific and Natural Area (SNA): Areas established by the DNR Division of Ecological and Water Resources to preserve natural features and rare resources of exceptional scientific and educational value.

Seedbed: The soil or forest floor on which seed falls.

Selection harvest: Removal of single scattered trees or small groups of trees at relatively short intervals. The continuous establishment of reproduction is encouraged, and an all-aged stand is maintained. A management option used for shade-tolerant species.

Silviculture: The art and science of establishing, growing, and tending stands of trees. The theory and practice of controlling the establishment, composition, growth, and quality of a forest stand to achieve certain desired conditions or management objectives.

Site Index (SI): A species-specific measure of actual or potential forest productivity or site quality, expressed in terms of the average height of dominant trees at specific key ages, usually 50 years in the eastern U.S.

Site preparation: Treatment of a site (e.g., hand or mechanical clearing, prescribed burning, or herbicide application) to prepare it for planting or seeding, and to enhance the success of regeneration.

Site productivity: The relative capacity of a site to sustain a production level over time. The rate at which biomass is produced per unit area. For example, cords per acre growth of timber.

Size class: A category of trees based on diameter class. The DNR's forest inventory has size classes such as Size Class 1 = 0 - 0.9 inch diameter; 2 = 1 - 2.9 inches diameter; 3 = 3 - 4.9 inches; 4 = 5 - 8.9 inches; 5 = 9 - 14.9 inches, etc. Also, size class may be referred to as seedling, sapling, pole timber, and sawtimber.

Slash: The non-utilized and generally unmarketable accumulation of woody material in the forest, such as limbs, tops, cull logs, and stumps that remain in the forest as residue after timber harvesting.

Snag: A standing dead tree.

Special concern species: A plant or animal species that is extremely uncommon in Minnesota or has unique or highly specific habitat requirements and deserves careful monitoring. Species on the periphery of their ranges may be included in this category, as well as species that were once threatened or endangered but now have increasing or stable and protected populations.

Special Management Area (SMA): An area that receives alternate modeling during stand selection and different treatment during management to account for values on the landscape other than timber. Different types of special management areas are determined by statute (e.g., endangered and threatened species), by policy (e.g., old growth special management zones), or during the SFRMP process (management opportunity areas).

Special Management Zone (SMZ): A buffer immediately surrounding designated old growth forest stands. It is intended to minimize edge effects and windthrow damage to old-growth stands. The minimum width is 330 feet from the edge of the old-growth stand. Timber harvest is allowed in the SMZ, but there are limitations on how much can be clearcut at any given time.

Species of Greatest Conservation Need (SGCN): Animals whose populations are rare, declining, or vulnerable to decline and are below levels desirable to ensure their long-term health and stability, as defined in the state Wildlife Action Plan.

Stand: A contiguous group of vegetation similar in age, species composition, structure, and growing on a site of similar quality to be a distinguishable unit. A forest is comprised of many stands. A pure stand is composed of essentially a single species, such as planted red pine. A mixed stand is composed of a mixture of species, such as a northern hardwood stand consisting of maple, birch, basswood, and oak. An even-aged stand is one in which all of the trees present are essentially the same age, usually within ten years of age for aspen and jack pine stands. An uneven-aged stand is one in which a variety of ages and sizes of trees are growing together on a uniform site, such as a northern hardwood stand with three or more age classes.

Stand age: In the DNR's forest inventory, the average age of the main species within a stand.

Stand density: The quantity of trees per unit area. Density is usually evaluated in terms of basal area, the number of trees, volume, or percent crown cover.

Stand examination list: DNR forest stands to be considered for treatment (e.g., harvest, thinning, regeneration, prescribed burning, reinventory, etc.) over the planning period based on established criteria (e.g., rotation age, site index, basal area, desired future cover type composition, etc.). These stands are assigned preliminary prescriptions, and most will receive the prescribed treatment. However, based on field appraisal visits, prescriptions may change for some stands because of new information on the stand or its condition.

Stand selection criteria: Criteria used to help identify stands to be treated.

Stocking: An indication of the number of trees in a stand as compared to the desired number for best growth and management, such as well-stocked, overstocked, and partially stocked. A measure of the proportion of an area actually occupied by trees.

Succession: The natural replacement, over time, of one plant community with another.

Sucker: A shoot arising from below ground level from a root. Aspen regenerates from suckers.

Suppressed: The condition of a tree characterized by low growth rate and low vigor due to competition from overtopping trees or shrubs.

Sustainability: Protecting and restoring the natural environment while enhancing economic opportunity and community well-being. Sustainability addresses three related elements: the environment, the economy, and the community. The goal is to maintain all three elements in a healthy state indefinitely. Meeting the needs of the present without compromising the ability of future generations to meet their own needs.

Thermal cover: Habitat components (e.g., conifer stands such as white cedar, balsam fir, and jack pine) that provide wildlife protection from the cold in the winter and heat in the summer. The vegetative cover used by animals against the weather.

Thinning: A silvicultural treatment made to reduce the density of trees within a forest stand primarily to improve growth, enhance forest health, or recover potential mortality. Row thinning is where selected rows are harvested, usually the first thinning, which provides equipment operating room for future selective thinnings. Selective thinning is where individual trees are marked or specified (e.g., by diameter, spacing, or quality) for harvest. Variable density or variable retention thinnings vary the distribution of trees that are removed or retained in the stand. Commercial thinning is thinning after the trees are of merchantable size for timber markets. Pre-commercial thinning is done before the trees reach a merchantable size, usually done in overstocked (very high stems per acre) stands to provide more growing space for crop trees that will be harvested in future years.

Threatened species: A plant or animal species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range in Minnesota.

Timberland: Forestland capable of producing timber of marketable size and volume at the normal harvest age for the cover type. It does not include lands withdrawn from timber utilization by statute (e.g., Boundary Waters Canoe Area Wilderness) or administrative regulation such as designated old growth forest and state parks. On state forestlands, this includes stands that can produce at least three cords per acre of merchantable timber at the normal rotation age for that cover type. It does not include very low-productivity sites such as those classified as stagnant spruce, tamarack, cedar, offsite aspen, or non-forestland.

Timber productivity: The quantity and quality of timber produced on a site. The rate at which timber volume is produced per unit area over a period of time (e.g., cords per acre per year). The relative capacity of a site to sustain a level of timber production over time.

Timber Stand Improvement (TSI): A practice in which the quality of a residual forest stand is improved by removing less desirable trees and large shrubs to achieve the desired stocking of the best quality trees or to improve the reproduction, composition, structure, condition, and volume growth of a stand. TSI occurs after trees in the stand are free to grow and includes pruning.

Tolerant: A plant capable of becoming established and growing beneath overtopping vegetation. A tree or seedling capable of growing in shaded conditions.

Underplant: The planting of seedlings under an existing canopy or overstory.

Understory: The shorter vegetation (shrubs, seedlings, saplings, small trees) within a forest stand that forms a layer between the overstory and the herbaceous plants of the forest floor.

Uneven-aged management: Forest management resulting in forest stands comprised of intermingling trees or small groups that have three or more distinct age classes. Best suited for shade-tolerant species.

Uneven-aged stand: A stand of trees of a variety of ages and sizes growing together on a uniform site. A stand of trees having three or more distinct age classes.

Variable density: Thinning or planting in a clumped or dispersed pattern so that tree spacing more closely replicates patterns after natural disturbance (e.g., use gap management, vary the residual density within a stand when thinning, or plant seedlings at various densities within a stand).

Variable retention: A harvesting system based on the retention of structural elements or biological legacies (e.g., retain tree species and diameters present at older growth stages, snags, large downed logs, etc.) from the harvested stand for integration into the new stand to achieve various ecological objectives. Aggregate retention retains these structural elements in small patches or clumps within the harvest unit. Dispersed retention retains these structural elements as individual trees scattered throughout the harvest unit.

Volume: The amount of wood in a tree or stand according to some unit of measurement (board feet, cubic feet, cords) or some standard of use (pulpwood, sawtimber, etc.).

Well stocked: The situation in which a forest stand contains trees spaced widely enough to prevent competition yet close enough to utilize the entire site.

Wildlife Management Area (WMA): Areas established by the Department of Natural Resources to manage, preserve, and restore natural communities, perpetuate wildlife populations, and provide recreational and educational opportunities.

Windthrow: A tree pushed over by the wind. Windthrows are more common among shallow-rooted species.