DEPARTMENT OF NATURAL RESOURCES

Western Superior Uplands

Section Forest Resource Management Plan - DRAFT

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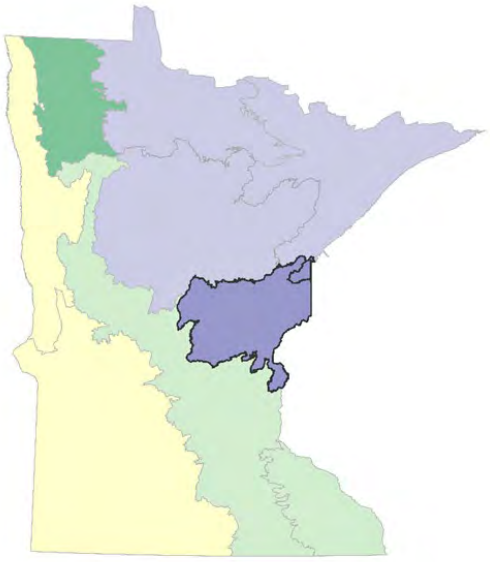

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List of Abbreviations

Abbreviation	Description
APA	Annual plan addition
Con-Con	Consolidated-conservation land
CSA	Common stand assessment
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
LUP	Land utilization program
MBS	Minnesota Biological Survey
MFRC	Minnesota Forest Resources Council
MOA	Management opportunity area
NHIS	Natural heritage information system
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 of 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) 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 Western Superior Uplands (WSU) Ecological Section. The primary audience for this plan is land managers within the DNR; however, it also serves to inform stakeholders and the informed and interested public about DNR forest resource management in the WSU Section. This plan replaces portions of the Mille Lacs Uplands and North Shore SFRMPs.

Narrative SFRMPs are components of the DNR's Forest Resource Management Plan System (Plan System) and complement the other two plan components: the strategic direction for forest resources management and the 10-year stand exam list. Together, these components form the authoritative plan for vegetation management on DNR-administered forest lands within the management pool. Additionally, they communicate how we intend to address the values we manage for to tribes, our stakeholders, and the public.

In 2016, Governor Dayton ordered the DNR to reassess the sustainable harvest level for DNR-administered land (Sustainable Timber Harvest Analysis, STHA). In 2018, after a 16-month process including analysis by a modeling contractor, input from DNR Divisions of Forestry, Fish and Wildlife, and Ecological and Water Resources, and input from a stakeholder advisory group and the public, the DNR settled on new strategic direction for forest resources management in all ecological sections of the state. The new strategic direction ensures that the DNR will meet statutory requirements for managing DNR forest lands in the management pool while balancing multiple values and providing associated benefits in perpetuity. The strategic direction for this plan period is to continue developing desired forest age class distributions to sustainably supply multiple forest benefits, including timber products and wildlife habitat over time, by offering 870,000 cords per year for sale on timber harvest permits statewide. To test whether the DNR can stimulate markets and increase the management of forests threatened by emerald ash borer and Eastern larch beetle, the DNR decided to offer 30,000 additional cords of ash and tamarack annually as a pilot during the first five years of the plan period. This volume offered is the tool for initiating the disturbance needed to meet forest condition goals and ultimately provide broad social, economic, and environmental benefits over time[1].

To implement the Strategic direction, in 2019, the DNR created a 10-year stand exam list for all forested ecological sections in Minnesota, including the WSU Section[2]. During fiscal years 2021 through 2030, the DNR plans to evaluate approximately 76,600 acres to potentially offer for sale in the WSU Section, or approximately 7,660 acres per year, on average. This translates into an estimated 92,600 cords per year; however, actual cords offered per year from the WSU Section may vary. The DNR will determine which stands on this list are offered for sale based on interdisciplinary coordination and field examinations. Some stands on the stand exam list may not be offered for sale based on conditions on the ground and stand objectives, and some stands that are not needed to meet strategic direction may be released for planning in future years. Annual stand exam lists are

[1] Sustainable Timber Harvest Determination: companion document to Mason, Bruce & Girard Sustainable Timber Harvest Analysis, March 1, 2018

[2] Sustainable Timber Harvest: Development of the DNR 10-year Stand Exam List report

available for public comment each year (see the DNR's annual stand exam lists webpage for more information and to sign up for updates).

Guiding Principles for the SFRMP process

- Provide guidance for forest management activities that address landscape scale goals for ecological protection, timber production, and cultural/recreational values.
- Provide guidance to managers and foresters on implementing the strategic forest resource management direction.
- Ensure recommendations for vegetation management adhere to Department directions, guidelines, and policy.
- 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 WSU 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.
- Young 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 aimed at providing older forest characteristics within stands, especially in management opportunity areas such as old forest management complexes and older forest patches, on Division of Fish and Wildlife administered lands, in riparian areas, and in natural-origin pine stands.
- Riparian areas will be managed to retain their integrity and provide habitat for fish, wildlife, and plant species. Strategies for achieving this include increasing longer-lived species and conifers, increasing forest age, and applying Minnesota Forest Resource Council Voluntary Site-Level Forest Management Guidelines in riparian areas.
- As part of this process, management opportunity areas in the Section that were included during the 10-year stand exam list development process were reviewed. Management guidance was developed for them, and they were approved for implementation. These areas contribute toward meeting goals for providing habitat and ecosystem functions that require management at broader scales than individual stands.
- Forest cover type conversion goals in this plan recognize or call for:
    - Decreasing a percentage of the aspen, ash/lowland hardwoods, birch, balsam fir, tamarack, and white spruce cover types.
    - Increasing acres of northern hardwoods, oak, black spruce lowlands, jack pine, red pine, white cedar, and white pine cover types.

- Additional topics addressed in the plan include: limiting damage from insects, disease, and non-native species; endangered, threatened, and rare species; managing areas of high and outstanding biodiversity significance; minimizing forest management impacts on visual quality; protecting cultural resources; and evaluating and responding to disturbance events (e.g., fire and wind).

Chapter 1: Introduction

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 the foundation on which the Department is able to plan for and execute its mission for the benefit of all Minnesotans.

State statutes, including Sustainable Forest Resources Act (Minnesota Statute 89A), provide primary statutory 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." On wildlife management areas (WMAs) administered by the Division of Fish and Wildlife, the state's policy is "to perpetuate, and if necessary, reestablish quality wildlife habitat for maximum production of a variety of wildlife species" (Minnesota Statute 86A.05 subd 8).

The Department's mission, the land base available to meet the mission, and the laws governing various land types and management activities, provide context for understanding the results of forest management planning.

State Lands Foundational to Forest Management

Throughout Minnesota, the DNR manages 5.6 million surface acres of state-owned land and 12 million acres of state-owned mineral rights that significantly contribute to the quality of life and economic opportunity in Minnesota. These lands and resources support natural resource-based economies, provide tourism and recreation opportunities, allow for the protection of 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) on behalf of their respective 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. There are approximately 64,000 acres of school trust lands in the WSU Section.

University trust lands are managed to generate revenue for the permanent university fund. Investment income is distributed to the University of Minnesota annually, which is used to fund professorial chairs, scholarships for students from the Iron Range, mineral and mineral-related research, a mining-related degree program offered through the University at the Mesabi Range Community and Technical Program, and scholarships for students to attend that program. There are approximately 7,000 acres of university trust land in the WSU Section.

State Non-trust Lands

The DNR manages non-trust lands according to their applicable statutory purposes. Statewide, these lands primarily include consolidated conservation lands (66,000 acres), Volstead lands (78 acres), and acquired lands (217,000).

Consolidated conservation lands ("Con-Con lands") were transferred to state ownership through tax forfeiture, often when drainage projects in the 1920s and 1930s failed to turn wetlands into farmlands. Counties initially assumed debt for the delinquent drainage bonds until state laws transferred the debt and the title of the forfeited lands to the state. Income generated from DNR natural resource management on these lands is split evenly with the county. There are approximately 66,000 acres of ConCon lands in the WSU Section. These lands are statutorily managed for conservation purposes. The granting authority for Con-Con lands is under:

- Laws of MN 1929, Chapter 258 (Minn. Stat., secs. 84A.01 to 84A.11), which established the Red Lake Game Preserve in Beltrami, Lake of the Woods, and Roseau counties.
- Laws of MN 1931, Chapter 407 (Minn. Stat., secs. 84A.20 to 84A.30), which covered lands in Aitkin, Roseau, and Mahnomen counties.
- Laws of MN 1933, Chapter 402 (Minn. Stat., secs. 84A.31 to 84A.42), which covered a reforestation project in Marshall County.

Volstead lands were purchased from the federal government with funds appropriated by the Legislature. These lands carried unpaid county liens for drainage ditches intended to make the land suitable for farming but were unsuccessful. Income generated from DNR natural resource management on these lands is split evenly with the county. There are approximately 78 acres of Volstead lands in the WSU Section. The granting authority for Volstead lands is under the Act of Congress, May 20, 1908 ("Volstead Act"), and the Act of Congress, May 1, 1958. Also, see Laws of MN 1961, Ch. 472, as amended by Laws of MN 1963, Ch. 390.

Acquired lands were gifted from private owners or 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, which may direct their management for recreation, conservation, or commercial uses of natural resources. Approximately 217,000 acres in the WSU Section are acquired lands.

State Land Administration

This SFRMP applies to lands of these various statuses administered by the DNR Divisions of Forestry and Fish and Wildlife in state forests and wildlife management areas.

Wildlife Management Areas (WMAs) are lands managed by the DNR Division of Fish and Wildlife as described in MN statute section 86A.05. They are developed and managed "…for the production of wildlife, for public hunting, fishing, and trapping, and for other compatible outdoor recreational uses." Wildlife management areas may include trust lands, which are managed to maximize long-term economic return to the trust while also incorporating WMA goals. Wildlife management areas cover approximately 491,545 acres in the WSU Section.

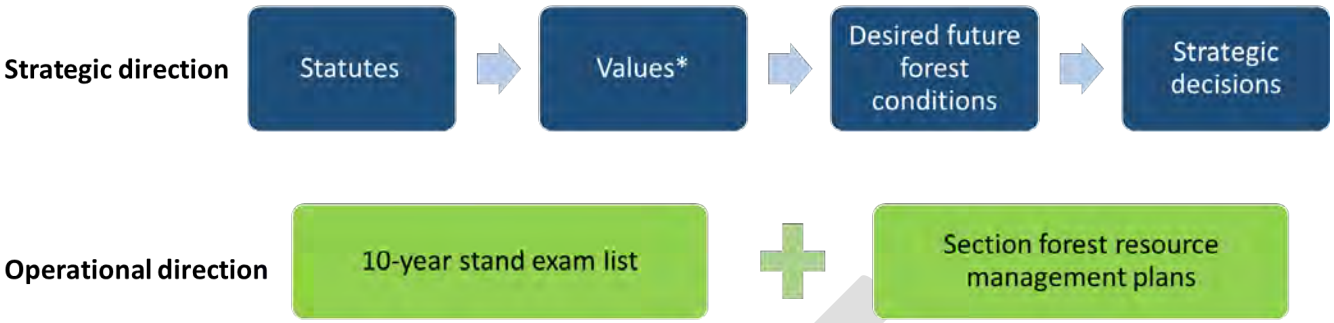
State forest lands are lands managed by the DNR Division of Forestry as described in chapter 89. They are managed under the principles of multiple use and sustained yield for forest resources that will best meet the needs of the people of the state, including timber, biological diversity, recreation, fish and wildlife habitat, rare and distinctive flora and fauna, and other values. The Division of Forestry administers approximately 1,713,172 acres in the WSU Section.

The DNR's Forest Resource Management Plan System

The DNR's forest resource management plan system guides forest management activities on state-administered lands, including when, where, how, and how much timber is harvested, to develop a mix of forest resource conditions that will provide multiple forest benefits continuously over time. Long-term planning helps ensure that state forest management activities meet statewide goals for various values, including ecological protection, timber production, cultural and recreational resource use, and wildlife habitat.

The DNR's Forest Resource Management Plan has two main components:

- Strategic direction
    - decisions for how to fulfill statutory requirements and balance multiple values sustainably through forest resource management
- Operational direction
    - 10-year stand exam list – operational plan for which forest stands to examine for potential management to meet the strategic direction
    - Section Forest Resource Management Plans (SFRMPs) – narrative plans for what to consider when making management decisions for stands on the 10-year stand exam list to advance landscape-scale goals



*wildlife habitat, biodiversity, timber productivity, forest health, water quality and quantity, economic impact

Interdisciplinary partners within DNR from the Divisions of Forestry, Fish & Wildlife, and Ecological & Water Resources develop the plans. The DNR also invites public input at various points in the planning process.

Scope of this Section Forest Resource Management Plan (SFRMP)

This SFRMP provides guidance for vegetation management on DNR-administered forest lands in both the Western Superior Uplands Section and the Southern Superior Uplands Section. They are both considered in this assessment and referred to when discussing the Western Superior Uplands (WSU) (Map 1.1; a detailed explanation of DNR's ecological classification system (ECS), including sections and subsections, is available on the DNR ECS webpage).

The WSU includes the Glacial Lake Superior Plain and Mille Lacs Uplands Subsections. Vegetation management includes actions that affect the composition and structure of forest lands, such as timber harvesting, thinning, prescribed burning, biomass harvest, and reforestation. SFRMPs consider the condition and management of forest lands in other ownerships but only propose forest management direction and actions for DNR-administered lands.

This plan considers only a portion of forested DNR-administered lands in the WSU Section for management 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 in that stand). Forest land includes land in the DNR forest stand inventory (Forest Inventory Module, or FIM), including cover types from aspen to stagnant conifers, muskeg, lowland brush, and other wetlands. Timberland includes cover types capable of producing merchantable timber and excludes very slow-growing trees (e.g., stagnant lowland conifers or offsite aspen). For this plan, managed acres are timberland acres available for timber management, excluding timberlands reserved as old growth, state parks, scientific and natural areas (SNAs), inoperable stands, etc. (see Appendix A for the full FIM query for managed acres).

Examples of forest resource management planning activities that are beyond the scope of SFRMPs include off-highway vehicle trail system planning, comprehensive road access plans, state park land management planning, old-growth forest designation, SNA establishment, wilderness designation, wildlife population goals, cumulative effects analysis at the watershed-level, fire management, and recreation facilities/systems planning.

Goals for the Planning Effort

This SFRMP provides goals and direction for resource managers in the WSU Section as they implement the strategic direction for this plan period and 10-year stand exam list, 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, that will best move the forest landscape toward the goals for state forest lands.
  - Some DFCs, for example, those related to harvest levels or age class distributions, are expressed in the strategic component of our plan.
  - Other DFCs expressed in this SFRMP, including cover type goals, are developed from assessment information, identified issues, and general direction statements in response to issues.
- **General direction statements and strategies**
  - General direction statements and strategies in Chapter 3 guide staff on what to consider when making decisions for stand management.
  - Products of this planning process include an implementation meeting and field guide for DNR staff.
- **Management Opportunity Areas (MOAs)**
  - MOAs provide opportunities to address values such as biodiversity, rare features, diversity of native plant community growth stages, and wildlife needs through vegetation management. See Section 3.13 in Chapter 3 for more information on MOAs.
  - MOAs include old forest management complexes (OFMCs), ruffed grouse management areas, older forest patch MOAs, open landscape priority areas, and deer yards, among others.
  - Management guidance documents developed for MOAs through SFRMP are included as appendices in this plan.

Staff Involved in Developing SFRMPs

The Division of Forestry is responsible for developing and maintaining SFRMPs. Past similar SFRMPs (developed by an interdisciplinary team) are used by Forest Resources Planners to develop a draft plan for the section. An interdisciplinary team of planners and personnel from DNR Divisions of Forestry, Fish and Wildlife, and Ecological and Water Resources work together to develop SFRMPs, with oversight from regional and executive 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 northeast (Region 2) FRIT co-managed the WSU SFRMP planning effort. Additional staff, such as GIS or administrative specialists, support SFRMP planning as needed.

Tribal Coordination Opportunities

Forest planners coordinate with native American tribes during the development of the SFRMP. This occurs at a minimum through a comment period on the draft plan. 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, at a minimum, through a comment period on the draft plan.

Additional public review and comment opportunities may arise if plan revisions are proposed during plan implementation.

SFRMP Process Overview

The SFRMP process is divided into four steps (Table 1.1). In Step 1, the Forest Resource Planner gathers information to assess the current forest resource conditions in the Section. The Planner works with interdisciplinary specialists from the DNR divisions of Ecological and Water Resources, Fish and Wildlife, and Forestry in the second step to revise the draft SFRMP. In Step 3, the plan is reviewed by regional and statewide DNR leaders and made available for tribes and the public to comment. In Step 4, the plan is distributed and implemented.

Table 1.1: Summary of the planning process for the WSU SFRMP.

Steps	SFRMP Process Description
Step 1	**Initiating the Planning Process** • Assemble baseline assessment information and develop an assessment document. • Establish a web page on the DNR website. • Update the mailing list of public/stakeholders. • Inform the public that the planning process is beginning, including sharing the estimated schedule and how and when they can be involved.
Step 2	**Develop Draft Plan** • Add Section context to issues to be addressed in the plan. • Develop strategies and desired future condition (DFC) goals consistent with the general direction statements and policy. • Prioritize, develop, and/or revise Management Opportunity Area guidance documents.

Steps	SFRMP Process Description
Step 3	**Plan Review and Comment Periods** • Review the draft plan with regional and statewide DNR leadership. • Send draft plan to tribes for comment. • Make the draft plan available to the public for comment. • Summarize tribal and public comments and develop DNR responses; revise the draft plan in response to comments as appropriate. • Commissioner approves the final plan.
Step 4	**Final Plan** • Present a summary of comments, responses, and plan revisions for the Commissioner's approval. • Commissioner approves the final plan. • Distribute the final plan. • Provide plan implementation training to DNR staff involved in forest management and coordination.
Step 5	**Monitoring** • After implementation, plans are periodically monitored to assess their implementation and effectiveness.

Other Planning Efforts

MFRC Regional Landscape Planning

This plan aligns with the goals and strategies related to vegetation management in the Minnesota Forest Resources Council (MFRC) East Central Landscape Forest Resource Management Plan. By aligning with the corresponding MFRC plan, the decisions for the management of DNR-administered lands in this SFRMP incorporate recommendations from 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 WSU Section covers approximately 3.5 million acres in east-central Minnesota, and over 45% of those acres are deciduous forests or woody wetlands. Diverse, extensive forests and lakes harbor numerous Species of Greatest Conservation Need (SGCN).

The vast majority of the land is privately owned, and over 18% is in public ownership (federal, county, state). State ownership accounts for approximately 626,000 acres, of which the Department of Natural Resources administers approximately 406,000 acres. Much of the Section is rural and encompasses the small cities of Carlton, Milaca, Pine City, and Sandstone, with Brainerd located just outside the WSU Section. Forestry, tourism,

and recreation, including hunting, fishing, snowmobiling, and skiing, are important land uses across the Section. Agriculture is also a major industry and land use in this area.

The WSU Section does not contain any major lumber mills, although it does include many minor mills and has major mills near the edges of the boundary.

Map 1. Location of Western Superior Uplands Section.

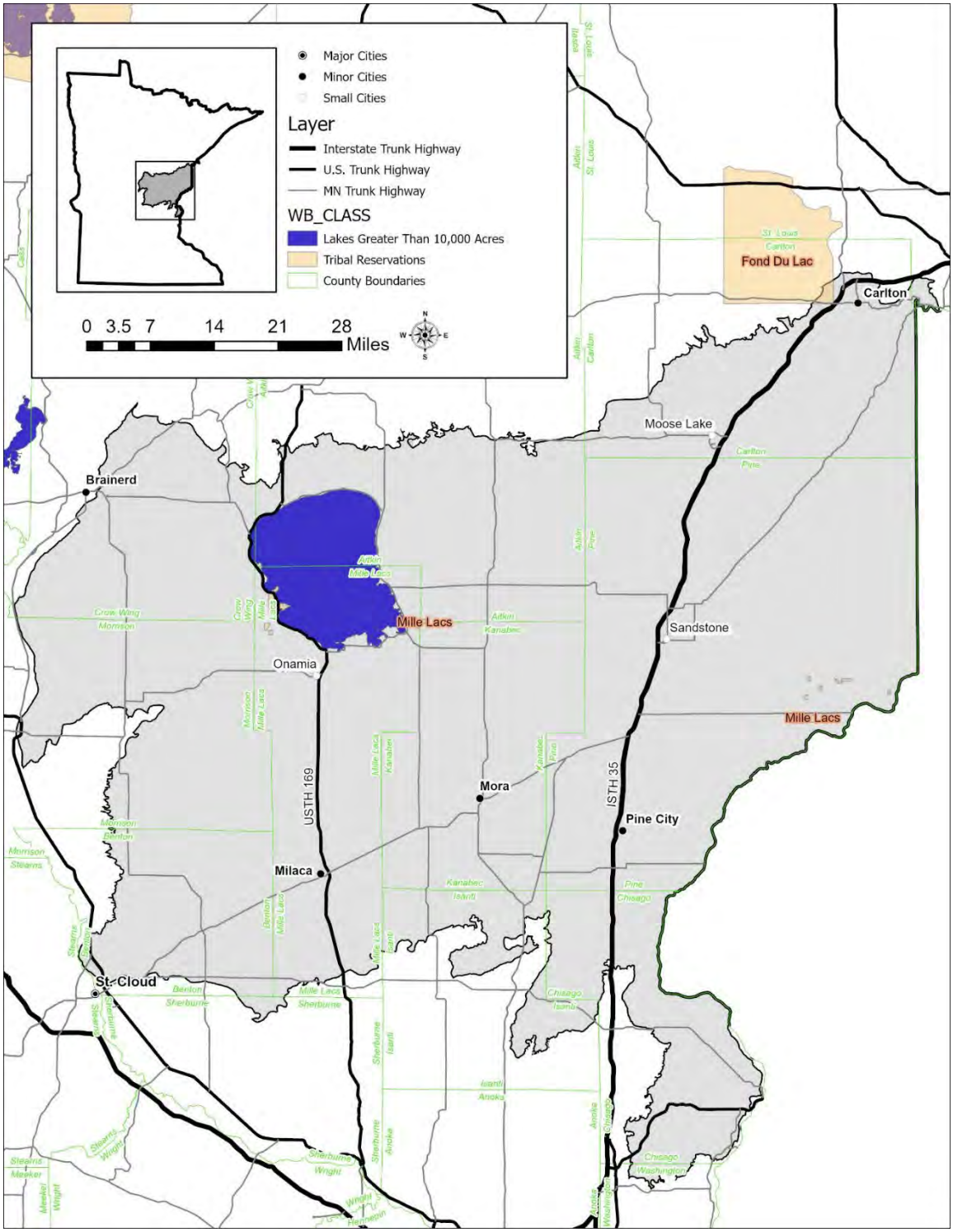


Table 1.2: Generalized cover type composition of DNR-administered lands in the WSU Section based on FIM inventory updated January 2014.

Cover type	2021 total acres
Ash/ lowland Hardwoods	23,066
Aspen	120,326
Birch	6,941
Jack Pine	2,998
Balsam Fir	1,481
Black Spruce Upland	46
White Spruce	2,350
Black Spruce lowland	21,014
Tamarack	12787
Red Pine	8,689
White Pine	1,000
Northern Hardwoods	43,482
Central Hardwoods	71
Oak	41,771
Cedar	505
Other forest types	838
Upland Brush	12,636
Upland Grass	4,860
Other Non-Forest	108,447
Total Acres	413,309

Table 1.3: Land ownership in the WSU Section (acres).[3]

Administrator Class	Acres	Percent
State	626,162	17.9%
Other Public	15,155	0.4%
Private	2,852,850	81.5%
Tribal	5,204	0.1%
Grand Total	**3,499,370**	**100.0%**

Table 1.4: State-administered acres in the WSU Section from the DNR's forest inventory data.

Row Labels	Acquired	ConCon	Trust	U Trust	Volstead	Grand Total
DNR	639					639
Forestry	151,708	58,914	64,310	6,552	78	281,563
Eco Waters	2,200					2,200
Parks and Trails	52,720					52,720
Fish and Wildlife	63,974	5,029	241			69,243
Grand Total	270,996	63,943	64,551	6,552	78	406,363

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 shown 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.

[3] Source: 2008 Minnesota GAP Stewardship – "All Ownership Types" Data

Chapter 2: Issues Considered During SFRMP Planning

Issue Definition

In this plan, issues are natural resource-related concerns that are directly affected by, or that directly affect, vegetation management decisions on lands administered by the 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. The description of any one issue in this chapter does not imply a DNR goal to address the issue to a particular extent. Future direction in Chapter 3 of this SFRMP 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 in determining forest stand management direction. 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 vegetation management issues on DNR-administered land are addressed or determined through developing 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 Chapter 2. Appendix B contains a table showing the relationship between the general direction statements in Chapter 3 and the issues in Chapter 2 that they address, and each section in Chapter 3 indicates the issues that are related to that section.

How Issues Were Identified

Section Forest Resource Management Plan issues were developed using assessment information, Minnesota Department of Natural Resources (DNR) policies and guidelines, local knowledge, existing plans, and public 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 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.

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

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

- vegetation conditions that support many species, including species with age-specific habitat requirements
- greater potential to provide a sustainable yield of timber
- 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 and designated old-growth stands, which are high-quality representations of stands in the later stages of forest succession.

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
    - Examples of species within WSU associated with old or later successional forests for at least part of their life cycle include: blunt-lobed grape fern, narrow triangle moonwort, American ginseng, white adder's-mouth orchid, butternut, northern goshawk, red-shouldered hawk, four-toed salamander, spotted salamander, St. Croix snake tail dragonfly, Acadian flycatcher, cerulean warbler, scarlet tanager, winter wren, wood thrush, and Louisiana waterthrush.
    - Old, large-diameter aspen is particularly important to bats, raptors, woodpeckers, fishers, pine martens, and other cavity-nesting species.
- development of late-successional native plant community (NPC) growth stages
- stable hydrology and groundwater in relatively undisturbed older forests, especially lowland forests
- provides greater 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
- large blocks of older forest may provide forest interior habitat for area-sensitive species

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, tamarack, balsam fir, upland black spruce, among other cover types.

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

- vegetation conditions that support associated plant and animal (game and non-game) species
  - Examples of species within WSU associated with young or early successional forest for at least part of their life cycle include: ruffed grouse, eastern whip-poor-will, American woodcock, golden-winged warbler, chestnut-sided warbler, mourning warbler, white-throated sparrow, song sparrow, rose-breasted grosbeak, white-tailed deer, and black bear.
- cover from predation and/or food supply for species that depend on dense young forest
- edges between young and more mature forest that some species depend on
- depending on distribution, young forest in larger blocks provides an opportunity to create contiguous habitat of uniform age to further develop
- 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 considered 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?

- forest composition and structure have been simplified, and within-stand diversity has decreased
- reduction of species associated with specific declining habitats
- more of the forest is in younger age classes and less in older age classes
- patch size has decreased, and fragmentation has increased
- connectivity of vegetation patches used by wildlife has decreased

- ability to produce a diversity of forest products (e.g., sawtimber, aesthetics, non-timber forest products, recreation, and tourism)
- ability to provide ecologically intact landscapes
- non-native invasive species have increased
- ability to respond to climate change

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?

- Historically unsustainable harvests, insect infestations, disease, drought, and browsing by wildlife have resulted in changes in forest age structure and composition. The consequences of this include:
  - reduced regenerative capacity for tree species due to factors such as lack of large downed trees, insects and disease, and a lack of seed trees
  - change in mycorrhizal relationships necessary for healthy soils and trees
  - changes to composition and structure necessary to sustain associated species
- increase native tree species diversity within forest communities
- ecologically appropriate tree species diversity helps maintain native plant community composition, structure, and ecological function
- the distribution of specific tree species in the Section provides for different social, economic, and ecological values
- climate change projections may impact decisions over which tree species are most appropriate for future vegetation management decisions

B3. Maintaining or enhancing imperiled and highly imperiled native plant communities in the Section.

Why is this issue important? 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
- limited number of occurrences in the Section
- limited number of reference sites for climate change adaptation
- limited habitat for unique native plant and wildlife assemblages and rare species
- significant changes in composition (short- and long-term trends) as compared to historical conditions
- examples of high-quality, intact native plant communities used as controls to compare and monitor the effects of management
- continued forest stand and landscape diversity
- maintaining overall forest biodiversity, sustainability, and resiliency
- Minnesota's 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 maintaining rare native plant communities as priority considerations during forest management planning

Examples of these types of communities in the Section include FDn22d (S2 rank), FDn43a (S2 rank), FDc34a (S2 rank), MHn44b (S2 rank), MHc47a (S3 rank), WFn55b (S3 rank), MHs38b (S3 rank) (see the DNR NPC website and DNR field guides to native plant communities for more information).

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

Natural disturbance events (e.g., wind, fire, insects) often create conditions with variable levels of disturbance across a site. This includes varying amounts of intact tree canopies, areas with both high and low levels of soil disturbance, coarse wood debris, and patches of intact ground layer vegetation.

Why is this issue important?

- Intensive management can include activities such as rock-raking and herbicide application. It is an important tool 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
  - take or damage/destroy habitat for listed or rare species
- 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 activities to better reflect natural landscape patterns (the size and configuration of growth stages and types resulting from broad-scale natural disturbances) in the Section.

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:

- fragmentation and 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 loss or decline of wildlife and plant 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
- managing a variety of patch sizes and age classes provides habitat for a variety of species with differing requirements

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

Why is this issue important? Harvesting and other factors such as road and trail construction, residential development, and ongoing sales of large tracts of land by private corporations have resulted in:

- reduced forest patch size
- increased numbers of disturbance events
- altered forest composition, structure, and age
- increased forest fragmentation and simplification
- reduced interior forest habitat, and increased edge disturbance, which can promote invasive species
- potential loss or decline of area-sensitive species
    - Examples of area-sensitive species include: northern goshawk, red-shouldered hawk, black-throated green warbler, cerulean warbler, northern parula, pileated woodpecker, scarlet tanager, and Louisiana waterthrush.
- reduced biodiversity and 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

The DNR's sustainable timber harvest level is part of the strategic component of our forest resource management plan. This plan provides summary information about the strategic plan and 10-year stand exam list within the Section and supplemental guidance on how we contribute to the sustainable timber harvest through management decisions.

C1. Contributing to sustainable forest management that meets the Department plans for offering timber volume for sale while considering all forest resources and trust lands responsibilities.

Why is this issue important?

- Some cover types in the planning area have pronounced age class imbalances, which, if not corrected, decrease our opportunity to sustainably offer and harvest timber, as well as provide a consistent supply of other forest resource benefits over time.
- Timber harvest provides forest products for society.
- School trust land is mandated to provide long-term economic benefit to the Permanent School Fund through sound natural resource management.
- Managing forests in an ecologically 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
    - provide a wide array of recreational opportunities

C2. Managing non-timber forest products.

Demand for some non-timber forest products (e.g., balsam boughs and decorative trees) is inconsistent over time and product with some increasing and others decreasing at various points.

Why is this issue important? Non-timber forest products:

- diversify local economies and are a traditional harvest activity for some groups
- are particularly important in areas where employment opportunities in the mainstream economy are limited
- support local individuals, families, and cottage industries in an expanding worldwide market
- maintain a sustainable harvest of these resources

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.

The relative value, in terms of size, condition, and quality, of native biological diversity for a given area of land or water.

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 and wildlife habitat at landscape scales
- potential for addressing biodiversity-related goals of the DNR and other landowners
- complexes of high-quality habitat for wildlife, particularly area-sensitive wildlife species
- legal compliance with state and federal law, DNR policy, and forest certification goals and requirements
- potential to provide landscape-level resilience for the forest-dependent species that intolerant of forest management
- healthy plant and animal populations that can adapt to changing climatic conditions
- allow DNR to enact its State Wildlife Action Plan (ensuring access to federal funds, among other things)
- carbon storage and sequestration
- protection for critical non-forest habitat features such as clean air and water
- human health, safety, and welfare depend on ecosystem services provided by healthy, diverse forest communities

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 regeneration of some tree species.
- Some forest management practices can reduce within-stand structural complexity and diversity.
- Older forest characteristics provide critical habitat and ecosystem services within forests. These habitat components can be requirements for long-term biodiversity (e.g., coarse woody debris is needed for some small vertebrates (amphibians, small mammals) to occupy forests).

E. Rare Features

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

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.
- Without special management consideration, rare species can become rarer or even extirpated. It is expensive and difficult to recover species once they are in decline.
- DNR Department-wide direction establishes the DNR's role in advocating for the maintenance and protection of habitat for rare features throughout the state, regardless of ownership.
- The DNR is legally required to protect state endangered and threatened species as well as federally listed species and is obligated through policy and the application of sound resource management to protect state special concern and SGCN species and their habitats.
- 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) (HCVs), such as rare features, associated with the site.
- Several species listed by the state as endangered, threatened, or of special concern live in forested areas in the Section, including American ginseng, Blanding's turtle, blunt-lobed grape fern, creek heelsplitter, four-toed salamander, gilt darter, northern goshawk, narrow triangle moonwort, northern long-eared bat, red-shouldered hawk, white adder's-mouth orchid, wood turtle, etc.

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.

- Forest wildlife is important to society and depends on healthy forest ecosystems.
- Legal mandates, the expectations of stakeholders, 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 include:
  - the economic vitality of forest and tourism industries
  - maintenance of recreation opportunities for the public
  - the health of wildlife species and populations
  - public health
  - control of forest insects and disease
  - maintenance of healthy forest ecosystems
- Reduced amounts of important forest habitats is a concern for some species, including listed and special concern species.
  - In the WSU Section, many wildlife species depend on early or late successional stages.
    - Example 1: Some species require open landscapes or brushland habitats within or near the forest, including Sandhill Crane, Sharp-tailed Grouse, Bobolink, Upland Sandpiper, Northern Harrier, Short Eared Owl, and Savannah Sparrow.
    - Example 2: Other species depend upon older forests, including four-toed salamanders, spotted salamanders, northern goshawks, red-shouldered, cerulean warbler, and fisher.
- In the WSU Section, historical and more recent changes have affected wildlife species and their habitat, including:
  - changes in the abundance of tree species, age structure, and structural and species diversity
  - increased habitat fragmentation from roads, trails, and development
  - alteration of natural fire disturbance events
  - a warming climate has a negative impact on species at the southern end of their range and a positive impact on species at the northern edge of their range
- The abundance of public forest land in the WSU Section 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.
  - Game species such as ruffed grouse, American woodcock, black bear, and white-tailed deer are sought by hunters, and species such as red fox, beaver, and bobcat are important to trappers.
  - The Section provides unique wildlife viewing and photography opportunities for sought-after species, including Blanding's turtle, wood turtle, eastern and plains hog-nosed snakes, spotted salamander, four-toed salamander, black-backed woodpecker, cerulean warbler, Connecticut warbler, golden-winged warbler, gray wolf, great gray owl, Louisiana waterthrush, pine marten, pine grosbeak, purple martins, red crossbill, red-shouldered hawk, sharp-tailed grouse, and a large number of other warbler species.

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 protect, maintain, or enhance aquatic habitat types, corridors and connectivity for plant and animal species, aesthetics, recreation, water quality, and forest products.
  - Watershed management impacts water quality that supports the trophic levels required to sustain all fish species.
  - Several rare animals (e.g., caddisflies, pugnose shiner, creek heelsplitter, gilt darter, mudpuppy, spotted salamander, four-toed salamander) and plants (e.g., small white water lily, false mermaid, bog bluegrass, slender naiad, discoid beggarticks) are negatively affected by changes to these factors.
- Management activities may affect permanent wetlands adjacent to upland stands. For example, young forest in the adjacent landscape may lead to faster and increased water runoff.
- Seasonal ponds are particularly important for maintaining populations of 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.
- Minnesota Forest Resource Council's *Voluntary Site-Level Forest Management Guidelines for Landowners, Loggers, and Resource Managers* (MFRC site-level guidelines) serve as the DNR minimum standard for protections/mitigations related to surface waters.
  - Applying MFRC site-level guidelines without considering site-specific conditions may not be adequate to protect surface waters.

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

Why is this issue important?

- The WSU Section contains all or parts of 10 major watersheds in Minnesota.
- Vegetation management activities, and the amount and condition of forest cover on the landscape, affect watershed or sub-watershed hydrology and overall water quality.

Note: A description of this issue is included in this SFRMP because of its relevance to forest management. However, because we do not currently have the data or scientific methodology to fully evaluate cumulative impacts across ownership and time, this plan does not include specific future direction related to cumulative impacts to aquatic resources. Instead, this plan and DNR forest management focus on addressing water quality issues and impacts to aquatic resources through applying MFRC site-level guidelines and guidance for site and landscape-level decisions in this plan (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.
- Timber sales are how the DNR accomplishes much of the vegetation management activities covered under this SFRMP.
- Maintaining a variety of forest industries is a critical component of our ability to manage forests.
- Ability to sustainably provide forest products over time.

I. Disturbance Impacts on Forest Ecosystems

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

Why is this issue important?

- Insects and diseases can reduce timber production and lumber grade, increase fire hazard, and provide food and habitat for wildlife.
    - Inadequate management response may negatively affect timber volume, aesthetics, and recreational enjoyment of the forest.
    - Aggressive management response can impact non-target and/or native species, ecosystem function, and overall species diversity and still may not solve the problem.
    - Widespread pest outbreaks outside their natural range cause high levels of tree mortality and significant ecological and economic consequences.
    - Insect outbreaks can be beneficial by providing food for some wildlife species like woodpeckers and spruce budworm specialists.
- Natural disturbances can promote a diversity of tree species and forest structure and generate dead wood, which provides important habitat components and soil nutrients.
    - Many plant and animal species are adapted to disturbances (e.g., fire) and need those processes to complete their life cycles or maintain a native plant community condition.
    - Some species closely track natural disturbances on the landscape and are found in higher abundance in disturbed areas for several years post-disturbance (e.g., fire and black-backed woodpeckers).
- Herbivory (browsing and grazing by wildlife) can - in some cases - adversely impact successful forest regeneration, with economic and management consequences.
- Herbivory can reduce herbaceous plant diversity, which is important for functions such as soil health, nutrient cycles, and wildlife food sources.

I2. 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 the loss of sensitive and rare species and communities.
- It is the DNR's policy, through the Invasive Species Operational Order #113, 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.
- Increased use of public lands results in a greater risk for the transport of invasive species of all kinds.

I3. Considering catastrophic natural disturbances in vegetation management decisions.

Why is this issue important?

- Catastrophic natural disturbance events such as wind and fire may negatively affect the amount of forest land available for harvest and marketable timber available for sale.
- Large-scale disturbance events influence the short- and long-term desired future condition (DFC) goals of this plan.
- 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.

Why is this issue important?

- Effects of climate change may include:
  - changes in frequency and intensity of precipitation events and disturbances such as fires and windstorms (blowdown)
  - changes in the distribution and survival of plant and animal species
  - increased reproductive capability and survival of some non-native invasive species, insect pests, and pathogens that affect forests and wildlife
  - negative effects on tree species, such as quaking aspen, black spruce, balsam fir, paper birch, jack pine, and northern red oak
  - expansion of habitat for some tree species, such as basswood, sugar and red maple, red and bur oak, black walnut, eastern white pine, and eastern red cedar
  - reduced timber production and access to winter management sites
- Forests with lower species and structural diversity are projected to be less resilient to climate change impacts.
- Communities thought to be most vulnerable to changing climate include peatlands, boreal forests, 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, may 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 choose to spend their recreation and vacation time in or near forested areas.
- Visual quality is an important consideration for vegetation management activities conducted adjacent to recreational trails, lakes, waterways, or near public roads and highways.

L. Access to State Land

L1. Providing access to stands identified for management.

Why is this issue important?

- Access routes are necessary for vegetation management activities, insect and disease control, fire response, and recreation.
- 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
  - limits impacts to water quality, changes to hydrology, 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 that is of spiritual, traditional, scientific, or educational value. Examples include the archaeological remains of a 2,000-year-old American Indian village, an abandoned logging camp, a portage trail, a cemetery, food-gathering sites such as wild rice harvesting and maple sugaring camps, birch peeling locations, 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 takes administrative land status and relevant statutes into consideration. Some examples include:

- The DNR is mandated by the Minnesota State Constitution and state statute 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 and other specific policies provided in state law.
- Wildlife habitat management and protection are mandated for Wildlife Management Area (WMA) lands.
- The DNR must comply with federal and state endangered species acts.

Chapter 3: Forest Types and Management Direction

Introduction

Managing for sustainability requires that we address the issues identified in Chapter 2 to balance multiple forest benefits. Sustainably managed forests support a healthy and competitive timber industry, provide the diversity of habitats needed by plant and animal species, maintain water quality and quantity, provide funding to the school trust fund, and provide a wide array of recreational opportunities. This chapter provides future direction to forest managers that aims to balance the issues identified in this plan while adhering to DNR policy.

Past similar SFRMPs (developed by an interdisciplinary team) are used by Forest Resources Planners to develop a draft plan for the section. Planners and personnel from DNR Divisions of Forestry, Fish and Wildlife, and Ecological and Water Resources review, revise and edit SFRMPs. In Chapter 3 are general direction statements (GDSs) and strategies developed 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). The WSU SFRMP considers and is in line with MFRC East Central and North Central regional landscape committees' desired outcomes, long-term goals, and strategies for forest lands and ecosystem types in the northern landscape region. The WSU Section most closely aligns with the MFRC East Central Landscape area.

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 direction provided in state statutes and rules, and Department policies, guidelines, and management direction
- incorporate DNR specialists' expert knowledge in their fields
- make recommendations such as increasing, decreasing, maintaining, or protecting a forest condition, output, or quality
- are grouped under 12 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) goals for the desired condition of DNR forest lands in the management pool in the Section
- were identified where we have the ability to measure and quantify progress

Role of Department Guidance Documents, Policy, and Management Recommendations

In addition to DFCs, GDSs, and strategies identified in this SFRMP, a vast array of planning documents, guidelines, policies, objectives, and initiatives direct vegetation management on state-administered land. Vegetation management decisions by the DNR must consider these directives as they apply to individual site-level decisions. The DNR's internal forest policy framework provides clarification and guidance to staff on how to interpret and implement these directives as they relate to one another.

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

- Does the treatment meet current DNR policies and apply guidelines as appropriate?
- Which DNR Division is the land administrator, and what is the land status?
- Does the planned management meet the intent of MFRC site-level guidelines?
- Is the management activity appropriate to the NPC? Is it consistent with the ECS silvicultural interpretation?
- Does the stand present a good opportunity to contribute to SFRMP conversion goals?
- Do planned actions account for ETS species and Species of Greatest Conservation Need as appropriate to the particular land status?
- If appropriate, have climate change adaptation strategies been implemented?
- If a forest health issue is present, have current guidelines or forest health specialists been consulted as appropriate?
- Is the site in a MOA? If yes, have the MOA guidance documents been accounted for?
- Have forest coordination agreements been documented and followed?

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

3.1 Forest Composition and Within-stand Diversity

Broadly, the goals for forest composition and within-stand diversity in this section 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 WSU Section.

The GDSs and Strategies in this section particularly 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 WSU 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 Intranet Forest Management Direction Documents page; those directions are updated to reflect current management guidance and policy. And other documents as available.

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 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 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 and, therefore, may deviate from these assumed management approaches. For more information, see the DNR's Development of the 10-year Stand Exam List report.

Table 3.1: General management strategies by cover type. Actual prescriptions may vary depending on the results of field examinations and stand management objectives.

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	✓	✓	✓	White cedar			✓
Oak	✓	✓	✓	White spruce natural			✓
Balsam fir		✓		White spruce plantation	✓	✓	
Black spruce-lowland		✓		White pine natural			✓
Black spruce-upland		✓		White pine plantation	✓	✓	✓ (FAW)

Ash/Lowland Hardwoods

The ash and lowland hardwoods (Ash/LH) cover types are combined into one management category for this SFRMP because they are commonly associated with each other and are managed under the same management prescriptions. Wet forest native plant communities that include ash and lowland hardwood species occur along water features or in depressions where the water table is generally within reach of plant roots.

These cover types are often managed using uneven-age treatments.

Current Acres: 19,443 acres in the WSU Section (approximately 5.5% of state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 19,243 acres (1% decrease)
- 50-year DFC: 18,443 acres (5% decrease)
- Increase within stand diversity.
- Increase the resilience of sites to emerald ash borer (EAB).
- Maintain forested conditions of ash and lowland hardwood sites in the wake of EAB.
- The conversion goal acres total is for the full Ash/LH cover type. Due to special concerns and management directions, it is assumed that Ash will decrease more significantly while efforts are made to maintain or even slightly increase LH.
- Continue to work to identify EAB infestations and take action appropriate to the current direction.

Strategies

- As field visits occur in ash cover type stands or stands with ash as a component, look for opportunities to:
  - Convert to other cover types dominated by species other than ash in stands assigned for harvest consideration.
  - Seek opportunities to increase the percentage of or plant NPC-suitable non-ash species in stands where harvest is not considered.
- Follow Department/Division guidelines on managing ash to address the threat of emerald ash borer, including:
  - Maintain an ash component in all stands, but attempt to reduce the number of ash.
  - Utilize forest management approaches that maintain water regulation and groundwater conditions suitable for forest growth.
  - Promote non-ash species appropriate to NPC.

Special Considerations

- Emerald ash borer (EAB)

Aspen/Balm-of-Gilead

Aspen and balm-of-Gilead (A/BG) cover types are combined in the SFRMP because they are commonly associated with each other and are managed similarly. Aspen/BG-dominated native plant communities in the WSU Section are typically mesic to wet-mesic forests with a mixture of hardwood species and some conifers in the canopy and understory.

Current Acres: 104,013 acres in the WSU Section (approximately 29.4% of state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 102,713 acres (1.25% decrease)
- 50-year DFC: 97,513 acres (6.25% decrease)
- Move toward balanced age class distribution.
- Increase within-stand diversity.

Strategies

- Use clearcut with reserves method to regenerate aspen.
- Convert utilizing NPC suitable species.
    - Convert 1% A/BG to other cover types to address NPC goals and climate change projections in this planning period.
    - Prioritize low density stands for conversion, stands growing of FD NPCs well suited to other species, as well as stands within old forest management complexes (OFMCs), management opportunity areas (MOAs), stands containing ETS species (if appropriate), old-growth special management zones (SMZs), and riparian management zones (RMZs).
    - Determine sites and species appropriate for conversion by field visits and NPC.
    - STH assumed conversion out of aspen on all land statuses.
    - Passive conversion may be appropriate on certain sites.
- Maintain upland cedar and tamarack where they occur in aspen stands.
- Increase northern hardwoods, birch and oak, and conifers, including white pine, white spruce, red pine, balsam fir, and upland white cedar, as appropriate to NPC, as components of the stand.

Special Considerations

- Conversion can be challenging due to aggressive suckering.
- Funding availability may limit the ability to achieve conversions
- 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
    - preferred host for gypsy moth
- Climate change effects may limit the ability to achieve goals for this cover type.

- Large diameter aspens are heavily utilized by cavity-dependent wildlife.
- Sustainable timber harvest model parameters included retaining 2.5% of aspen 60 years old and older statewide to provide habitat associated with older aspen.

Birch

The birch (Bi) cover type includes paper birch and, to a limited extent, yellow birch in WSU. Birch-dominated NPCs in the WSU Section are typically mesic to wet-mesic forests with a mixture of hardwood species and some conifers in the canopy and understory.

The Bi age class distribution does not reflect the desired balanced structure for even-aged managed cover types (Appendix C). Age classes are skewed towards old and young. Due to the small number of acres of this cover type in the WSU Section, attaining a balanced age class distribution is unlikely. However, improving the age class balance remains a goal for Bi.

Current Acres: 6,767 acres in the WSU Section (approximately 1.9% of state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 6,567 acres (3% decrease)
- 50-year DFC: 5,767 acres (14.75% decrease)
- Move closer to a balanced age class distribution.
- Increase within stand diversity.
- Maintain and encourage birch as a component of other cover types as appropriate.
- Note: Decrease is an indication of expected due to many factors, including climate change, not necessarily the desire of managers. Efforts will need to be made to limit the decrease to only this amount.

Strategies

- Use clearcut with reserves and seed tree methods to regenerate paper birch.
- Consider group selection cuts near yellow birch seed trees to maintain and/or increase yellow birch presence in stands on suitable NPCs.
- Manage stands selected for harvest that contain yellow birch for yellow birch regeneration.
  - A variety of methods can be used to regenerate yellow birch; however, seeds require decaying coniferous nurse logs, tip-up mounds, or exposed mineral soil to sprout.
- Consider opportunities to increase Bi cover type to contribute to A/BG conversion goals (see Strategies for A/BG above).
- Increase northern hardwoods, including birch and oak, and conifers, including white pine, white spruce, red pine, jack pine, and upland white cedar, on appropriate NPCs.

Special Considerations

- While balancing Bi age classes may not be attainable due to the small number of cover type acres, improving the imbalance by continuing to regenerate acres is a goal.
- Birch is used for non-timber harvest of chaga, birch bark, and poles and has cultural significance to tribal communities.
- Birch cover types are difficult to re-establish. Establishing a mixed stand is a more achievable goal.
- Birch regeneration appears to do well following heavy site disturbance.

Northern Hardwoods

Northern hardwood (NH) stands in the WSU Section usually occur on upland sites with moist soils in settings protected from fire. Natural, mature NH stands are comprised of mixed species, including sugar maple, American basswood, red maple, elm, and additional species found in other cover type groups (oak, birch, and aspen).

Northern hardwoods are often managed as an uneven-aged cover type, so balancing age class distributions is not a goal for this cover type.

Current Acres: 38,396 acres in the WSU Section (approximately 10.9% of state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 39,396 acres (2.6% increase)
- 50-year DFC: 43,396 acres (13% increase)
- Improve timber quality.
- Increase within stand diversity as appropriate.
- Encourage NH components in other cover types as appropriate.

Strategies

- Use uneven-aged and gap management to regenerate NH and manage species composition.
- Convert to NH cover type.
    - Passively or gradually convert from aspen-dominated stands to more diverse stands with additional hardwood trees.
    - Note: There may be some interplay between NH and Oak acre conversions due to percentages in stands.
- Increase the abundance of white pine, white spruce, and yellow birch components where opportunities exist.
- Increase oak and maintain birch and basswood in mixed stands as appropriate.

Special Considerations

- Without larger disturbances such as gaps, shade-tolerant species such as maple and basswood will increase in abundance at the expense of shade-intolerant species such as birch and oak.
- Considering climate change and market forces, some aspen stands may gradually convert to more NH-dominated stands.

Oak

The oak cover type includes northern pin, red, and bur oak. Natural, mature oak stands range from nearly pure oak to mixed stands, occurring in both mesic hardwood and fire-dependent NPCs. Oak species are commonly found as a component of other cover types, such as aspen, birch, northern hardwoods, and lowland hardwoods (bur oak).

The oak acres in the WSU Section tend a bit to the older age classes (Appendix C).

Current Acres: 33,870 acres in the WSU Section (approximately 9.6% of state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 34,620 acres (2.2% increase)
- 50-year DFC: 37,620 acres (11.1% increase)
- Maintain age and species composition within stands.

Strategies

- Convert approximately 600 acres (3,000 acres over 50 years total) to oak cover type as appropriate to the NPC.
  - Note: There may be some interplay between NH and oak acre conversions due to percentages in stands.
- Consider the amount of advanced regeneration when planning regeneration methods.
- Accelerate oak regeneration management efforts through the use of:
  - prescribed fire
  - planting
  - seedling protection
  - taking advantage of good natural acorn years
  - selecting for Oak in selective management efforts
  - stump sprout thinning
- Attempt to regenerate stands before their age begins to limit the success of stump regeneration.

Special Considerations

- Acorns are an important mast source for many species of wildlife; wildlife goals often stress a level of the continued presence of mast-producing trees during regeneration efforts.
- Considering climate change and market forces, some aspen stands may gradually include a greater component of oak.
- May need to begin recruiting advanced regeneration 20 or more years before the final harvest of a shelterwood system.
- Tending will be needed post-harvest to retain oak seedlings in the new stand.
- Post-final harvest regeneration can be challenged if there is not sufficient advanced regeneration.
- Mesification due to less frequent low intensity fire occurrence results in thicker duff layers and an increase in shade-tolerant/disturbance intolerant species.

- The age class of oak is not well balanced, and much of the acreage in the planning area is older and younger stands are not present in sufficient acres to replace them in the future; acceleration of regeneration efforts is needed to achieve goals.
- Oak wilt is a pathogen of increasing concern in WSU, and appropriate action should be taken when identified.

Balsam Fir

Natural, mature balsam fir (BF) stands are typically mixed stands. Balsam fir is best suited to wet-mesic sites where adequate soil moisture is available throughout the growing season but can be found as a minor component across a range of site conditions.

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

Current Acres: 1,636 acres in the WSU Section (approximately 0.5% of state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 1586 acres (3% decrease)
- 50-year DFC: 1386 acres (15.25% decrease)
- Desired within-stand composition is mixed, including long-lived conifers and upland hardwoods appropriate to NPC.
- Maintain some stands and retain fir as a component of stands on suitable NPCs.
- Manage balsam fir as a component of other mixed-species cover types.

Strategies

- Convert BF cover type on appropriate sites. (Note, much of this change is expected to happen due to a variety of conditions and will not need to be actively pursued)
- Manage BF primarily as even-aged for pulpwood and bolts and to support wildlife habitat.
- Use intermediate treatments to influence species composition and speed up stand development.
  - best results from release treatments in young, vigorous stands (approx. 6-10 feet tall)

Special Considerations

- Insect and disease concerns - see current management guidelines or consult a Forest Health Specialist:
  - spruce budworm
- Climate change may reduce habitat for the BF cover type.
- In some situations, this cover type may be managed as uneven-aged (particularly when there is a major natural-origin white pine component or on more mesic sites).
- The WSU is on the south end of the balsam fir range, and balsam fir often exists only for a brief transitional period during the stand's successional path.

Black Spruce (Lowland)

Natural, mature BSL stands range from pure or nearly pure stands to mixed stands, including secondary species such as tamarack, balsam fir, cedar, white pine, and birch. The black spruce (lowland) (BSL) cover type is managed as an even-age cover type for pulpwood.

The current BSL age class distribution does not reflect the desired balanced age class structure for even-age managed cover types. It tends to the older age classes. (Appendix C).

Current Acres: 10,313 acres in the WSU Section (approximately 2.9% of state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 10,413 acres (1% increase)
- 50-year DFC: 10,813 acres (4.8% increase)
- Move toward balanced age class distribution.
- Maintain or increase secondary component species such as tamarack, white cedar, balsam fir, and paper birch following harvest to retain structural and compositional diversity and promote additional natural seeding.

Strategies

- Much of the conversion to BSL will come from ash portions of ash/LH cover type on appropriate sites.
- Maintain or increase secondary component species such as tamarack, white cedar, balsam fir, and paper birch.

Special Considerations

- BSL grows slowly and may have reduced vigor in some NPCs, especially on sites compacted by harvest operations.
- Insect and disease concerns - see current management guidelines or consult a Forest Health Specialist regarding Eastern dwarf mistletoe.
    - Eastern dwarf mistletoe may be addressed differently, depending on the land administrator.
- BSL may lose habitat and decline in abundance according to some projected climate change scenarios. Include a mix of species in regeneration plans to increase climate change resilience.
- As stands are harvested, consider management to reduce the potential of a rise in water level.
- Harvest has the potential to release Sphagnum mosses and/or Ericaceous shrubs, altering the groundcover and suppressing black spruce regeneration.
- WSU is on the southern edge of the natural range.

Black Spruce (Upland)

Upland black spruce (BSU) stands are typically mixed with other conifers (often co-dominant with jack pine), aspen, and birch. BSU stands are found on nutrient-poor, dry to mesic sites.

Very little BSU is found in the WSU, so age class distribution is difficult to assess and maintain as a goal.

Current Acres: 82 acres in the WSU Section (<0.1% of state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 82 acres (no change)
- 50-year DFC: 82 acres (no change)
- Maintain acres of BSU and increase upland black spruce abundance in other cover types.

Strategies

- Use small-gap strategies to perpetuate advanced regeneration of BSU, take advantage of seed trees, and reduce aspen competition.

Special Considerations

- Reduced seed sources and aspen competition challenge our ability to maintain and increase this cover type.
- WSU is on the southern edge of the natural range.

Jack Pine

Mature jack pine (JP) stands are often nearly pure but can include other conifers, birch, and possibly red maple. Most JP stands are found on dry, sandy upland sites. Jack pine in the central and northern floristic regions are adapted to different disturbance regimes. Central floristic region jack pine is adapted to more frequent fire, and have a shorter life span and few serotinous cones, and stands often regenerate over longer periods of time. The jack pine (JP) cover type is managed primarily as an even-aged cover type for pulpwood and bolts and to support wildlife habitat and biodiversity.

Current Acres: 1,071 acres in the WSU Section (approximately 0.3% of state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 1,121 acres (4.7% increase)
- 50-year DFC: 1,321 acres (23.3% increase)
- Move toward a more balanced age class structure as possible.
- Desired within-stand composition is relatively pure jack pine in younger growth stages. As stands mature, other species may increase depending on NPC.
- Encourage JP as a component of other cover types as appropriate.

Strategies

- Convert to JP cover type on appropriate NPCs.
- Consider local seed zones and ECS floristic region in reforestation plans.
- Mix in other NPC appropriate species in regeneration efforts to help mitigate potential climate change impacts.
- Consider the use of seed trees for regeneration in suitable FDc or FDs NPC stands.

Special Considerations

- Insect and disease concerns - see current management guidelines or consult a Forest Health Specialist:
  - Jack pine budworm
- Jack pine woodlands can have naturally low stocking. For more information, refer to regeneration standards in *Regeneration Monitoring: Procedures and Standards* for information on jack pine stocking levels in the northern floristic region.
- Jack pine is expected to decrease in abundance and have reduced habitat under some projected climate change scenarios. Include a mix of species in regeneration plans to increase climate change resilience.
- Many JP-dominated FDn communities (e.g., FDc23, FDn23) have elevated conservation status ranks (state critically imperiled, imperiled, and/or vulnerable). Follow the latest guidelines when managing these rare NPCs.
- Natural jack pine regeneration is often delayed in newly regenerating stands. If site conditions are favorable and a seed source is present, consider delaying the assessment of regeneration for five years after treatment when jack pine seedlings are more evident.
- Jack pine will also often fill in a young red pine stand following the planting.
  Chemical release options for young jack pine seedlings or stands are severely limited.

Red (Norway) Pine – Natural Origin

Red pine (RP) on DNR timberlands is treated as two distinct cover types. Planted stands are managed using an economic rotation age. Natural origin stands are managed to reflect a more natural age class distribution, with a final harvest consideration given to maintaining the qualities and characteristics of natural origin stands. Natural origin stands are often planted after a final harvest, but the stands are still considered natural origin and follow the rotation age for natural origin stands.

Red pine-dominated NPCs in the WSU Section are typically dry to mesic forests that range from nearly pure stands to mixtures with other conifers and hardwood species, especially aspen and birch.

Natural Origin Red Pine age distribution is fairly even in the WSU Section (Appendix C).

Current Acres: 742 acres in the WSU Section (0.2% of state-managed forest acres; planted and natural origin red pine together represent approximately 2.2% of state-managed forest acres)

Future Direction and Goals

- Maintain natural origin red pine cover type acres.
- Desired structure within red pine ranges from predominantly single-canopied even-aged stands to multi-canopied, mixed-aged stands with red pine, other conifers, and deciduous species as co-dominants.
- Manage red pine as a component of other cover types as appropriate to NPC.

Strategies

- 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.
  - 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 tolerant species where seed sources or advance regeneration for these are lacking. For species suggestions, refer to the *Field Guide to Native Plant Communities of Minnesota* and NPC silviculture strategies.
- Consider the following recommendations when regenerating red pine:
  - Use natural regeneration in natural origin stands when opportunities arise.
  - If natural regeneration alone is not feasible, consider implementing a mix of strategies during stand regeneration, including natural seeding, artificial seeding, and planting.
  - Evaluate and prepare an adequate seedbed or planting site for red pine regeneration while retaining areas of undisturbed ground layer.
  - Maintain or enhance within-stand diversity during site preparation and release treatments considering desired future condition and NPC.

- Prescribed fire in mature red pine stands can be an effective management tool for eliminating shrub competition, reducing thick duff layers, and preparing seedbeds. Summer fires conducted over several growing seasons are most effective at controlling dense shrub competition and exposing mineral soil.
- Evaluate the presence of *Diplodia* tip blight and canker (*Sphaeropsis sapinea*) and shoot blight (*Sirococcus conigens*) in understory pine.
- Consider managing for other conifer species (e.g., white pine, jack pine) near adjacent mature red pine where *Diplodia/Sirococcus* are a concern.
- Identify and protect legacy trees per Department legacy tree direction.

- Consider the potential impacts of bark beetles during intermediate harvest in red pine (see below).

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 conigens*)
  - bark beetles (*Ips* and *Dendroctonus* spp.)
- Several RP-dominated FDn communities (e.g., FDc34, FDn43) have elevated conservation status ranks (state critically imperiled, imperiled, and/or vulnerable). Follow the latest guidelines when managing these rare NPCs.
- Red pine may lose habitat and decline in abundance according to some projected climate change scenarios.
- As red pine stands mature, they tend to lose overstory tree species diversity due to mortality and cull selection during thinning. Understory diversity, however, tends to increase as the stand ages.
- Keeping understory tree and shrub competition under control during the life of the stand will assist any natural regeneration efforts.

Red (Norway) Pine – Planted

Red pine (RP) on DNR timberlands is treated as two distinct cover types. Planted stands are managed using an economic rotation age. They are typically dominated by planted red pine but often include components of jack pine, birch, and aspen.

Planted red pine tends towards the older age classes with a rise again at the young (Appendix C).

Current Acres: 7,203 acres in the WSU Section (approximately 2% of state-managed forest acres; planted and natural origin red pine together represent approximately 2.2% of state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 7,603 acres (5.5% increase)
- 50-year DFC: 9,203 acres (27.8% increase)
- Move toward a more balanced age class structure for classes between 0 years and economic rotation age.
- Manage for high-value forest products, biological diversity, riparian buffers, recreation, and aesthetics, where possible or appropriate.
- Diversify stands as they age.
- Increase within-stand structure to maintain or improve site productivity, wildlife habitat, and biodiversity.

Strategies

- Convert to RP planted cover type on suitable FD NPCs.
  - Where possible, take opportunities to mimic the qualities and characteristics of natural origin stands.
  - Include a diversity of species in the establishment of RP sites (include other NPC appropriate species in planting prescriptions).
- 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). Use thinning to reduce stand density to increase future tree growth, quality and vigor, and to obtain the desired composition of the stand. Recommendations are:
  - Conduct normal rotation stand thinnings in merchantable stands at approximately 10-year intervals, depending on site quality.
  - Older stands may have longer intervals between thinnings to compensate for slower growth rates and to facilitate the growth of desirable understory species.
  - Consider incorporating variable density thinning or other techniques to meet biodiversity or habitat objectives.
- Large gaps (~3 ac) may be produced during early thinnings in mixed red pine/jack pine stands to encourage jack pine seeding, thereby ensuring that the species is not eliminated from the stand during later thinnings or due to early mortality.

- To regenerate planted RP, use clearcut or clearcut with reserves or seed trees as forest health issues allow. Use the following considerations:
  - Maintain or enhance within-stand diversity during site preparation and release treatments considering 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 conigens*) 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 *and legacy trees as required by DNR legacy tree direction.*
- Reserve biological legacies such as large, healthy, live trees, decadent trees, snags, logs, and other coarse woody debris.
- Limit herbicide use and consider its impact on non-red pine trees and mast-producing species. These provide important sources of diversity and food for wildlife.

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 conigens*)
  - bark beetles (*Ips* and *Dendroctonus* spp.)
- Of the red pine cover types, planted red pine is specifically projected to have a moderate to high vulnerability to climate change in some models.
- Several RP-dominated FDn communities (e.g., FDc34, FDn43) have elevated conservation status ranks (state critically imperiled, imperiled, and/or vulnerable). Follow the latest guidelines when managing these rare NPCs.
- As red pine stands mature, they tend to lose overstory tree species diversity due to mortality and cull selection during thinning. Understory diversity, however, tends to increase as the stand ages.
- If a seed source is present, jack pine will often fill in a young red pine stands following planting.
- A red pine stand can be a good transition cover type when converting a hardwood stand to a conifer stand.

Stagnant Spruce

This cover type is mostly composed of lowland black spruce or a mix of black spruce and other lowland conifers growing on very poor sites with organic soils that are saturated throughout the year and have low nutrient levels. Stagnant spruce has a site index of less than 23, meaning that when trees are 50 years old, they are 22 feet tall or less.

Stagnant spruce (Sx) is not considered a commercial cover type; however, some harvest occurs for non-timber forest products, such as decorative spruce tops. Tree tops from 1 ½ to 6 feet in length are cut from selected trees, which typically grow new tops from lateral branches over time. Harvest level varies with tree size and quality and industry product specifications. In most stands, selection harvest ranges from 5-10 percent to as high as 20 percent of trees. Harvesting in higher quality stands has occurred periodically on a 10-15 year cycle.

Balancing the Sx age class distribution is not a goal for this cover type.

Current Acres: 10,493 acres in the WSU Section

Future Direction and Goals

- Maintain existing cover types to support ecological and wildlife values associated with stagnant spruce.

Future Direction and Goals

- Consider the hydrologic effects of management activities within or adjacent to this cover type.
- When managing around stagnant spruce stands, use reserves to maintain corridors for plant and animal species.

Special Considerations

- Consider reassessing the site index on some stagnant stands that may be productive.
- WSU is on the southern edge of the natural range

Tamarack

Natural, mature tamarack (T) stands range from pure or nearly pure stands to mixed stands and predominantly occur in poorly drained peatland settings, although historically upland tamarack had a larger extent than today. Secondary species in the cover type include black spruce, balsam fir, cedar, and birch.

Current Acres: 9,993 acres in the WSU Section (approximately 2.8% of state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 9,633 acres (3% decrease)
- 50-year DFC: 8,493 acres (15% decrease)
  - NOTE: Much of the conversion will result due to factors such as insects, disease, and climate change.
- Move toward balanced age class distribution.
- Maintain or increase secondary component species such as black spruce, white cedar, balsam fir, and paper birch following harvest to retain structural and compositional diversity and promote additional natural seeding.
- Manage tamarack as a component of other cover types as appropriate to NPC.

Strategies

- Harvest, leaving seed trees, in advance of Eastern larch beetle (ELB). Leaving at least 6-12 tamarack per acre is recommended for successful seeding.
- Increase tamarack within other cover types and on upland sites as appropriate.
- Maintain or increase secondary component species of T stands where possible by:
  - reserving seed trees, reserve islands, clumps of mature trees, or advanced regeneration
  - including other species such as black spruce and cedar when artificial seeding

Special Considerations

- Insect and disease concerns - see current management guidelines or consult a Forest Health Specialist:
  - Eastern larch beetle (ELB)
- WSU is on the southern edge of the natural range.

White Cedar

White cedar (WC) is long-lived and is the climax species in most NPCs in which it occurs. Natural, mature WC stands range from pure to mixed stands. White cedar occurs on a wide range of site conditions.

Balancing WC's age class distribution is not a goal for this cover type. Most WC acres are in the 90-150+ age classes, with relatively few acres in the 1-90 age classes (Appendix C).

Current Acres: 429 acres in the WSU Section (approximately 0.1% of state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 448 acres (4.7% increase)
- 50-year DFC: 528 acres (23.4% increase)
- Increase the abundance of white cedar as a component of other cover types.
- Emphasize retaining WC in deer wintering areas.

Strategies

- Convert to WC cover type.
- Maintain acreage of WC stands used as thermal cover areas by deer.
- Maintain or increase white cedar as a component of other forest cover types.
- Limited harvesting is expected of cedar in this planning area. Manage stands as multi-age and mixed-species stands.

Special Considerations

- Tree protection from browsing by deer, mice, and snowshoe hares may be required to increase or maintain WC stands.
- Limited harvesting is expected because markets are poor for cedar products and because of regeneration challenges, especially for upland cedar.
- White cedar swamps are home to many species of rare plants within this ecological section, including several state-listed orchids.
- WSU is on the southern edge of the natural range.

White Pine

White pine (WP) occurs as pure stands and as a component of many other upland cover types in the WSU Section, including both fire-dependent and mesic hardwood NPCs. A stand can belong to the WP cover type if it contains greater than 33% white pine by volume or basal area. While white pine was more common historically in WSU, currently, it is uncommon.

WP stands receive uneven-aged management, so balancing age class distributions is not a goal for this cover type.

Current Acres: 633 acres in the WSU Section (approximately 0.2% of state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 663 acres (4.7% increase)
- 50-year DFC: 783 acres (23.7% increase)
- Maintain age and species composition within stands.
- Maintain or increase white pine as a component of other forest cover types as appropriate to NPC.

Strategies

- Convert to WP cover type.
  - Assess the suitability of stands that include white pine for capacity to convert to the WP cover type considering NPC and *Suitability of Tree Species by Native Plant Community* table.
  - Prioritize conversions to WP in locations with older forest or pine cover type goals, such as OFMCs, forest interior habitat MOAs, and old forest patches.
  - Immediate conversion to white pine plantations will generally be discouraged.

  In most cases, conversions to type will take place over several planning periods. Assess stands chosen for conversion for the need for tree protection measures.
- 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 appropriate stands.
- Review stands for the presence of legacy trees and follow Department legacy tree direction where found.
- Increase the amount of white pine occurring as a component in mixed stands as appropriate to NPC.
- Look for options to re-introduce white pine back into stands or increase the white pine component through low density under-planting in other cover types.

Special Considerations

- White pine is projected to fare well and expand with the impacts of climate change.
- Insect and disease concerns – see current management guidelines or consult a Forest Health Specialist:
  - white pine blister rust
- Deer herbivory can be a challenge for white pine recruitment.
- Establishing pure white pine stands can be quite challenging and should be discouraged. Mixed stands are preferred.

- Chemical release options for young white pine seedlings or stands are severely limited.

White Spruce

White spruce (WS) stands vary from planted monotypic stands of nearly pure white spruce to natural origin stands that include other canopy tree species. Natural origin white spruce is managed as an uneven-aged cover type, while plantation white spruce is managed as an even-aged cover type.

Current Acres: 2,332 acres in the WSU Section (approximately 0.7% of state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 2,029 acres (13% decrease)
- 50-year DFC: 817 acres (65% decrease)
  - NOTE: much of the conversion is due to outside factors more than the desire of managers.
- Increase within stand diversity.
- Maintain white spruce as a component of other forest cover types as appropriate to NPC.

Strategies

- Convert approximately 303 acres (1,515 acres over 50 years total) of WS cover type on appropriate sites. (Note, much of this change is expected to happen due to a variety of conditions and will not need to be actively pursued)
- Manage natural-origin WS as multi-age and mixed-species stands. Recommendations include:
  - Retain some super canopy trees in patches or clumps at each treatment; assess stands for the presence of legacy trees.
  - Encourage multi-layered understory development.
  - Emphasize regenerating white spruce in the understory.
  - Use single-tree and group selection harvest methods for stands that are already multi-aged.
  - For even-aged stands, use shelterwood, seed tree with reserves, or group selection harvest methods to move the stand toward becoming multi-aged.
- Assess the NPC of white spruce plantations and future growth potential; consider conversion to other cover types where NPC/future growth potential limitations exist.
- Manage WS planted on suitable NPCs as normal rotation stands on an even-aged basis for pulpwood, bolts, and sawtimber products.
- After final harvest, convert plantation WS stands to mixed species, structurally diverse stands using NPC information to select the most appropriate species.

Special Considerations

- Insect and disease concerns - see current management guidelines or consult a Forest Health Specialist:
  - spruce budworm and yellow-headed spruce sawfly
  - needle cast diseases and other insects (e.g., spruce weevil, spruce beetle, etc.)
- Thinning damage to the shallow root system of WS.
  - Thin only when the ground is frozen, and snow is present to avoid damaging shallow spruce tree roots.

    - Conduct the first thinning before the plantation is 30 years old.
    - Consider forgoing intermediate treatments in lieu of final harvest, as WS may decline as a result of multiple stand entries.
- Consider managing aspen/spruce/fir mixed stands on suitable NPCs for their high value to wildlife species.

Open Landscapes (upland and lowland grass and brush)

The upland and lowland grass (UG/LG) and upland and lowland brush (UB/LB) cover types are managed together as open landscapes. Species composition is variable and depends on factors such as NPC, hydrology, disturbances, management history, presence of invasive species, etc. In this Section, most lowland brush acres are dominated by willow and alder species.

The management emphasis is to maintain and enhance these cover types so they can provide ecosystem services, including sustaining populations of wildlife and plants. Strategies in this plan focus on habitat for sharp-tailed grouse, which will also benefit other species associated with open landscapes.

Many of these cover types are more recent developments due to increased water levels and increased fire intervals over the last 150 years.

Current Acres: 103,199 acres in the WSU Section (approximately 29% of state-managed forest acres)

Future Direction and Goals

- Maintain species diversity and abundance appropriate to NPC.
- Maintain open landscape acres on the landscape.

Strategies

- Coordinate on open landscape projects designed to enhance open landscape conditions in sharp-tailed grouse habitat:
  - Identify open landscape projects within the Section using available information and review by field staff.
  - Allow selection of hardwood stands younger than rotation age for even-age management.
  - Use prescriptions that enhance open landscape habitat conditions (e.g., creating larger blocks of even-age cover types managed with a clearcut prescription, minimizing leave trees in the interior of harvest blocks, discouraging conifer planting).
  - Consider swapping upland stands over or approaching rotation age and merchantable lowland conifer stands with stands within or adjacent to open landscapes on stand exam lists.
  - Encourage biomass removal on timber sales and promote brushland biomass harvest when feasible.
  - Enhance and maintain open habitat landscapes by increasing patch size and connectivity, especially within two miles of a sharp-tailed grouse lek.
  - Discourage tree planting in open landscape areas.
  - Coordinate across divisions on projects designed to set back or maintain successional stages (e.g., prescribed fire, mechanical winter shearing, or mowing).
- Encourage communication and coordination within DNR, with private landowners, and with other agencies and organizations to ensure awareness of open landscapes and recommended management.
- Some ash stands are, or have already, converted to lowland brush open landscapes naturally.

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 WSU Section, including projections of habitat suitability for those species under climate change, refer to the *NPC Silviculture Strategies for forest stand prescriptions* webpage.
- Convert cover types where appropriate (Table 3.2a and b; see Fig. 3.1 for example and Cover Type accounts for more detail).
  - Determine sites and species appropriate for conversion during site visits and native plant community evaluations.
  - Increase the acreage of white pine, jack pine, white cedar, red pine, oak, and northern hardwoods.
  - Options available include:
    - Allow some stands to convert through natural succession with or without harvest (e.g., aspen to white spruce or balsam fir). Applicability of this option depends on land administration and status, ability to offer the annual planned volume, operability, and marketability, among other considerations.
    - 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.

Figure 3.1: Example of converting an aspen stand to a white spruce stand, resulting in an increase in conifer 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.

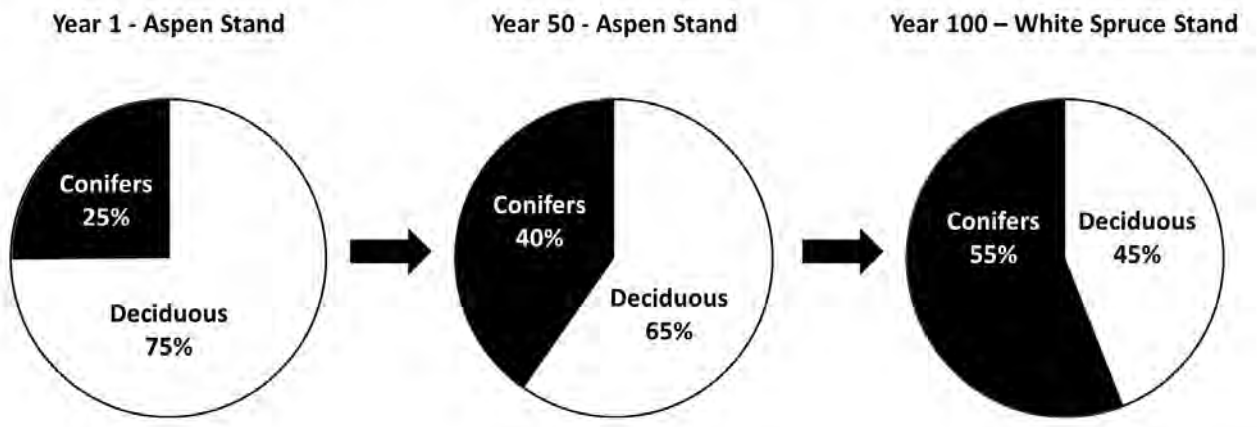


Table 3.2a: Current managed cover type acres in the WSU Section from the DNR's forest inventory and desired future conditions for the first decade and 50-year planning period (see Cover Types section below for more information on how conversion goals were developed).

Cover Type	Current Cover Type Acres	Conversion Acres (First Plan Decade)	% Change	Conversion Acres (50-year DFC)	Final Cover Type Acres (Current+50-year DFC)
Ash/Lowland Hardwoods	19,443	-200	-1.03%	-1,000	18,443
Aspen/Balm-of-Gilead	104,013	-1300	-1.25%	-6,500	97,513
Birch	6,767	-200	-2.96%	-1,000	5,767
Northern Hardwoods	38,396	1000	2.60%	5,000	43,396
Oak	33,870	750	2.21%	3,750	37,620
Balsam Fir	1,636	-50	-3.06%	-250	1,386
Black Spruce-Lowland	10,313	100	0.97%	500	10,813
Black Spruce-Upland	82	0	0.00%	0	82
Jack Pine	1,071	50	4.67%	250	1,321
Red Pine Nat	742	0	0.00%	0	742
Red Pine Plant	7,203	400	5.55%	2,000	9,203
Stagnant Spruce	10,493	0	0.00%	0	10,493
Tamarack	9,993	-300	-3.00%	-1,500	8,493
White Cedar	428	20	4.67%	100	528
White Pine	633	30	4.74%	150	783
White Spruce	2,332	-300	-12.86%	-1,500	832

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 Laurentian Mixed 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, that are characteristic of various NPC growth stages in stands.
- Use 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 Suitability of Tree Species by Native Plant Community table, including information on species affinity for warmer and/or dryer site conditions.

- Retain biological legacies through the incorporation of MFRC site-level guidelines.

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 selection harvesting to encourage diversity of species, ages, and stand structures.
- Meet or exceed the MFRC site-level guidelines designed to maintain a diversity of tree species within a stand.
- Follow the Department Legacy tree direction.
- 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 and saplings in a stand, timber sale regulations should specify outcomes to protect these regenerating trees. In some cases, portions of the stand may be delineated to protect regeneration by restricting harvest activity in those areas. To enhance seedling recruitment of some species, a partial canopy may be retained to meet the needed moisture and light requirements of the seedlings.
- Identify some stands where succession is allowed to occur to encourage the development of within-stand diversity. Movement to the next successional stage may be achieved with or without harvest.
- Increase and/or maintain target species, including white pine, white spruce, upland cedar, upland tamarack, upland black spruce, yellow birch, and oak 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 and variation within NPCs. This may be accomplished by:
  - accepting lower stocking levels of planted species in younger plantations if other desirable species are present
  - planting or seeding mixed species appropriate to the site
  - 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. This low species diversity occurred historically in peatlands and in association with large-scale disturbances, such as fire.
- All of the above-listed methods to maintain or enhance species diversity apply to these NPCs, but for a smaller set of species than would be found in more diverse NPCs.

3.2 Harvest Levels

The GDSs and Strategies in this section address Issues: C1, C2

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

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 plan and implement that disturbance because it is the most efficient and effective metric we have to align our actions to our objectives and 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 how the DNR manages forest lands
- age class imbalances for even-age 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-age 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

The statewide 10-year stand exam list was developed to implement the strategic direction for this plan period. See the DNR 10-year stand exam list report for more information. See Tables 3.3-3.4, Fig. 3.2, and Appendix D for acre and volume summaries for the 10-year stand exam list in WSU. 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 offered on timber sale permits, and the volume offered is not equivalent to the volume harvested.

After site visits, foresters determine whether forest stands should be appraised and offered for sale, have their inventory corrected, or have 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 treating stands older than normal rotation age and visiting the oldest stands on the stand examination list first.
- Consider SFRMP goals, MOA guidance document direction, and land administration when proposing annual plan additions (APAs) and assess how APAs (and deferred acres) interact with annual planned volumes.
    - Annual plan additions are stands or portions of stands that make sense to treat immediately (e.g., to address insect and disease, accelerated decline, salvage needs, or to adhere to policy) and are not on the stand exam list.
    - Consider the effects of APAs on future needs.
    - Follow applicable APA directions.
- 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.

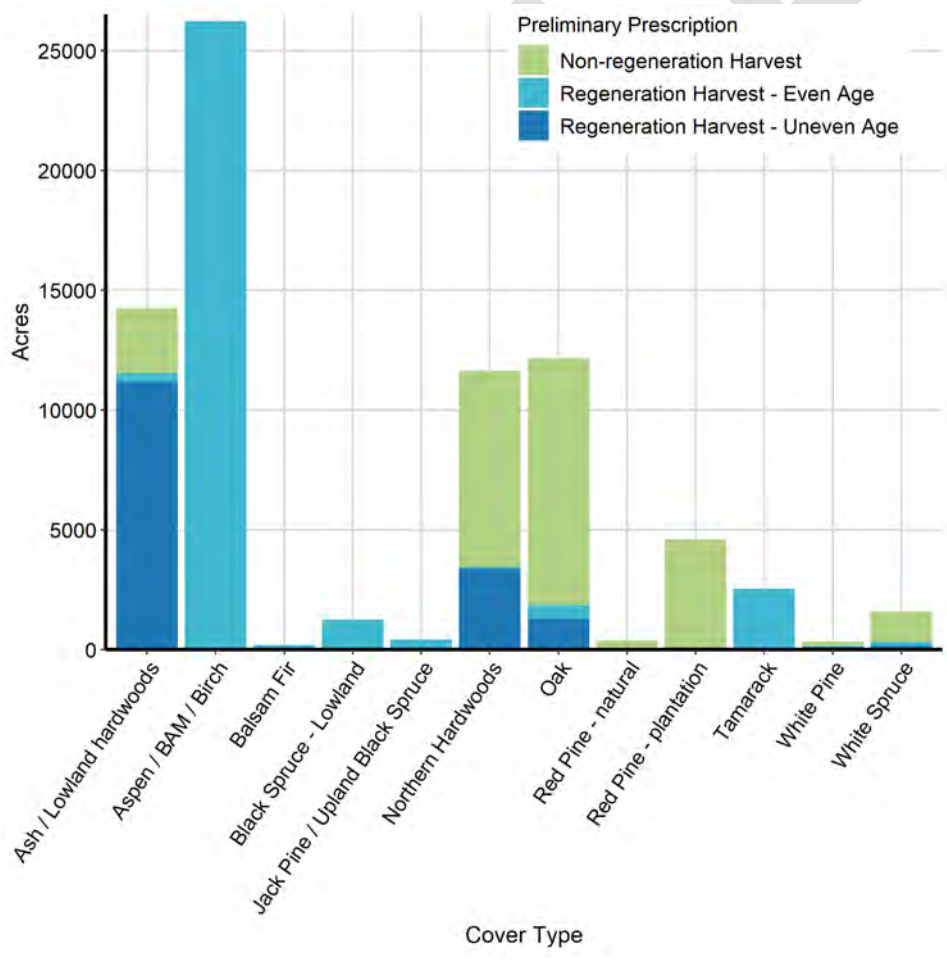
Table 3.3: Planned stand exam list acres and by cover type and land administrator on the 10-year stand exam list for the WSU Section (FY 2021-2030). SI = Site Index.

Modeled Cover Type	Forestry Acres Planned	Fish and Wildlife acres Planned	Grand Total
Ash / LH	12,666	1,583	14,250
Aspen/BAM/Birch	23,158	3,967	27,125
Balsam Fir	192		192
Black Spruce - Lowland	1,242	13	1,255
Jack Pine / Upland B Spruce	370	47	417
Non-Forest	16		16
Northern Hdwds	9,111	2,499	11,610
Oak	10,401	1,889	12,290
Red Pine - natural	372		372
Red Pine - plantation	4,429	167	4,596
Tamarack	2,389	142	2,531
White Pine	294	39	333
White Spruce	1,544	64	1,608
Grand Total	66,185	10,410	76,595

Table 3.4: Model estimated volume (cords) for acres on the FY2021-2030 stand exam list by land administering DNR Division and treatment groups in the WSU Section. The model estimated volume using yield estimates and assumptions about how DNR lands are managed to address multiple values. The volume offered for sale over the plan period may differ from the estimated volume on the 10-year stand exam list, in part because it will be unnecessary to offer all stands for sale to meet the annual planned volume. To avoid impacts on future goals, the Department is committed to not exceeding the annual planned volume. 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	493,228	81,393	**574,621**
Thinning	199,062	19,555	**218,617**
Uneven-aged harvest	93,358	39,454	**132,812**
Total	785,648	140,042	**926,050**

Figure 3.2: Acres on the 10-year stand exam list by cover types and preliminary prescription in the WSU Section (for cover types with at least 500 acres planned).



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

Non-timber forest products include decorative materials, foods, herbs, medicinal materials, 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 administration.

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.
- Consider known locations of important wildlife habitats, rare native plant communities, or rare species before issuing special product permits.
- Maintain non-timber forest products projected to be negatively impacted by climate change.

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

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 make-up of the forest.

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: In the early 20th century, timber harvesting practices and large wildfires caused much of the long-lived coniferous forest to be replaced by early successional species. The scale and intensity of timber harvest and wildfires had profound and long-lasting effects on seed sources, soil fertility, and subsequent re-vegetation. Current land ownership patterns, forest resource management goals, and constraints on different ownerships influence distributions of species, age classes, natural and human disturbances, and NPC growth stages across the landscape. In this section, historical drainage ditches continue to impact hydrology, forest 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 quaking aspen, balm-of-Gilead, and paper birch

cover type acreages and corresponding increases in cover types dominated by mid- and late-successional tree species such as northern hardwoods and long-lived conifers.

Wildlife browse: Browsing effects on vegetation vary with herbivore densities, including deer and snowshoe hare, and the availability and selection of browse material. In many areas today, it can be difficult to regenerate several tree species that are preferred by deer or hares. White pine, white cedar, oaks, and many other forest plants often fail to survive without protection from browsing or a reduction in deer numbers.

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, a 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, eastern white pine). 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 range from stands being over standard DNR rotation age for a cover type ("older forest") to stands designated as old growth to inclusions or past reserves of older trees within a stand represent mature to old forest on the landscape. These conditions are created or maintained in many ways on DNR-administered land and on other ownerships in the WSU landscape, including:

- Designation of old-growth stands.
- Incorporating older forest values in sustainable timber harvest analysis and stand exam list modeling:
  - Older forest across ownerships is considered during DNR planning (see below).
  - Annual planned volumes are based on model results that provide for the development and retention of some older forest.
  - Management regimes on FAW administered lands and in some management opportunity areas increase the potential for maintaining and creating older forest.
  - Allowance for 2.5% older aspen (at least 60 years old) statewide.
- 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 30% of acres on DNR annual stand exam lists don't result in timber sales. A portion of these represent or will become older forests.
- Application of site-level guidelines for leave tree and Department legacy tree direction
- Management for High Conservation Values.
- Conversions from shorter to longer-lived species (e.g., aspen to pine).

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.
   a. Current estimates of older forest from FIA across ownerships are significantly greater than original older forest SFRMP benchmarks.
3. DNR forest age class management may be adjusted in response to changing conditions across all ownerships.

GDS-3A Strategies

- Communicate any discrepancies between old forest benchmarks and current old forest across ownerships that are found during monitoring or plan preparation work to managers with recommendations on how to address them.
- Allow some stands, especially those with old forest characteristics, to succeed to long-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 E).
- Consider the presence of old-growth stands or characteristics in newly acquired Department lands; evaluate and manage according to old-growth policy.
- Use silvicultural treatments that retain old forest components in some stands such as OFMCs, FAW-administered lands, riparian areas, in relevant MOAs, and natural origin red pine stands.
    - When making decisions to add and offer unplanned wood for harvest, consider the habitat values of old forest in the area.
- Use silvicultural prescriptions or reserves to create corridors that connect older stands.
- Target long-lived tree species to leave as legacies.

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

Species of greatest conservation need (SGCN) are native animals whose populations are rare, declining, or vulnerable to decline and are below levels necessary to ensure their 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

- Apply SGCN data and Wildlife Action Plan guidance in vegetation management.
- Incorporate new SGCN locations and data into coordination and management as they are collected.
- Manage some MOAs consistent with their association with SGCNs.
- Maintain or enhance habitat for SGCNs during forest management, when feasible, given the land status.
- 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. Large forest patches may be formally recognized as patch management opportunity areas (MOAs), but 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.

In this plan, large forest patches:

- are categorized as old, intermediate, and young within cover types or groups of cover types
- 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 primary goal in this plan is to set the stage in the short term (10 years) to maintain or improve the distribution of patch sizes and age classes across the landscape over the long term (50 years). The strategies below provide general guidance for working toward these goals.

In addition, eleven patch MOAs were adopted through this planning process. The list of all MOAs, including patch MOAs, and links to their guidance documents are in Appendix E.

GDS-3C Strategies

- Review and incorporate MOA guidance documents in management activities.
- Maintain existing large patches where feasible outside MOAs.
- 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) during future stand selection efforts.
- Increase the size of clearcuts 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 contain intact native plant communities, populations, and/or concentrations of rare species, critical animal habitat, and/or functional landscapes.

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.

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 Wildlife-administered lands within MBS sites following the guidance and directions contained in this plan. Forest management activities carried out in those MBS sites determined to be of greatest concern or importance for SFRMP will emphasize the following strategies to help minimize the loss of the factors on which the MBS sites of biodiversity significance were ranked.

- Work within interdisciplinary teams to clarify which MBS sites are of greatest concern or importance during management planning and which are feasible to manage for their biodiversity significance given their land status.
- 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.
- As opportunities arise, inform other landowners of the significance of shared MBS sites, their biodiversity objectives, and the management options for addressing them.

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. Endangered and threatened species are protected under state law. Species listed as special concern are not statutorily protected but may be 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 operational order (in development).

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 into NHIS as it becomes available.
- Consult (NHIS) prior to all management activities (i.e., appraisal, harvesting, and stand development work).
- Follow Department rare species guidelines as they become available.
- Implement rare species avoidance from the EWR specialists to the extent possible when planning management activities to maintain and enhance ETS species and their habitats.
  - Endangered and threatened species are required to be protected during management activities.
  - Protect special concern species and their habitats during management activities, when feasible, given the land status.
- Use management to mitigate the effects of climate change on ETS species.

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

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 – rare or uncommon
- S4 – widespread, abundant, and apparently secure, but with cause for long-term concern
- S5 – demonstrably widespread, abundant, and secure

Some NPCs with ranks of S3 or lower 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 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.
- Avoid creating access routes and landings in rare NPCs to the extent possible.

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

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.

This SFRMP 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 stands and in some protected areas such as state parks and SNAs.

GDS-3G Strategies

- Consider the NPC and current growth stage of stands under management consideration when developing management plans.
- Look for opportunities to maintain and/or develop characteristics of under-represented growth stages.
- Consider the proximity to inoperable stands and reserved areas (e.g., old growth, SNAs, state parks) in decisions to provide representations of growth stages when developing prescriptions and look for opportunities to compliment/coordinate growth stages when similar are adjoining.

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, and jack pine cover types represents upland young, early successional forest in this plan. The goal of balancing age class distributions in even-age 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 STH Section during the course of this ten-year planning effort 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., ruffed grouse management areas). Management opportunity areas are summarized, with links for their management guidance documents, in Appendix E.

3.4 Wildlife Habitat

The GDS and Strategies in this section address Issues: A2, B1, B2, D2, E1, F1, G1

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 positively or negatively affect wildlife species, as well as provide habitats for a variety of wildlife species. A range of vegetation conditions and components of species' habitats are provided in the WSU Section through a variety of mechanisms:

- **Some species associated with older forest** are provided for in statutory preserves, old-growth stands and old forest management complexes (OFMCs), minimum of 2.5% aspen over 60 years old statewide, 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 that may provide older forest (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.
- **Species associated with forest interior habitat** are provided for through large patch management opportunity areas (MOAs; see GDS 3C).
- **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.

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

Through this planning process, management opportunity areas (MOAs) focused on providing wildlife habitat at landscape spatial scales were adopted. These include ruffed grouse management areas, deer management areas (aimed at providing winter habitat), old forest patches, and Open Landscape Management Areas. Summary information for all MOAs and links to their guidance documents are in Appendix E.

GDS-4 Strategies

- Retain the integrity of riparian areas and protect wetlands (seasonal and permanent) to provide intact and contiguous wildlife habitat and travel corridors.
- 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 and other opportunities as possible.
- Promote the development of mast- and berry-producing trees and shrubs to provide food for wildlife, including promoting oak into the forest canopy where present.
- Apply management recommendations for wildlife species' habitats in DNR guidelines and policies and other sources as appropriate.
- Ensure the presence of wildlife habitat benefits when developing prescriptions on non-school trust land WMAs.
- Manage for stands with high species and structural diversity as appropriate for the NPC.
- Provide for the needs of species associated with conifer stands and mixed conifer/hardwood stands. Opportunities include:
    - Thinning or selective harvesting to reduce the basal area on some red pine stands in WMAs and considering wildlife benefits before harvesting natural origin red pine stands on WMAs.
    - Increasing acres of long-lived conifer cover types through active management or allowing some stands to naturally succeed to conifer types.
    - Increasing mixed forest conditions in some stands through selection harvesting and stand improvement projects.
- 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. Management of riparian areas can influence water quality and temperature, erosion rates, deposition of woody debris into water bodies, and the diversity of fish, wildlife, and plant species found in and near water bodies. A riparian management zone (RMZ) is the 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.
- Favor the development of uneven-age mixed-species stands of longer-lived species to help protect riparian functions and values.
- Emphasize conifers to maintain shade, where appropriate, and discourage species beavers prefer, such as aspen and birch, in the RMZ of designated trout streams.
- 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.

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

Wetland areas include lowland forested areas, lowland brush and lowland grass cover types, and seasonal ponds. 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 stand exam review, timber sales supervision, and inspections.
- Maintain canopy cover around seasonal ponds.
- In areas with high densities of seasonal wetlands, prioritize marking stands in the spring when seasonal wetlands are more easily identified.
- Favor reserves in locations around wetland habitats to maintain ecosystem functions.

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-age managed cover types at their rotation ages (Appendix F).
- 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.
- Design prescriptions to consider climate change, allowing for sustainable timber productivity in the future.

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

- 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 retained trees (e.g., leave trees or crop trees) and minimize the spread of invasive insects, diseases, and plants.
- Consider implementing prescribed burning to improve stand health as a tool to prevent or control the effects of insect and disease outbreaks.
- Cooperate with MDA in invasive insect sampling, control methods, quarantines, and movement restrictions.
- Incorporate the presence of invasive species into stand Rx's; treat invasives before harvest as necessary to control/avoid increasing the presence of invasives.

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

Wildlife species such as deer, hare, porcupine, beaver, 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

- Consider the potential for wildlife impacts on planted or naturally regenerating trees before damage occurs.
  - 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.
- Favor conifer species on NPC-appropriate sites in riparian areas to discourage beaver activity.
- Use mitigation techniques on sites where damage from wildlife is anticipated.
  - Consider the potential for wildlife impact mortality in regeneration plans.
  - Seed or plant a mix of species rather than a single species.
  - 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, 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 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.
- Emphasize species that are predicted to do well with climate changes and are appropriate for the NPC.
- Seek to maintain forest connectivity across ownerships to allow for the migration of plants and animals.
- Maintain refugia for species that cannot migrate.
- Seek to 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 and NPC when selecting tree species for regeneration or conversion.
- Maintain or increase conifers adjacent to cold water streams to provide a cooling effect in warm weather and retain snowpack longer, slowing discharge in the spring.
- Consider the concept and benefits of carbon sequestration in forest management decisions.

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 visual quality of the site during and after management activities.

GDS-9 Strategies

- Apply MFRC site-level guidelines for visual quality, including:
  - Minimize visibility of harvest areas along travel and recreation routes with moderate or high sensitivity ratings.
  - Consider harvesting strips along higher moderate or high sensitivity rating locations and regeneration to help minimize future harvest visibility issues.
  - Avoid management operations during periods of peak recreational use whenever possible.
  - 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.
- Evaluate if access is needed in sensitive areas on a case-by-case basis through interdisciplinary coordination.
  - Avoid access routes across sensitive areas if possible.
  - If the only reasonable access to stands to be treated is across sensitive areas, then strive to minimize impacts.

3.11 Cultural Resources

The GDS and Strategies in this section address Issues: L1

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

Cultural resources are usually remaining evidence of past human activities. To be considered important, a cultural resource generally has to be at least 50 years old. They often possess spiritual, traditional, scientific, and educational values. 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.

- Maintain positive, continuing, and respectful communications with Tribal Government Partners on conservation, natural resource, and land management issues. This will help identify, understand, and strategize protecting of cultural resources important to Tribal partners.

3.12 Natural Disturbance Events

The GDS and Strategies in this section address Issues: M1

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

By promptly evaluating known disturbance events (e.g., fire, wind, or insects and disease), land managers will be able to quickly recommend what, if any, forest management activities are necessary to mitigate the impacts of the event. 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 annual planned volumes.
  - Cooperate in the assessment and implementation of management actions with other agencies and landowners when possible.
  - Communications protocol:
    - Initial notification/Call to action: Responsible land manager calls a meeting of decision makers of all affected divisions within the first few days after the initial assessment.
    - Follow-up and evaluation: complete a multi-discipline After Action Review at the request of the regional manager.
- 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.

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., red-shouldered hawk, four-toed salamander, northern forest owl MOA). Note: Not all examples of MOAs occur in WSU, but the information given is for understanding what MOAs are.

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 F). 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 F). In practice, MOA reserve amounts can be applied on average at the MOA scale to meet MOA objectives.

As part of developing this SFRMP, the preliminary MOAs included in the stand exam list modeling in the WSU 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 WSU Section. Management opportunity areas will be implemented to the extent possible within the context of current policy and Department direction (e.g., Management of School Trust Lands Operational Order, Sustainable Timber Harvest decisions).

The information on adopted MOAs is available on the DNR's WSU SFRMP intranet page (click to expand WSU when there). Individual MOA Guidance documents can be downloaded from the links in the tables for each MOA type in Appendix E.

Appendix A: FIM Managed Acres Query

Total DNR Administration with inventory data (in Forest Inventory Module) in the WSU Section = 406,000 acres

Source: DNR FIM April 2017

- **Total managed acres = 354,000 acres**

  Land administered by the DNR Divisions of Forestry and Fish and Wildlife, excluding state parks, scientific and natural areas, meandered waters, old-growth stands, 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 = 237,000 acres.***

    Excludes non-forest (lowland brush, marsh, lowland grass, muskeg, upland grass, water, flooded, others) and forested stagnant and offsite cover types (stagnant spruce, tamarack, cedar, and offsite aspen and oak). Non-forest cover types assigned managed acres = 1.4 million acres, stagnant and off-site forest cover types assigned managed acres = 0.7 million 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.

	GDS																							
Issue	1A	1B	1C	2A	2B	3A	3B	3C	3D	3E	3F	3G	3H	4	5A	5B	6	7A	7B	8	9	10	11	12	Cover Types
A1	X	X	X			X						X	X												X
A2		X	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																				
D1									X																
D2		X	X			X								X											X
E1							X		X	X	X			X											
F1	X	X	X			X	X	X	X	X			X	X	X	X				X					
G1														X	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																							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 imperiled and highly imperiled 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 activities 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 timber harvest that meets the Department plans for offering timber volume while considering all forest resources and trust lands responsibilities.

C2. Managing non-timber 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 Species of 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 to aquatic resources of vegetation management 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, herbivory, wind, and fire events 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 availability of non-timber forest products.

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 of 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 to the maximum extent possible.

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

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 the negative impacts of wildlife on forest vegetation on state forest lands.

8. Climate Change

GDS-8: Use best-available science to increase 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

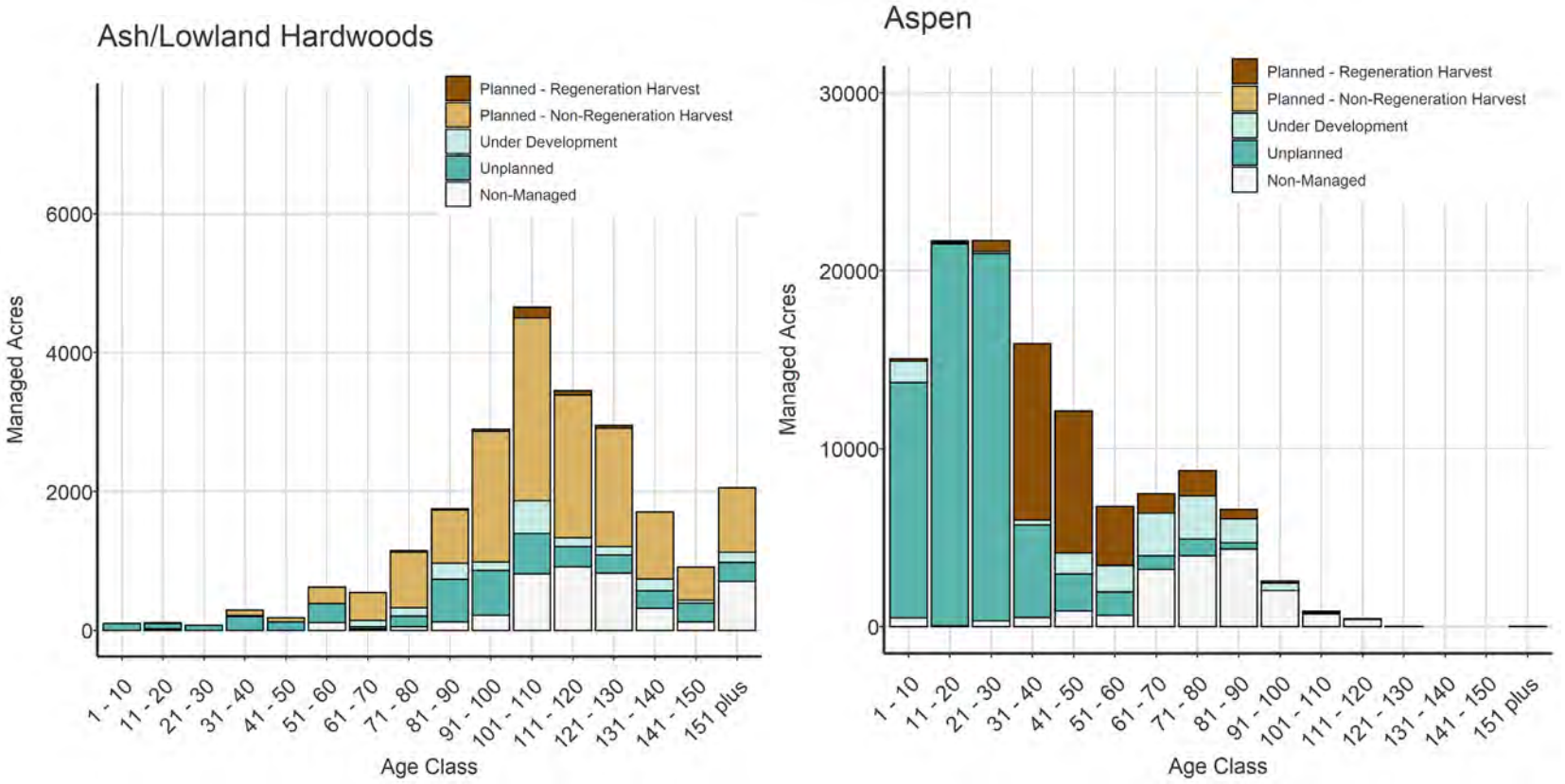
GDS-11: Protect cultural resources on state-administered lands.

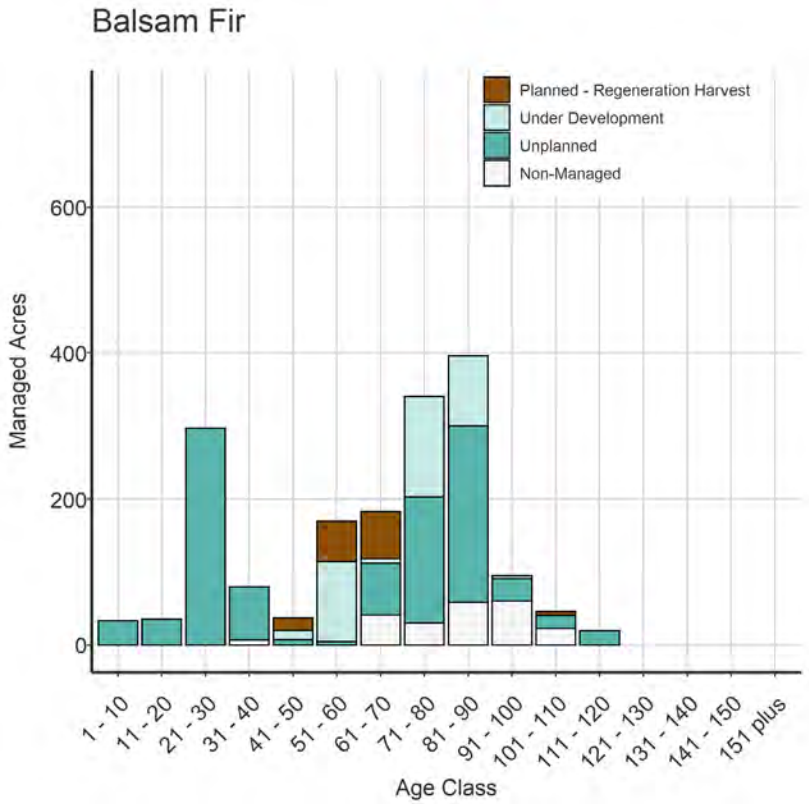
12. Natural Disturbance Events

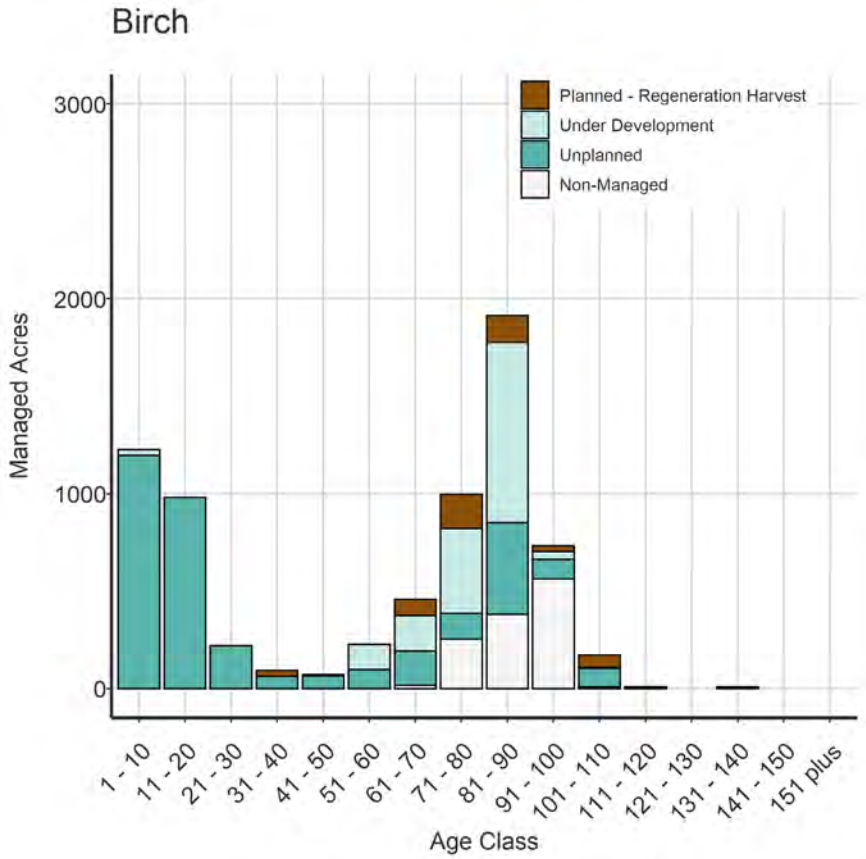
GDS-12: Promptly evaluate and determine appropriate response to natural disturbance events on state land.

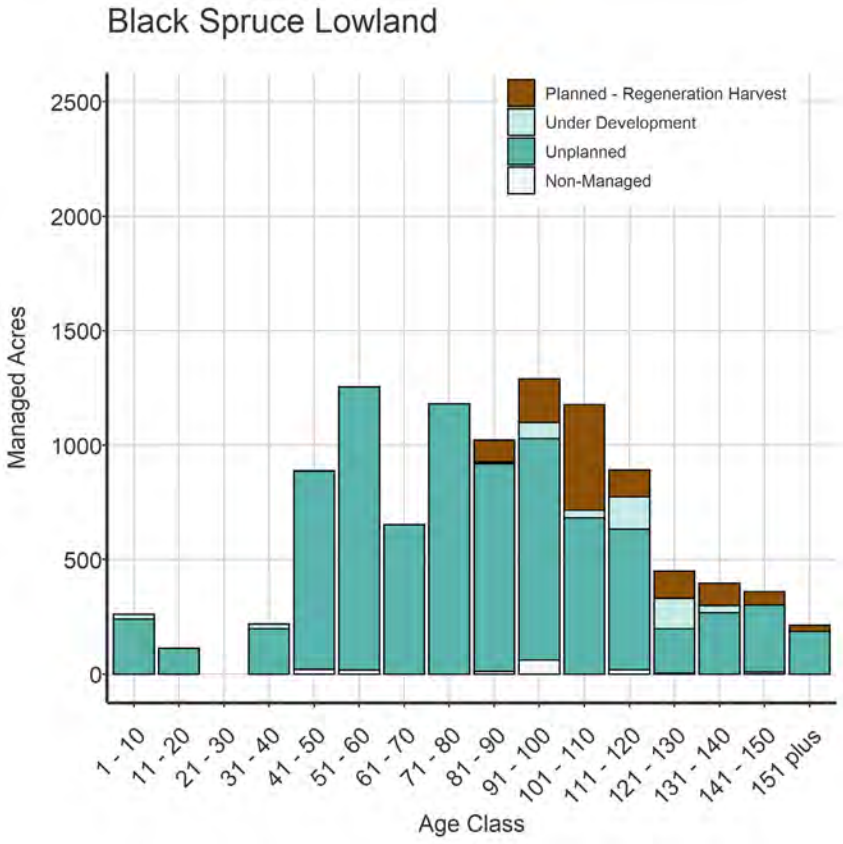
Appendix C: Cover Type Age Class Distributions

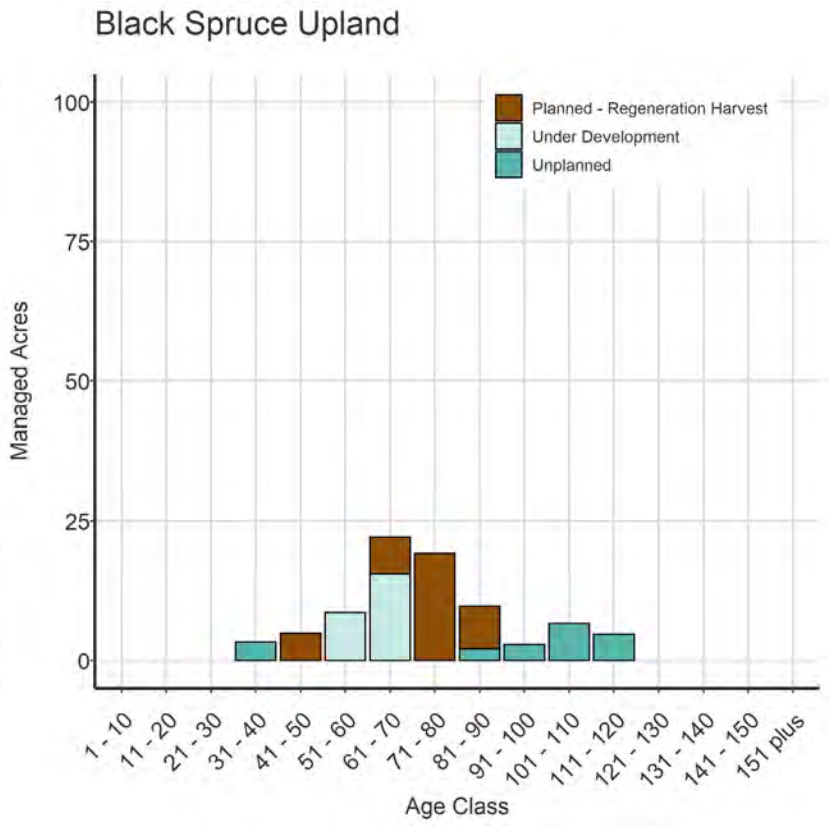
These charts show current age class distributions for cover types in the Western Superior Uplands with acres planned on the 10-year stand exam list. Acres under development at the time of plan writing are indicated in each chart, as are stand exam acres that are planned to be visited through 2030. Acres 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).

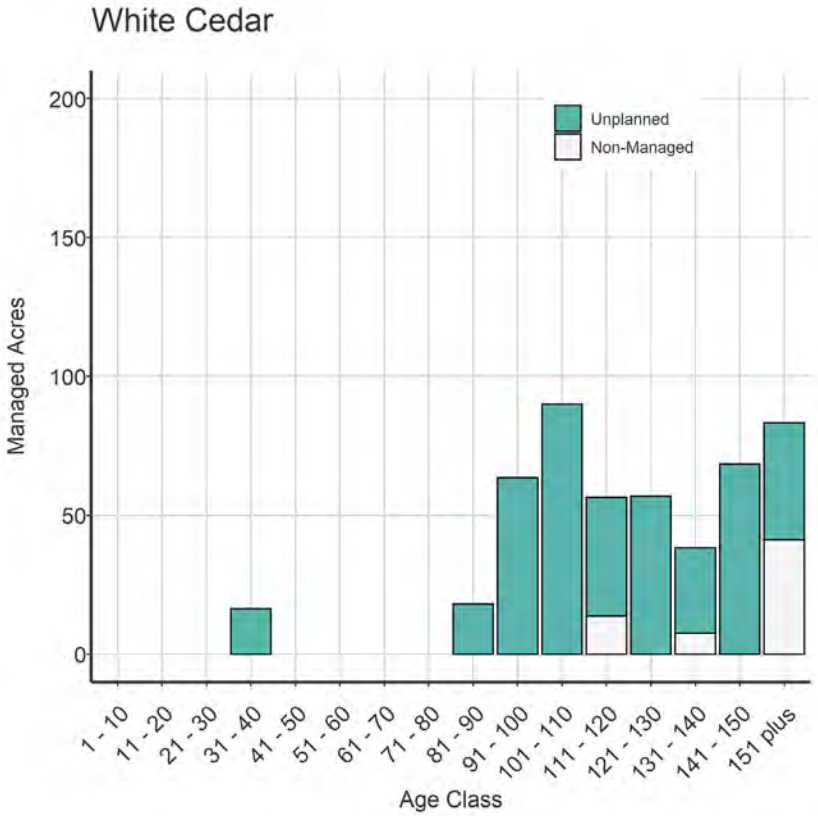


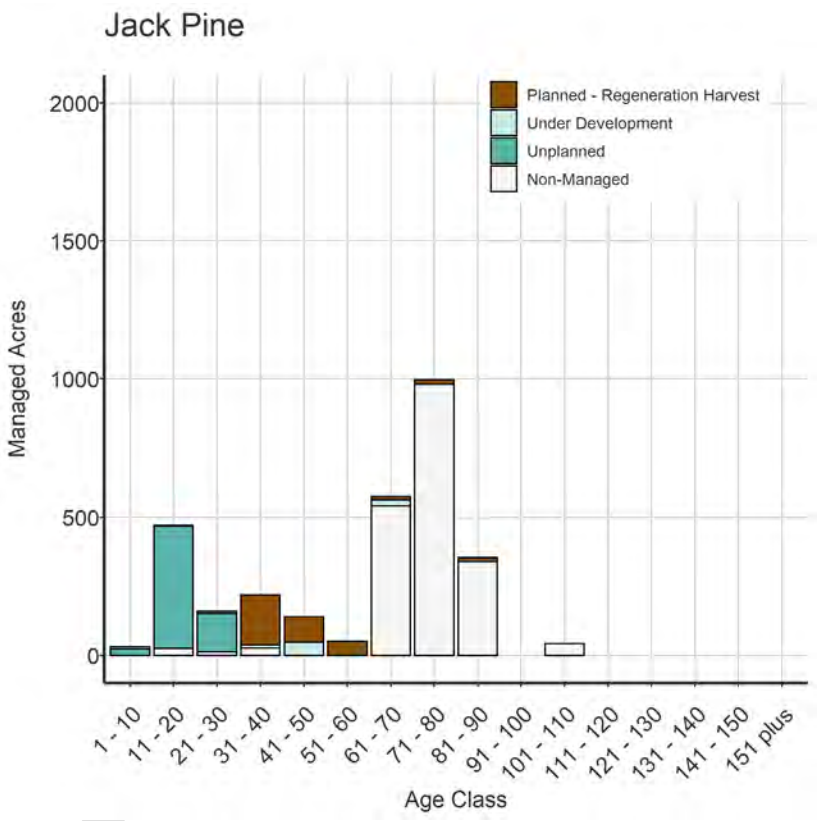

Balsam Fir
Planned - Regeneration Harvest
Under Development
Unplanned
Non-Managed
Managed Acres
0
200
400
600
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
101 - 110
111 - 120
121 - 130
131 - 140
141 - 150
151 plus
Age Class

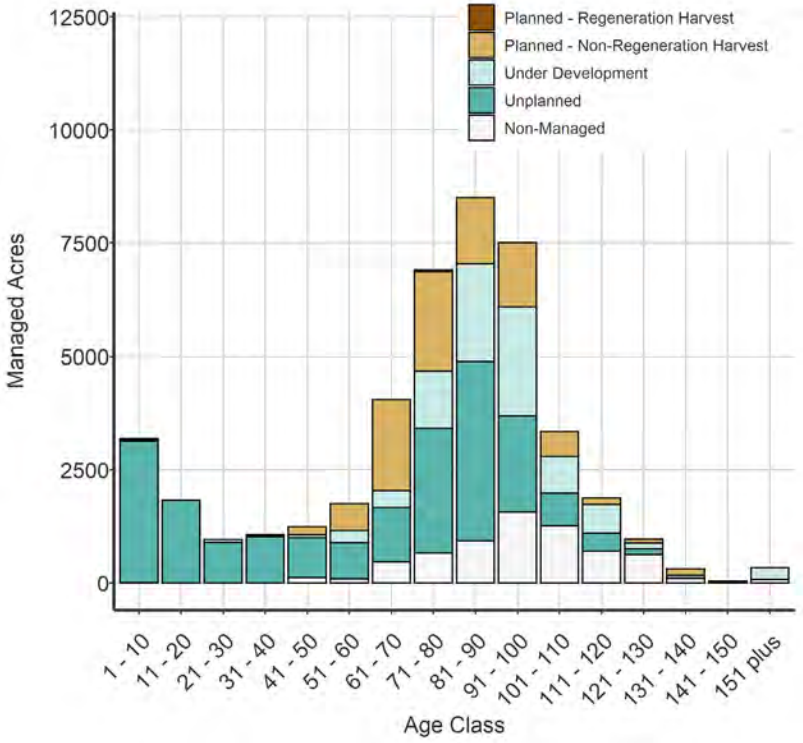

Birch
Planned - Regeneration Harvest
Under Development
Unplanned
Non-Managed
Managed Acres
0
1000
2000
3000
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
101 - 110
111 - 120
121 - 130
131 - 140
141 - 150
151 plus
Age Class

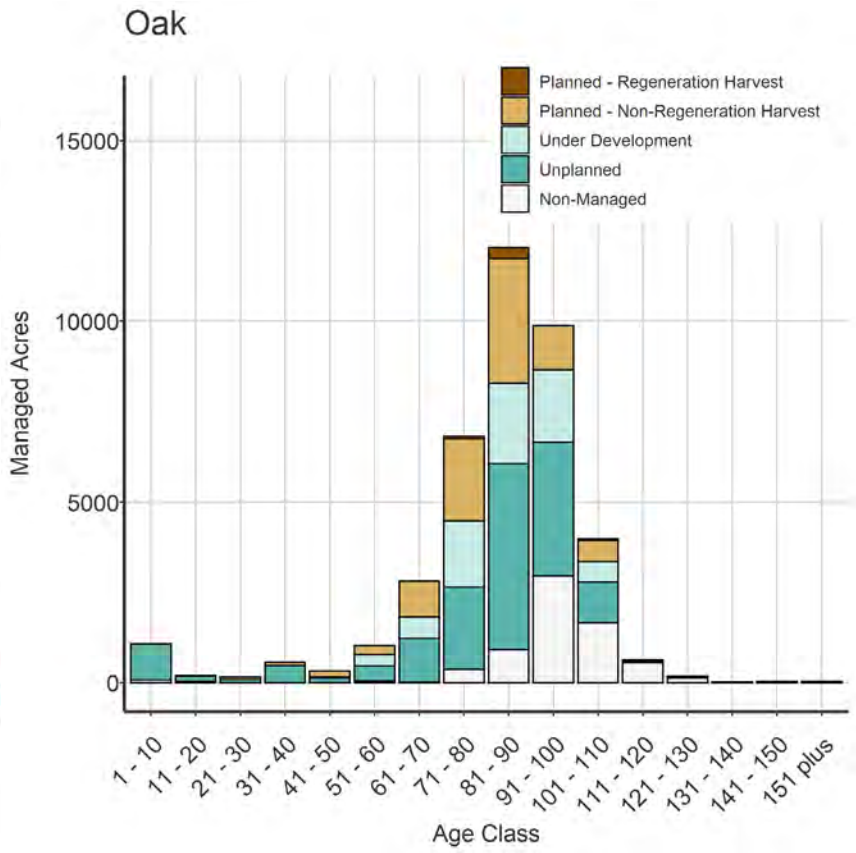

Black Spruce Lowland
Planned - Regeneration Harvest
Under Development
Unplanned
Non-Managed
Managed Acres
2500
2000
1500
1000
500
0
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
101 - 110
111 - 120
121 - 130
131 - 140
141 - 150
151 plus
Age Class

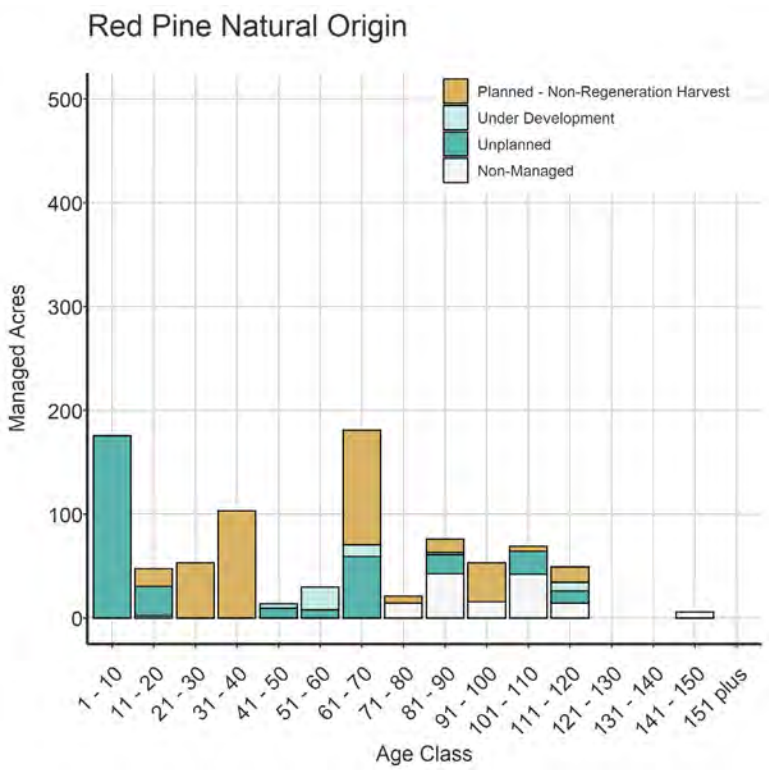

Black Spruce Upland
Planned - Regeneration Harvest
Under Development
Unplanned
Managed Acres
100
75
50
25
0
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
101 - 110
111 - 120
121 - 130
131 - 140
141 - 150
151 plus
Age Class

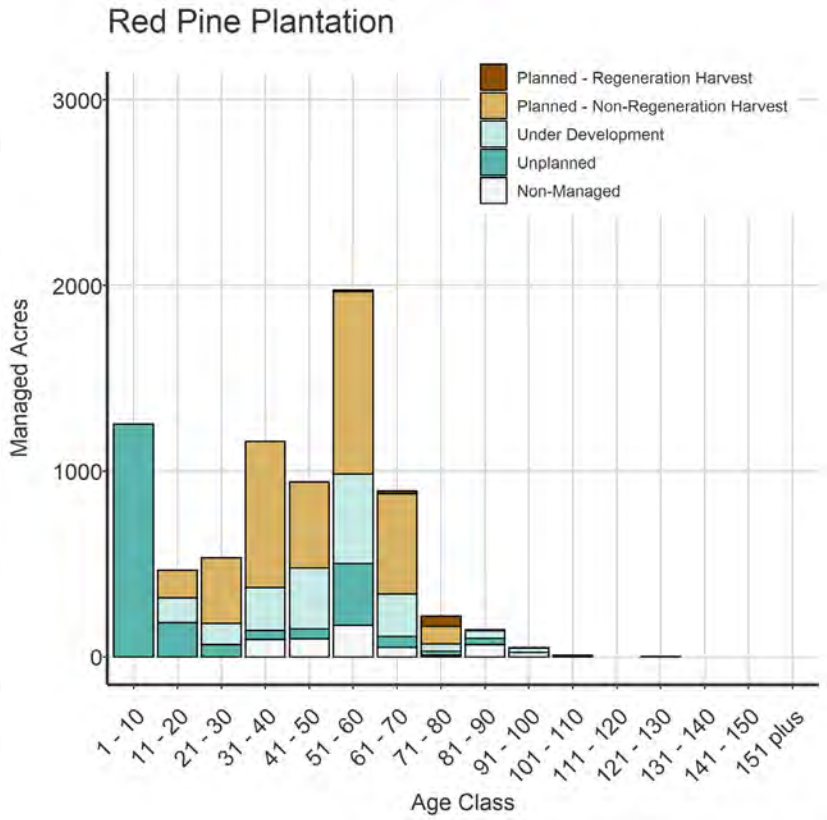

White Cedar
Unplanned
Non-Managed
Managed Acres
200
150
100
50
0
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
101 - 110
111 - 120
121 - 130
131 - 140
141 - 150
151 plus
Age Class

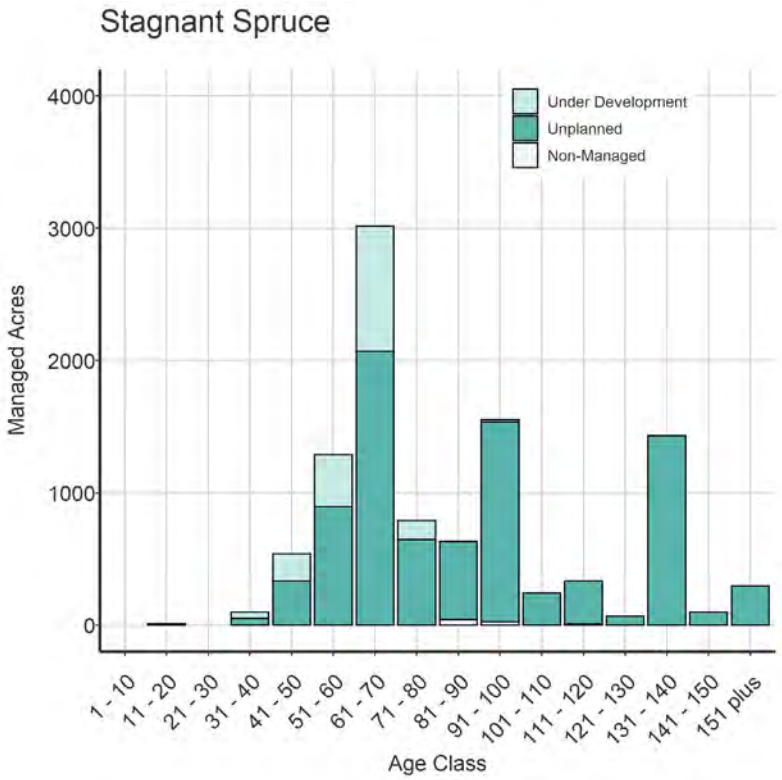

Jack Pine
Planned - Regeneration Harvest
Under Development
Unplanned
Non-Managed
Managed Acres
2000
1500
1000
500
0
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
101 - 110
111 - 120
121 - 130
131 - 140
141 - 150
151 plus
Age Class

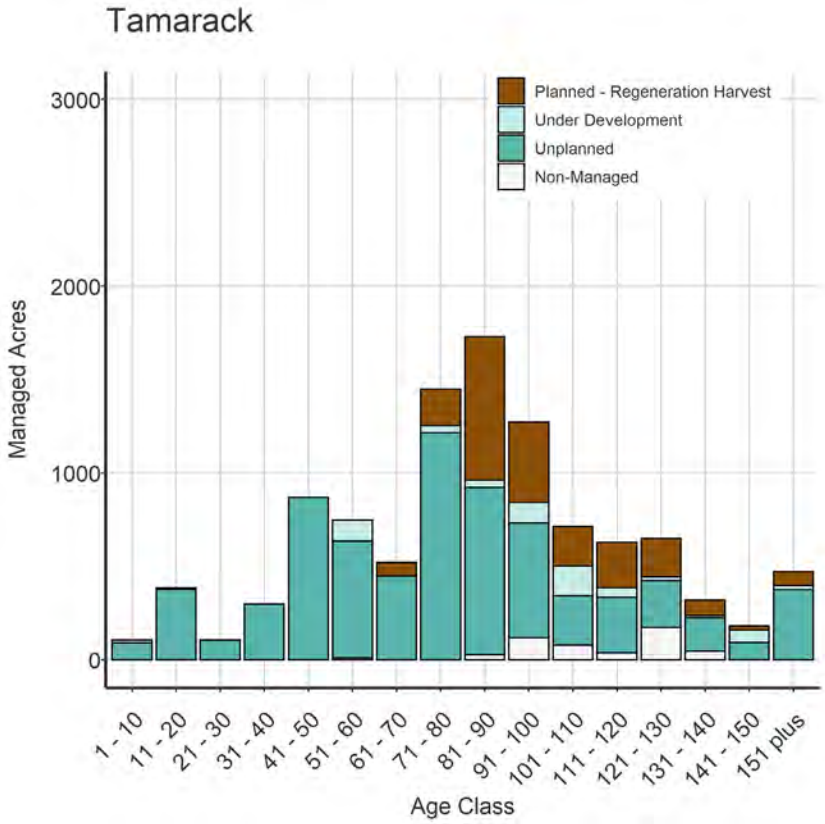

Northern Hardwoods
Planned - Regeneration Harvest
Planned - Non-Regeneration Harvest
Under Development
Unplanned
Non-Managed
Managed Acres
12500
10000
7500
5000
2500
0
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
101 - 110
111 - 120
121 - 130
131 - 140
141 - 150
151 plus
Age Class

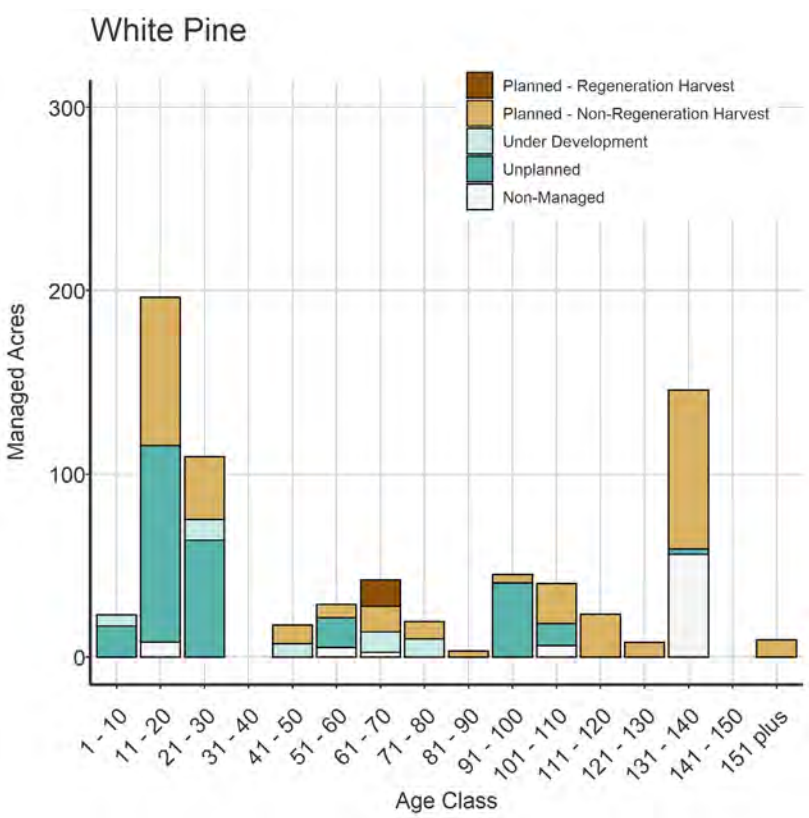

Oak
Planned - Regeneration Harvest
Planned - Non-Regeneration Harvest
Under Development
Unplanned
Non-Managed
Managed Acres
15000
10000
5000
0
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
101 - 110
111 - 120
121 - 130
131 - 140
141 - 150
151 plus
Age Class

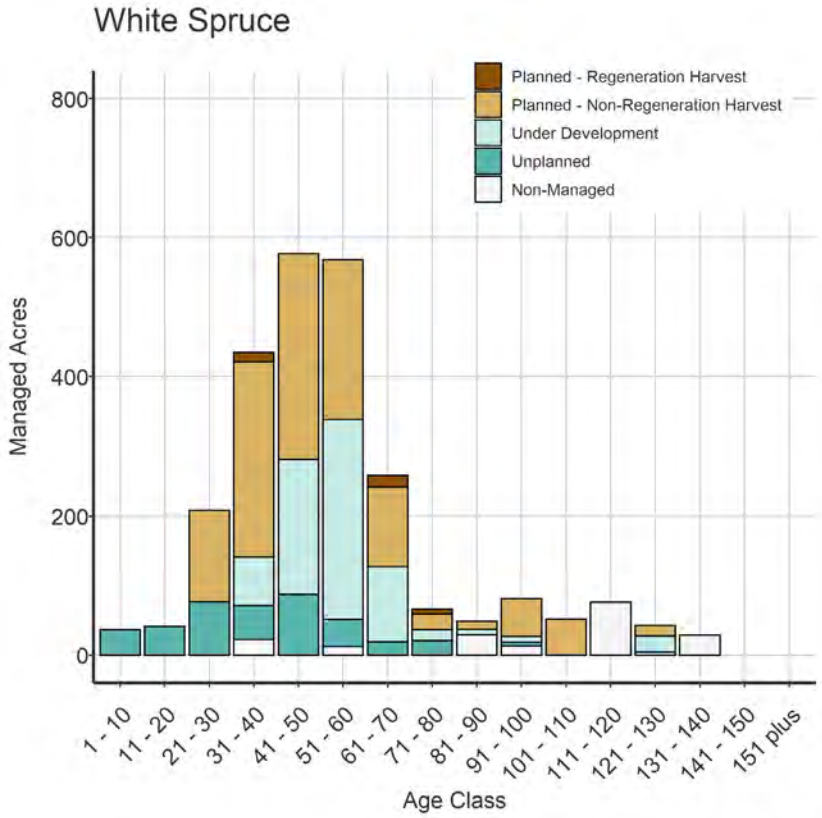

Red Pine Natural Origin
Planned - Non-Regeneration Harvest
Under Development
Unplanned
Non-Managed
Managed Acres
0
100
200
300
400
500
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
101 - 110
111 - 120
121 - 130
131 - 140
141 - 150
151 plus
Age Class


Red Pine Plantation
Planned - Regeneration Harvest
Planned - Non-Regeneration Harvest
Under Development
Unplanned
Non-Managed
Managed Acres
0
1000
2000
3000
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
101 - 110
111 - 120
121 - 130
131 - 140
141 - 150
151 plus
Age Class


Stagnant Spruce
Under Development
Unplanned
Non-Managed
Managed Acres
4000
3000
2000
1000
0
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
101 - 110
111 - 120
121 - 130
131 - 140
141 - 150
151 plus
Age Class


Tamarack
Planned - Regeneration Harvest
Under Development
Unplanned
Non-Managed
Managed Acres
3000
2000
1000
0
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
101 - 110
111 - 120
121 - 130
131 - 140
141 - 150
151 plus
Age Class


White Pine
Planned - Regeneration Harvest
Planned - Non-Regeneration Harvest
Under Development
Unplanned
Non-Managed
Managed Acres
300
200
100
0
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
101 - 110
111 - 120
121 - 130
131 - 140
141 - 150
151 plus
Age Class


White Spruce
Planned - Regeneration Harvest
Planned - Non-Regeneration Harvest
Under Development
Unplanned
Non-Managed
Managed Acres
800
600
400
200
0
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
101 - 110
111 - 120
121 - 130
131 - 140
141 - 150
151 plus
Age Class

Appendix D: Planned Acre and Volume Summary Tables

This appendix includes summary tables for volume estimates and planned acres from the 10-year stand exam list for the WSU Section. The 10-year stand exam list for the WSU Section was created at the same time as the 10-year stand exam lists for all other ecological planning sections. Additional details on modeling, stand selection criteria, and stand exam list results are available in the Sustainable Timber Harvest: Development of the DNR 10-year Stand Exam List report.

Table D.1: Planned acres and model estimated volume (cords) by administrator within WSU on the FY 2021-2030 stand exam list.

Administrator	Acres Planned	Modeled Volume (Cords)
Forestry	66,185	785,648
Fish and Wildlife	10,410	140,402
Total	76,595	926,050

Table D.2: Cover type planned stand exam acres by DNR Division of Forestry administrative Area (3-digit Region/Area Number (RAN)) over FY 2021-2030 within WSU. SI = Site Index.

Cover Type	142	232	251	312	344	Grand Total
Non-Forest		16				16
Aspen and balm of Gilead SI<65	91	1,537	1,748	1,900	3,387	8,664
Aspen and balm of Gilead SI>64	443	3,619	1,241	5,122	7,459	17,885
Balsam Fir		24	50		118	192
Birch		89	148	21	319	576
Lowland black spruce 29<SI<40		300		8	310	617
Lowland black spruce SI<30		154			303	457
Lowland Black Spruce SI>39		57	7		117	180
Lowland Hardwood & Ash	253	4,387	632	2,253	6,725	14,250
Hardwood Northern	88	3,470	363	3,977	3,712	11,610
Oak	555	4,203	344	4,624	2,563	12,290
Pine Jack		25	11		343	379
Pine Red Natural	20		28	4	321	372
Pine Red Planted	32	755	306	273	3,230	4,596
Pine White	14	22	118	78	101	333
Tamarack SI<40	22	723	6	86	358	1,195
Tamarack SI>39	31	410	69	65	760	1,336
Upland Black Spruce					38	38
White Spruce	43	662	202	217	483	1,608
Grand Total	1,593	20452	5,272	18,630	30,647	76,595

Note: RAN 142=Backus Area, RAN 232= Aitkin Area, RAN 251= Cloquet Area, RAN 312= Little Falls Area, RAN 344= Sandstone Area

Appendix E: 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., red-shouldered hawk, four-toed salamander, northern forest owl MOA).

The information on adopted MOAs is available on the DNR's WSU SFRMP intranet page (click to expand WSU when there). Individual MOA guidance documents can be downloaded from the links in the tables for each MOA type in Appendix E.

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 Guidelines and amendments for more information.

Map E.3: Location of old forest management complexes in the WSU Section.

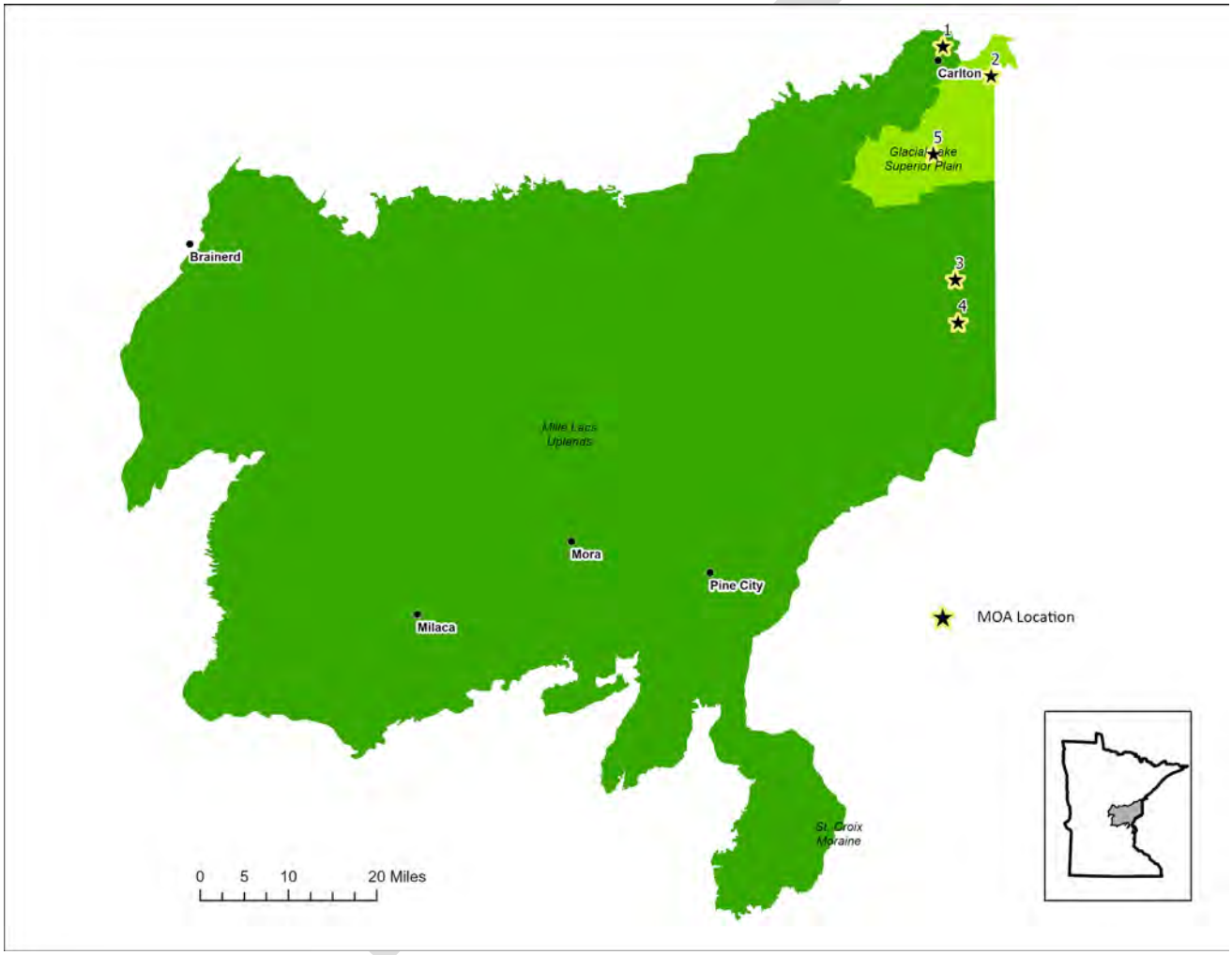


Table E.3: Old forest management complexes in the WSU Section. Click on the name of a MOA to view or download its management guidance document.

Map Number	Name	Forestry Area	Total Acres
1	Big Rapids	Cloquet	800
2	East Border	Cloquet	763
3	Ludwig	Sandstone	593
4	McDermott	Sandstone	978
5	Red Clay	Cloquet	399

Patch MOAs

Large forest patches reduce habitat fragmentation and provide habitat for some species dependent on large, contiguous areas of forest. They also help represent natural variability in patch sizes across the landscape. The emphasis of the patch MOAs is primarily on large, older forest patches since this is what is most limiting on the landscape. This plan includes eleven patch MOAs.

Map E.4: Location of patch MOAs in the WSU Section.

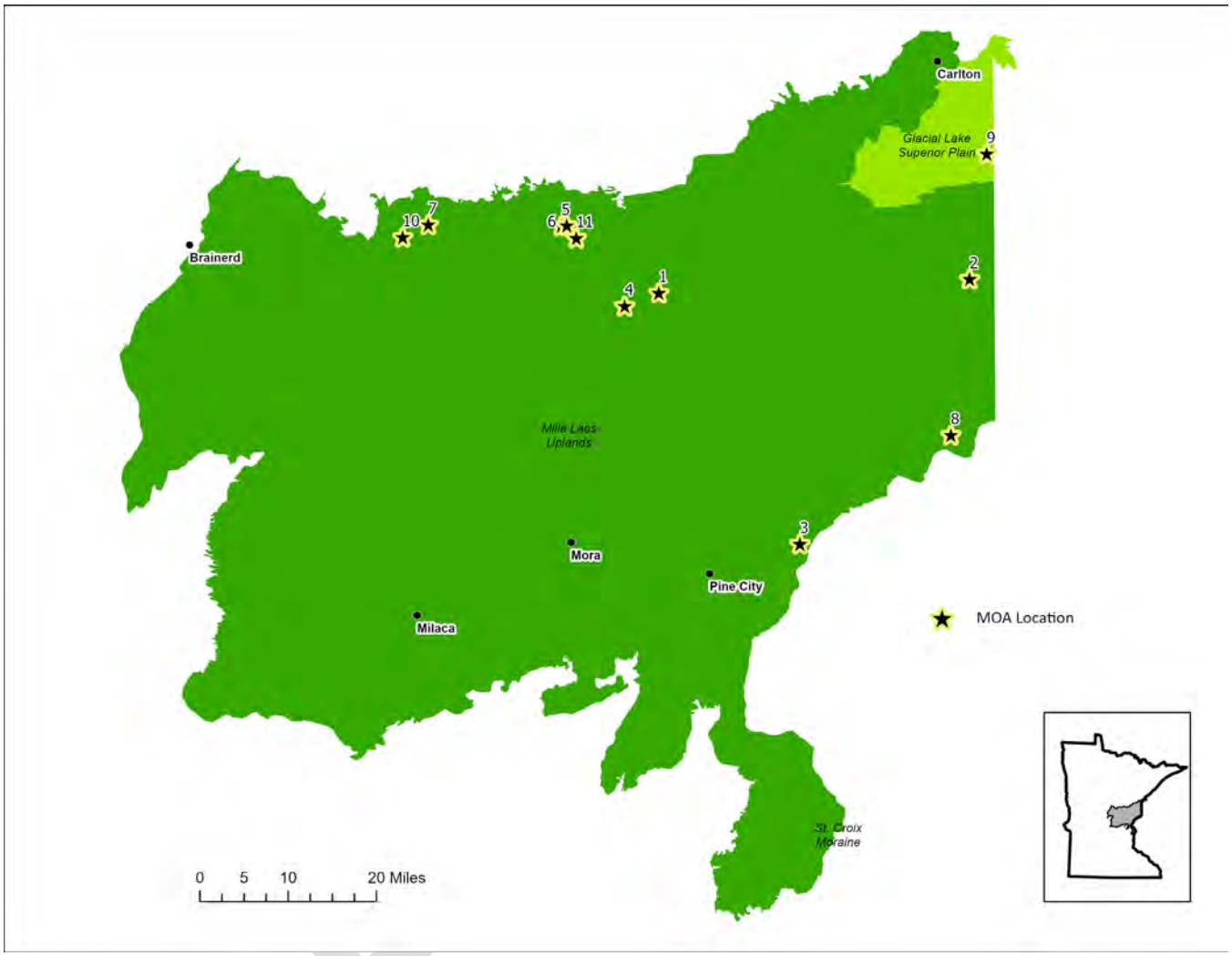


Table E.4: Patch MOAs in the WSU Section. Click on the name of a MOA to view or download its management guidance document.

Map Number	Name	Forestry Area	Total Acres
1	Beaver Haven Bog	Aitkin	357
2	Belden Swamp	Sandstone	2,338
3	Chengwatana Aspen	Sandstone	1,053
4	Giese Hardwoods	Aitkin	1,447
5	Porcupine Lake Tamarack	Aitkin	257

Map Number	Name	Forestry Area	Total Acres
6	Rice River Lowland Hardwood	Aitkin	387
7	Ripple River	Aitkin	353
8	Tamarack River	Sandstone	364
9	Trout Tributary	Cloquet	431
10	Wealthwood	Aitkin	2,702
11	West White Pine Swamp	Aitkin	1,010

Ruffed Grouse Management Areas (RGMAs)

Ruffed grouse management areas are managed to supply all of the habitat needs of ruffed grouse, as well as other species with similar habitat requirements, such as woodcock, and maximize their abundance. These species need several age classes of certain forest cover types, especially aspen, within a relatively small area. Configuration of habitat elements within RGMAs is meant to maximize the abundance of grouse to provide quality hunting experiences around Hunter Walking Trail networks when present.

Map E.6: Location of ruffed grouse management areas in the WSU Section.

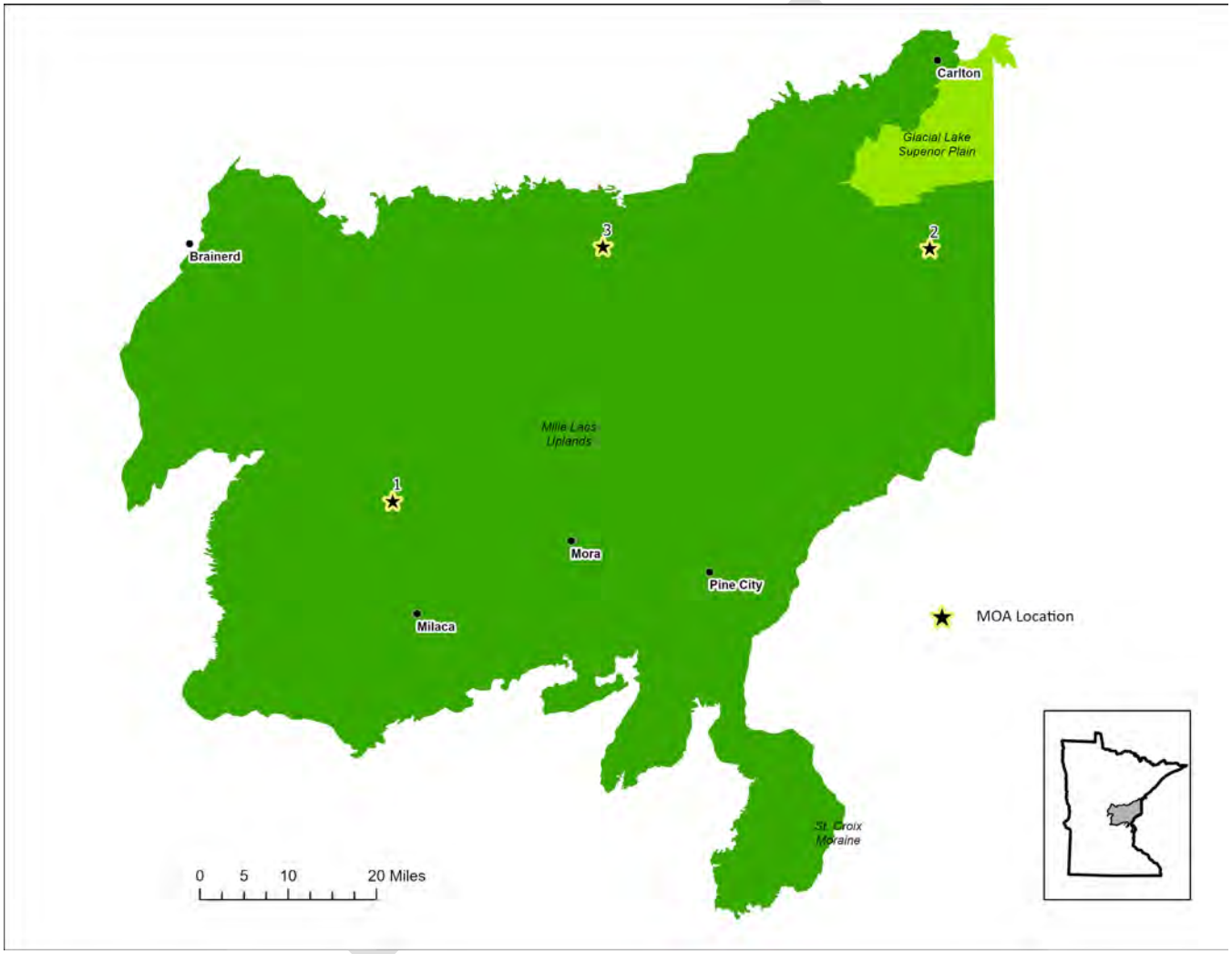


Table E.6: Ruffed grouse management areas (RGMAs) in the WSU Section. Click on the name of a MOA to view or download its management guidance document.

Map Number	Name	Forestry Area	Total Acres
1	Four Brooks	Little Falls	3,496
2	Klondike Trail	Sandstone	3,492
3	Thunder Chicken	Aitkin	4,611

Appendix F. Modeled Management Regimes

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 to estimate volume resulting from harvest. 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 WSU, 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 include 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 than standard regimes to benefit the forest resources located there. Examples include areas with native plant communities that have global conservation ranks, old-growth forest stand special management zones, and management opportunity areas (MOAs).

The modeled management regimes used to develop the 10-year stand exam list for WSU 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 DNR's strategic direction 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-Age 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
Ruffed grouse management area	RGMA
Patch MOAs	PATCH

Dashes indicate that standard DNR or Division of Fish and Wildlife management regimes apply for even-age 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.

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	60	10	40	10	55	10	50	10	50	10	45	10
Aspen/ Balm-of-Gilead - SI < 65	50	5	60	10	50	10	60	10	55	10	55	-	45	10
Birch	50	5	60	15	50	10	65	10	60	10	60	10	50	10
Jack Pine	40	5	45	15	40	5	50	5	45	5	45	5	-	-
Black Spruce Upland	40	5	45	15	40	5	50	5	45	5	45	5	-	-
Balsam Fir	60	5	50	15	60	10	55	15	50	15	50	15	-	-
White Spruce Planted	50	5	45	5	-	-	50	5	50	5	45	5	-	-
White Spruce Natural	50	5	UE	UE	-	-	-	-	-	-	-	-	-	-
Black Spruce Lowland - SI 40+	80	5	110	10	80	5	80	10	80	10	80	10	-	-
Black Spruce Lowland - SI 30-39	100	5	110	10	100	5	100	10	100	10	100	10	-	-
Black Spruce Lowland - SI 23-29	120	5	120	10	120	5	120	10	120	10	120	10	-	-
Tamarack - SI 40+	60	5	80	5	60	5	60	5	60	5	55	5	-	-
Tamarack - SI < 40	100	5	110	5	100	5	100	5	100	5	95	5	-	-
Red Pine Plantation - SI 65+	60	5	55	5	60	5	60	5	60	5	60	5	-	-
Red Pine Plantation - SI 55-64	65	5	60	5	65	5	65	5	65	5	65	5	-	-
Red Pine Plantation - SI < 55	70	5	65	5	70	5	70	5	70	5	70	5	-	-
Red Pine Natural	120	5	115	66	120	10	120	10	120	10	115	10	115	5
White Pine Plantation - SI 65+	60	5	UE	UE	-	-	60	-	65	-	60	10	-	-
White Pine Plantation - SI 55 – 60	65	5	UE	UE	-	-	60	-	65	-	60	10	-	-
White Pine Plantation - SI < 50	70	5	UE	UE	-	-	60	-	65	-	60	10	-	-
White Pine Natural	120	5	UE	UE	-	-	-	-	-	-	-	-	-	-
Northern Hardwoods	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-
Central Hardwoods	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-
Oak - SI 75+	120	5	90	15	-	-	-	20	80	20	-	20	90	20
Oak - SI < 75	150	5	90	15	-	-	-	20	80	20	-	20	90	20
Cedar	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-

Note: Dashes indicate that either standard DNR or FAW division management regimes apply for even-age managed cover types or that the cover type is managed uneven-aged.

Cover Type	Standard DNR		Fish and Wildlife		RGMA		HCVF Med		UPLD		INT		DMA	
	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	60	10	45	10	40	10	-	-	40	10	40	10
Aspen/ Balm-of-Gilead - SI < 65	50	5	60	10	45	10	50	10	-	-	50	10	50	10
Birch	50	5	60	15	50	10	50	10	-	-	50	10	60	10
Jack Pine	40	5	45	15	-	-	40	10	-	-	40	10	45	5
Black Spruce Upland	40	5	45	15	-	-	40	10	-	-	40	10	45	5
Balsam Fir	60	5	50	15	-	-	55	10	-	-	55	10	50	15
White Spruce Planted	50	5	45	5	-	-	50	5	-	-	50	5	50	-
White Spruce Natural	50	5	UE	UE	-	-	50	-	-	-	-	-	-	-
Black Spruce Lowland - SI 40+	80	5	110	10	-	-	80	5	-	-	80	5	80	5
Black Spruce Lowland - SI 30-39	100	5	110	10	-	-	100	5	-	-	100	5	100	5
Black Spruce Lowland - SI 23-29	120	5	120	10	-	-	120	5	-	-	120	5	120	5
Tamarack - SI 40+	60	5	80	5	-	-	60	5	-	-	60	5	-	-
Tamarack - SI < 40	100	5	110	5	-	-	100	5	-	-	100	5	-	-
Red Pine Plantation - SI 65+	60	5	55	5	-	-	60	5	-	-	60	5	-	-
Red Pine Plantation - SI 55-64	65	5	60	5	-	-	65	5	-	-	65	5	-	-
Red Pine Plantation - SI < 55	70	5	65	5	-	-	70	5	-	-	70	5	-	-
Red Pine Natural	120	5	115	66	-	-	115	5	-	-	115	5	110	10
White Pine Plantation - SI 65+	60	5	UE	UE	-	-	60	5	-	-	60	5	-	-
White Pine Plantation - SI 55 – 60	65	5	UE	UE	-	-	65	5	-	-	65	5	-	-
White Pine Plantation - SI < 50	70	5	UE	UE	-	-	70	5	-	-	70	5	-	-
White Pine Natural	120	5	UE	UE	-	-	-	-	-	-	-	-	-	-
Northern Hardwoods	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-
Central Hardwoods	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-
Oak - SI 75+	120	5	90	15	90	20	80	10	-	-	80	10	80	15
Oak - SI < 75	150	5	90	15	90	20	80	10	-	-	80	10	80	15
Cedar	UE	UE	UE	UE	-	-	-	-	-	-	-	-	-	-

Note: Dashes indicate that either standard DNR or FAW division management regimes apply for even-age managed cover types or that the cover type is managed uneven-aged.

Uneven-Age 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".

WSU DNR Standard Uneven-Age Regimes

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

Cover Type	Site Index	Treatment Age	Treatment BA	Lock (years)
Ash/Lowland Hardwoods	All	>= 70	NA	20
Central Hardwoods	All	>= 30	NA	20
Northern Hardwoods	> 40	>= 40	NA	20
White Pine (natural)	All	>= 45	NA	20
White Spruce (natural)	All	>= 80	NA	20

WSU Division of Fish & Wildlife Uneven-Age Regimes

Cover Type	Site Index	Treatment Age	Treatment BA	Lock (years)
White Spruce	All	>= 50	NA	25

WSU Old-Growth Special Management Zone (OG SMZ) Uneven-Age Regimes

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

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

Cover Type	Site Index	Treatment Age	Treatment BA	Lock (years)
Ash/Lowland Hardwoods	All	>= 40	NA	20
Northern Hardwoods	All	>= 60	NA	20
Oak	All	>= 60	NA	20
White Pine	All	>= 60	NA	20
White Pine Plantation	All	>= 35	NA	20
White Spruce	All	>= 55	NA	20
White Spruce Plantation	All	>= 55	NA	20

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

WSU Ruffed Grouse Management Area (RGMA) MOA Uneven-Age Regimes

Cover Type	Site Index	Treatment Age	Treatment BA	Lock (years)
White Pine	All	>= 45	NA	20
White Spruce	All	>= 80	NA	20

WSU HCVF and G1/G2 Medium Harvest Uneven-Age 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 Plantation	All	>= 30	NA	20
White Spruce	All	>= 35	NA	20
White Spruce Plantation	All	>= 80	NA	20

WSU Older Forest Patch MOA Uneven-Age Regimes

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

Thinning Regimes

WSU Standard DNR Thinning Regimes

Cover Type	Site Index	Thin Number	Min. Thin Age	Max. Thin Age
Northern Hardwoods	<=35	Unthinned	30	70
Northern Hardwoods	<=35	Thin1	45	70
Northern Hardwoods	<=35	Thin2	60	70
Oak	All	Unthinned	40	80
Oak	All	Thin1	55	80
Oak	All	Thin2	70	80
Red Pine	All	Unthinned	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 Plantation	All	Unthinned	25	90
Red Pine Plantation	All	Thin1	35	90
Red Pine Plantation	All	Thin2	45	90
Red Pine Plantation	All	Thin3	55	90
Red Pine Plantation	All	Thin4	65	90
Red Pine Plantation	All	Thin5	75	90
White Pine Plantation	All	Unthinned	25	90
White Pine Plantation	All	Thin1	35	90
White Pine Plantation	All	Thin2	45	90
White Pine Plantation	All	Thin3	55	90
White Pine Plantation	All	Thin4	65	90
White Pine Plantation	All	Thin5	75	90
White Spruce Plantation	All	Unthinned	30	60

WSU Division of Fish and Wildlife Thinning Regimes

Cover Type	Site Index	Thin Number	Min. Thin Age	Max. Thin Age
Red Pine Plantation	>=65	Unthinned	30	45
Red Pine Plantation	>=65	Thin1	50	65
White Spruce Plantation	All	Unthinned	35	45
White Spruce Plantation	All	Thin1	50	60

WSU Ruffed Grouse Management Area (RGMA) MOA Thinning Regimes

Cover Type	Site Index	Thin Number	Min. Thin Age	Max. Thin Age
Oak	All	Unthinned	50	65
Oak	All	Thin1	70	85
White Spruce	All	Unthinned	25	35
White Spruce	All	Thin1	40	50
White Spruce	All	Thin2	55	65
White Spruce Plantation	All	Unthinned	50	65
White Spruce Plantation	All	Thin1	70	85

WSU HCVF and G1/G2 Medium Harvest Thinning Regimes

Cover Type	Site Index	Thin Number	Min. Thin Age	Max. Thin Age
Red Pine	All	Unthinned	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

WSU Older Forest Patch MOA Thinning Regimes

Cover Type	Site Index	Thin Number	Min. Thin Age	Max. Thin Age
Oak	>=60	Unthinned	30	40
Oak	>=60	Thin1	45	55
Oak	>=60	Thin2	60	70
Red Pine	All	Unthinned	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	Unthinned	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	Unthinned	25	80
White Spruce	All	Thin1	40	80
White Spruce	All	Thin2	55	80
White Spruce Plantation	All	Unthinned	30	60

Glossary

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 forestlands 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, reviewed by cooperating partners, 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 harvest 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 6-inch 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 (active) or without management actions (passive).

Cooperative Stand Assessment (CSA): The forest stand mapping and information system used by the Minnesota Department of Natural Resources to inventory the approximately five million acres (7,800 square miles) owned and administered by the state. The spatial information and stand attributes are now maintained in the DNR forest inventory system.

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 feet 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 (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.

Cover type distribution: The location and/or proportionate representation of cover types in a forest or a given geographic area.

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).

Even-aged prescription: Planned forest management action that promotes stand composition of trees of primarily the same age or age class. Examples of even-aged silvicultural treatments, or prescriptions, include clearcut and shelterwood harvests.

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 current status of and monitors recent trends in, forest area, volume, growth, and removals.

Forest Inventory Module (FIM) (and other forest inventory systems): 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: Consists of all lands included in the forest inventory that have forested cover types, from aspen and pine cover types to stagnant conifers.

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 often used on a daily basis. 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-need 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 low clearance licensed highway vehicles can travel routinely on them. The roads will be graded and graveled as needed for forest management purposes. Major damage, such as culvert washouts or other conditions that may pose a safety hazard to the public will be repaired as reported and 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 on 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 mortality or blowdown of an individual tree or groups of trees. Gap management uses timber harvest methods to emulate this type of forest spatial 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.

Group selection: A process of harvesting patches of selected trees to create openings in the forest canopy and to encourage reproduction of uneven-aged stands.

Growth stage: Growth stages of native plant communities as presented in the Field Guide to the Native Plant Communities of Minnesota: The Laurentian Mixed 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.

High-quality native plant community: A community that has experienced relatively little human disturbance, has few exotic species and supports the appropriate mix of native plant species and vegetation structure for that community. A high-quality native plant community may be unique or have a limited occurrence in the subsection, have a known association with rare species, or be an exemplary representative of the native plant community diversity prior to European settlement.

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 pine plantations. 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).

Intermediate cut: The removal of immature trees from the forest sometime between establishment and final harvest with the primary objective of improving the quality of the remaining forest stand.

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 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): These are 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 critical 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.

Mixed forest or stand: A forest or stand composed of two or more prominent species.

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

Multi-aged stand: A stand with two or more age classes.

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: Refers to the size, shape, and arrangement of patches in forested landscapes as determined primarily by natural disturbance and physical factors.

Non-forestland: 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 all animal species that are not hunted, trapped, or fished (i.e., birds, mammals, fish, reptiles, amphibians, invertebrates).

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, medicinals, decoratives, 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 (heigh, 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 characteristics: Characteristics typically found in older 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): Represents an area of land made up of several to many stands that are managed for old growth, and their special management zones (SMZ), 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 Old-Growth Forests Guidelines (1994) and amendments.

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, as well as vegetation type and age category, and differs from the surrounding forest. It may be one stand or a group of stands.

Plantation: A stand composed primarily of trees established by planting or artificial seeding.

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, fiber board, or chip board. 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 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 (except the gray wolf), as well as all animal species that are listed as State endangered, threatened, or special concern. All Species of Greatest Conservation Need, which are species identified in the State Wildlife Action Plan whose populations are rare, declining, or vulnerable to decline."

Rare species: A plant or animal species that is designated as endangered, threatened, or a species of special concern by the state of Minnesota (this includes all species designated as endangered or threatened at the

federal level), Species of Greatest Conservation Need, or an uncommon species that does 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.

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 period of years between when a forest stand (primarily even-aged) is established (i.e., regeneration) and when it receives its final harvest. This time period is an administrative decision based on economics, site condition, 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.

Seed tree: Any tree that bears seed; specifically, a tree left standing to provide the seed for natural regeneration.

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.

Shade tolerance: Relative ability of a tree species to reproduce and grow under shade. The capacity to withstand low light intensities caused by shading from surrounding vegetation. Tolerant species tolerate shade, while intolerant species require full sunlight.

Shelterwood harvest: A harvest cutting in which trees on the harvest area are removed in a series of two or more cuttings to allow the establishment and early growth of new seedlings under partial shade and protection of older trees. Produces an even-aged forest.

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 forest stands 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 a unique or highly specific habitat requirement 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 other than timber on the landscape. 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, and 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 a red pine plantation. 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 usually is evaluated in terms of basal area, 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 desirable 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.

Sustainable treatment level: A treatment level (e.g., harvest acres or volume per year) that can be sustained over time at a given intensity of management without damaging the forest resource base or compromising the ability of future generations to meet their own needs. Treatment levels may need to be varied above and/or below the sustainable treatment level until the desired age class structure or stocking level is reached.

Thermal cover: Habitat component (e.g., conifer stands such as white cedar, balsam fir, and jack pine) that provides wildlife protection from the cold in the winter and heat in the summer. A 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 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 that results 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 plantation).

Variable retention: A harvest 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.

Viable populations: The number of individuals of a species sufficient to ensure the long-term existence of the species in natural, self-sustaining populations that are adequately distributed throughout their range.

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, Section of Wildlife, 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.