DEPARTMENT OF NATURAL RESOURCES

Northern Superior Uplands

Section Forest Resource Management Plan (SFRMP)

<<MONTH>>, 2022

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Executive Summary

This Section Forest Resource Management Plan (SFRMP) provides direction, goals, and strategies that guide vegetation management on state forest lands administered by the Department of Natural Resources (DNR) Divisions of Forestry and Fish and Wildlife in the Northern Superior Uplands (NSU) Ecological Section.

Guiding Principles for the SFRMP process

- Pursue the sustainable management, use, and protection of the state's forest resources to achieve the state's economic, environmental, and social goals in accordance with MS 89A.01.
- Manage school trust land to maximize the long-term economic return from the school trust lands consistent with sound natural resource conservation and management principles (Minn. Stat. 127A.31)
- Provide guidance to managers and foresters on implementation of the statewide Sustainable Timber Harvest Analysis.
- Use the expertise of interdisciplinary team members across DNR divisions to identify issues, goals, and strategies for vegetation management on state-administered land in the NSU.
- Develop goals and strategies in consideration of the Minnesota Forest Resource Council's Northeast Landscape Management Plan and other regional management plans.
- Consider and incorporate the results of public review in the planning process.
- Comply with DNR policy.

Chapter 1: Introduction

The Minnesota Department of Natural Resources (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 recreational opportunities, allow for protection of rare resources, provide habitat for fish and wildlife, and provide important ecological services like clean air and water.

The mission of the DNR is to work with citizens 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. The state-owned, DNR-managed lands and associate resources are the foundation for which the department is able to plan for and execute its mission for the benefit of all Minnesotans.

Land Ownership/Acquisition Types

State Trust Lands

The DNR manages school trust (2.5 million acres) and university trust lands (25,840 acres) 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.

For example, in the case of **school trust lands**, the department manages school trust land to maximize the long-term economic return from the school trust lands 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.

Similarly, the department manages **university trust lands** 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.

State Non-trust Lands

The DNR manages non-trust lands according to their applicable statutory purposes. These lands primarily include Volstead lands (31,500 acres) and acquired lands (1.49 million acres).

Land & Water Conservation Fund ("LAWCON Lands") The purpose of LAWCON is to provide public outdoor recreation opportunities. Forest management to preserve the natural attributes of the forest and promote

outdoor recreation is allowed - even if this includes selling timber. Harvesting chiefly to meet a commercial demand is not allowed. The state is free to manage a site as we judge best, as long as it is solely for outdoor recreation. These requirements are codified in 36 CFR Part 59.3.

Former Minnesota Power Lands are lands which have been acquired through various means by the DNR. These lands are now part of the Riverlands State Forest.

Volstead lands were purchased from the federal government with funds appropriated by the Legislature. These lands carried unpaid county liens for drainage ditches that were intended to make the land suitable for farming, but were not successful. Income generated from DNR natural resource management on these lands is split evenly with the county. 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.

Wildlife Management Areas and Aquatic Management Areas are lands managed by the DNR Division of Fish and Wildlife as described in MN statute section 86A.05 They are managed to maintain habitat for the production of fish and wildlife, to protect/develop and manage lakes, rivers, and streams critical for fish and aquatic life, water quality, for public hunting and fishing, trapping, and other compatible outdoor uses. WMA may include some percentage of trust land. These portions are treated as trust land, but are also focused towards the goals of the WMA.

State Lands Foundational to Forest Management

It is more helpful to understand the results of forest resource management planning when described within the context of the department's mission, the land base available to meet the mission, and the laws governing the various land types and management activities.

The department's primary statutory direction for forest management is pursuant to the Sustainable Forest Resources Act (Minnesota Statute 89A) and 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." This statute is the basis of the DNR's Section Forest Resource Management Planning process.

Scope of this Section Forest Resource Management Plan

This SFRMP directs vegetation management on forest lands administered by the DNR in the Northern Superior Uplands (NSU) Ecological Section, which contains the Border Lakes, Nashwauk Uplands, Laurentian Uplands, Toimi Uplands, and North Shore Highlands Subsections (Map 1.1; a detailed explanation of DNR's Ecological Classification System (ECS), including sections and subsections, is available on the DNR ECS webpage). Vegetation management includes actions that affect the composition and structure of forest lands, such as

timber harvesting, thinning, prescribed burning, biomass harvest, and reforestation. SFRMPs consider the condition and management of forest lands in other ownerships, but only propose forest management direction and actions for DNR managed lands.

This plan considers only a portion of forested state-administered lands for management. Forest land includes all lands in the DNR forest stand inventory (i.e., cooperative stand assessment, or CSA), 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). For this plan, managed acres are timberland acres available for timber management, excluding timberlands reserved as old-growth, state parks, or SNAs, inoperable stands, etc. Approximately 634,775 acres of DNR-administered forest lands are managed acres.

Examples of forest resource management planning activities that are beyond the scope of SFRMPs include: OHV trail system planning, comprehensive road access plans, state park land management planning, old-growth forest designation, SNA establishment, wilderness designation, wildlife population goals, fire management, and recreation facilities/systems planning.

Goals for the Planning Effort

The SFRMP process develops the following outcomes:

- ***Desired Future Condition (DFC) Goals:***
    - These are long-term (50+ years) and short-term (10 years) changes in vegetation structure and composition.
    - DFCs are developed from assessment information, identified issues, and general direction statements in response to issues.
    - DFCs are determined based on the management activities, including no action, that will best move the forest landscape toward the goals for state forest lands.
    - 50-year DFCs in cover type conversions are given to aid in visualization of scale of change, and do not necessarily represent the goals of future planning periods.
- ***Guidance to staff on stand exam list implementation***
    - Products of the planning process include an implementation meeting and field guide for DNR staff.
- **Guidance and prioritization of Management Opportunity Areas (MOAs)**
    - MOAs are intended to provide opportunities to address values such as biodiversity, rare features, diversity of native plant community growth stages, and wildlife needs through vegetation management.
    - MOAs include old forest management complexes (OFMCs), patches, such as ruffed grouse management areas, and deer yards, among others.
    - Management guidance documents developed for MOAs through SFRMP are included as an appendix in this plan.

Who Develops SFRMPs?

The Division of Forestry is responsible for developing and maintaining SFRMPs. In order to do that, an interdisciplinary team of planners and personnel from DNR divisions of Forestry, Fish and Wildlife, and Ecological and Water Resources (SFRMP team) work together to develop, revise, and edit SFRMPs, with direction from regional and executive Forest Resource Issues Teams (FRITs) as well as the Forest Issue Resolution Staff Team (FIRST). Executive FRIT and FIRST are involved when decisions or issues are needed at a statewide level or cannot be resolved at a lower level. 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 led the NSU planning effort. Teams work with additional support staff, such as GIS or administrative specialists, as needed.

Public Involvement Opportunities

Public involvement in SFRMP development occurs, at a minimum, through:

- Availability of the Preliminary Issues and Assessment document for review on the DNR website.
- A presentation and comment period to:
    - explain the SFRMP process
    - identify key forest management concerns
    - solicit stakeholder input on the draft plan and strategic direction

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 Steps 1 and 2, the SFRMP team prepares information to assess the current forest resource conditions in the section and identifies forest resource management issues to be addressed in the section plan. In Step 3, the SFRMP team finalizes the issues and develops general directions, strategies, and cover type recommendations to address the issues. In Step 4, the plan is finalized and distributed. The planning process includes opportunities for public input during plan development.

The NSU SFRMP process started in 2014 and steps 1, 2, and parts of step 3 (table 1.1) were subsequently completed. Those steps included requesting public comment on forest model parameters and timber harvest levels in the Section, among other topics. In 2016, then Governor Dayton requested that the DNR analyze the sustainability of harvesting one million cords per year on DNR-administered forest lands (see sustainable timber harvest analysis, STHA, below) and the SFRMP process was paused. External input was incorporated in STHA through a stakeholder advisory group and opportunities for public comment. In 2018, DNR set a new 10-year sustainable timber target of 870,000 cords offered for sale annually from DNR administered forest lands. The NSU team reconvened in 2019 to complete the SFRMP in alignment with policy-level decisions resulting from STHA, which include timber harvest levels statewide and within the Section (see below). Other aspects of planning related to management opportunity areas, cover type conversions, and goals for within-stand diversity, among others, remain within the scope of the SFRMP process.

Table 1.1. SFRMP process summary.

Steps	SFRMP Process Description
Step 1	**Initiating the Planning Process** • Form interdisciplinary team for the section. • Assemble baseline assessment information. • Establish web page on the DNR website. • Update mailing list of public/stakeholders. • Inform public that planning process is beginning, including sharing the estimated schedule, and how and when they can be involved.
Step 2	**Development of the Preliminary Issues and Assessment document** • Interdisciplinary team adjusts and supplements the baseline resource assessment information for the section plan. • Team updates the preliminary issues to be addressed in the plan. • DNR makes assessment information and the preliminary issues available for public review and input.
Step 3	**Develop Draft Plan** • Complete list of issues to be addressed in the plan based on public input from Step 2. • Update general direction statements (GDSs) in response to the final list of issues. • Develop strategies and desired future condition (DFC) goals consistent with the general direction statements. • Prioritize, develop, and/or revise Management Opportunity Area guidance documents. • Make draft plan available for public review and comment.
Step 4	**Final Plan** • Summarize public comments and develop DNR responses. • Present summary of comments, responses, and plan revisions for the Commissioner's approval. • Commissioner approves final plan. • Distribute final plan, including summary of public comments and DNR responses.

Efforts Related to SFRMP

Sustainable Timber Harvest Analysis (STHA)

The STHA is a 2018 statewide decision from a multi-year analysis to determine the optimal timber harvest level that will also maintain other important forest resource values. The analysis considered six key forest values: timber productivity, natural resource economies, biodiversity, water quality, wildlife habitat, and forest health based on forest inventory data and modeling techniques, interdisciplinary expertise across DNR divisions, and input from key stakeholders and the public. The results of this analysis carry policy-level authority within DNR and include:

- a department-wide, interdisciplinary decision for annual volume offered for sale on state-administered timberlands
- a 10-year statewide stand exam list

The STHA is a separate effort from the SFRMP, but interacts with this plan in the following ways:

- SFRMPs guide implementation of STHA.
    - This plan provides general direction and strategies to achieve the department volume target and manage stands on the 10-year stand exam list in the NSU Section.
    - DNR foresters and partners from other divisions use general direction and strategies in this plan to make management decisions consistent with both STHA targets and SFRMP goals.
- The STHA consolidated existing and draft MOA locations statewide, developed silvicultural regimes considering MOA objectives, and ran scenarios assessing the harvest level impacts of those regimes.
    - SFRMPs communicate decisions about which MOAs are included in the plan and their final geography, and provide guidance to staff on MOA implementation.
- STHA documentation provides specific information on treatment level and other metrics, such as *cover type age class distributions, rotation ages, even flows, and other section outputs that should be referenced when implementing this plan.*
    - *STHA documentation is cited throughout this plan where it provides additional information.*

For more information, visit the DNR's Sustainable Timber Harvest Analysis website.

MFRC Regional Landscape Planning

In developing this SFRMP, the team considered the recommended desired outcomes, goals, and strategies developed for the northeast landscape region under the direction of the Minnesota Forest Resources Council (MFRC) Landscape Program. By considering the recommendations from the landscape region plans, the decisions for management of DNR-administered lands in this plan incorporate recommendations from a broader landscape perspective across all ownerships. This assists in cooperation across ownerships in this larger landscape area.

Planning Area Description

The NSU consists of a total land area of approximately 6 million acres, including all or parts of the following counties: Koochiching, Itasca, Carlton, St. Louis, Lake, and Cook (Map 1.1). Recreation, mining, forestry, and tourism are major economic activities in this Section. Lowland and upland forests (conifer and deciduous), peatlands, and marsh systems are the dominant land cover classes in the NSU. Much of the land in the Section (64 %) is in public ownership, with the state owning approximately 981,000 acres (approximately 634,775 acres of the state-administered land is timber land that will be considered in this plan). Other major landowners in the Section include private landowners, tribes, counties, industry, and the federal government. For more detailed land descriptions, refer to chapters one through three of the NSU SFRMP Preliminary Issues and Assessment document on the NSU SFRMP Website.

Map 1.1: Location of Northern Superior Uplands Section and included subsections

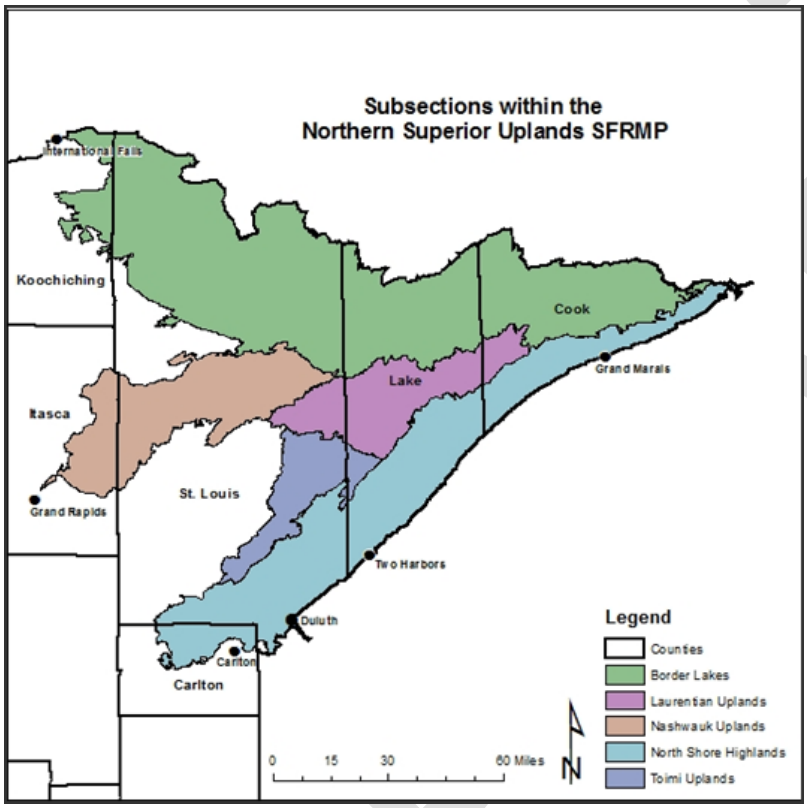


Table 1.2: Generalized forest cover type composition in the subsection(s)

Cover Type Group	Border Lakes	Laurentian Uplands	Nashwauk Uplands	North Shore Highlands	Toimi Uplands	Total
Aspen, birch, and balm-of-Gilead	125,656	14,059	30,148	75,873	12,276	258,012
Other upland hardwoods (maple, basswood, oak)	2,060	217	1,502	17,802	631	22,212
Lowland hardwoods (ash, elm, and silver maple)	7,838	336	2,599	7,531	492	18,796
Pine (red pine, white pine, and jack pine)	56,980	6,883	9,567	8,596	3,131	85,157
White spruce, balsam fir, and upland black spruce	16,108	6,634	3,528	19,430	3,355	49,055
Lowland conifers (black spruce, tamarack, and white cedar)	50,022	21,230	9,542	30,597	3,962	115,353
Stagnant conifers (black spruce, tamarack, and white cedar)	15,621	16,973	8,841	9,811	1,607	52,853
Other	36,605	14,260	20,584	31,755	5,650	108,854
Totals	**310,890**	**80,592**	**86,311**	**201,395**	**31,104**	**710,292**

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 have a significant effect on the recommendations in this plan. For this reason, acreage goals in this plan should be viewed as desired trends, not exact targets.

Chapter 2: SFRMP Issues

Issue Definition

SFRMP issues are natural resource-related concerns or conflicts that are directly affected by, or directly affect, vegetation management decisions on lands administered by the DNR Divisions of Forestry, Fish and Wildlife. Relevant issues are defined by current, anticipated, or desired forest vegetation conditions and trends, threats to forest vegetation, and vegetation management opportunities. The key factor in determining the importance of SFRMP issues is whether they can be addressed in whole or substantial part by vegetation management decisions on DNR-administered lands.

Issues that cannot be addressed in whole or substantial part by vegetation management decisions on DNR-administered lands are outside the scope of the SFRMP process. For example, SFRMPs do not address recreation trails 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.

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.

How SFRMP Issues Were Identified

Section Forest Resource Management Plan teams used assessment information[1] , Minnesota Department of Natural Resources (DNR) policies and guidelines, local knowledge, existing plans, and public input to identify the final issues relevant to the scope of this plan. The SFRMP team began with a common set of issues developed from previous SFRMPs. These common SFRMP issues were refined and supplemented based on section-specific conditions, considerations, and public comments.

Issues

A. Age Class Distribution & Growth Stages

A1. What are the desired age class and growth stage distributions of forest types across the landscape?

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

- a supply of habitat types that supports many species
- greater potential to provide a sustainable yield of timber
- ecological values, including healthier, diverse forests that are more resilient to insect and disease outbreaks and negative effects of climate change

[1] Minn. DNR July 2014 Preliminary Issues and Assessment, Subsection Forest Resource Management Plan.

What are the likely consequences of not addressing this issue? Managing a forest lacking adequate representation of age classes and growth stages can result in:

- increased risk of epidemic insect and disease outbreaks
- loss of species with age-specific habitat requirements
- long-term loss of forest productivity
- loss of forest-wide diversity
- boom and bust supply for forest industries that depend on an even supply of forest products over time

A2. What are the appropriate amounts, types, and distribution of older forest?

Older forest, in the context of this issue, is defined as stands that exceed their normal rotation age. The distribution of older forest represents age classes beyond the normal rotation age of each cover type. Designated old-growth stands are the highest quality representations of stands in the later stages of forest succession.

Why is this issue important? Older forest provides the following benefits that may be truncated or lost when final harvest occurs at or below normal rotation age (NRA):

- later successional growth stages associated with animal, plant, and fungi species' habitats
- development of late-successional native plant community (NPC) growth stages
- stable hydrology and groundwater in older forests
- overall structural and species diversity on the forest landscape
- growth of large trees for sawing into lumber

Tradeoffs include the potential for older forest to have reduced timber quantity and quality for some types of forest products compared to forests at or below NRA.

What are the likely consequences of not addressing this issue? The likely consequences of managing a forest without age classes beyond the normal rotation age are:

- loss of individuals or populations of species with old forest-specific habitat associations
- loss of diversity
- reduced recreational and economic opportunities associated with the loss of old forest conditions
- reduced ecological services associated with old forest conditions such as maintaining water quality, natural disturbance regimes, and biodiversity
- loss of potential for some large-diameter forest products (sawtimber, cabin logs, etc.)

A3. What are the appropriate amounts, types, and distribution of young, early successional forest?

This plan defines young, early successional forest as the 0-30 age class of aspen, balm-of-Gilead, birch, and jack pine 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

- 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
- future timber production in these forest types

What are the likely consequences of not addressing this issue? Not maintaining an appropriate amount of early successional forest can result in:

- reduced populations of important game species, particularly ruffed grouse, deer, moose, and American woodcock
- reduced populations of associated non-game species, particularly songbirds
- loss of social, economic, and ecological value of these species
- loss of 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

B1. How should we address biodiversity, forest health, and productivity goals through management of forest composition, structure, representation of growth stages, within-stand diversity, spatial arrangement of vegetative types, and native plant community distributions in the Section?

Why is this issue important? Current conditions deviate significantly from historical ecological diversity pre-European settlement:

- forest composition and structure have been simplified
- white pine, white spruce, tamarack, and upland white cedar have declined while aspen has increased
- within-stand diversity has decreased
- non-native invasive species have increased
- 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

What are the likely consequences of not addressing this issue?

- loss or reduction of species associated with specific declining habitat types
- increase in non-native invasive species
- increase in populations of desirable species to the point where they reach undesirable levels
- loss of biodiversity
- loss of ecologically intact landscapes
- loss of ability to produce a diversity of forest products (e.g., sawtimber, aesthetics, non-timber forest products, recreation, and tourism)
- loss of ability to respond to climate change

Planning efforts intend to produce a more regulated age class structure, which may differ from historical patterns.

B2. Which tree species should be represented within forest communities in the Section?

Why is this issue important?

- Historic unsustainable harvests, insect infestations, disease, drought, and browsing by wildlife have resulted in changes in forest age structure and composition compared to historic conditions. The consequences of this include:
    - loss of regenerative capacity for tree species due to factors such as lack of large downed trees, insects and disease, and a lack of seed trees
    - loss of composition and structure necessary to sustain associated species
- Climate change projections may impact decisions over which cover types are most appropriate for future vegetation management decisions.

What are the likely consequences of not addressing this issue?

- loss of native tree species diversity within forest communities
- loss of native plant community composition, structure, and function
- loss of composition and structure necessary to sustain species associated with cavity trees, leaning and downed logs, and other forest structure elements.
- loss of associated wildlife and coldwater-dependent aquatic species
- loss of the social, economic, and ecological values provided by these species

B3. How will imperiled and highly imperiled native plant communities in the Section be maintained or enhanced?

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 occurrence in the Section
- known association with rare species
- significant changes in composition as compared to historical conditions

Examples of these types of communities in the Section are FDn43a, MHn45b&c, and FDn32e (see the DNR NPC website and DNR field guides to native plant communities for more information).

What are the likely consequences of not addressing this issue?

- loss of examples of high-quality, intact native plant communities used as controls to compare and monitor the effects of management
- continued forest stand and landscape simplification
- loss of habitat for native and rare species

- loss of overall forest biodiversity and sustainability
- loss of native plant communities that are at risk of extirpation statewide and/or globally
- loss of reference sites for climate change adaptation
- loss of habitat for unique native plant assemblages and rare species

B4. How can we use intensive management of forest communities when necessary, while retaining some of the characteristics of natural stand-replacement disturbance events?

Why is this issue important?

- Intensive management is an important tool for successfully regenerating certain species, controlling insect or disease problems, and wildlife habitat management.
- Intensive management of forest communities can result in forest simplification and fragmentation of native plant communities at the stand and landscape scale.
- 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.
- Intensive management can include ground-disturbing activities such as rock-raking and herbicide application that can potentially: 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.

What are the likely consequences of not addressing this issue?

- increased simplification of forest stand and landscape communities
- fragmentation of native plant communities and forest cover types
- loss of forest diversity created by natural disturbances that supports wildlife and nongame habitat

B5. How can management on state lands 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 much less frequent in managed forest landscapes than they were historically. This change has resulted in problems with:

- fragmentation and simplification of forest ecosystems at the landscape scale
- change in the spatial arrangement of vegetation patches used by plants and animals

What are the likely consequences of not addressing this issue?

- increasing isolation of wildlife and plant populations
- species loss or decline
- reduced resilience of forest ecosystems to disturbance events and climate change
- increases of certain populations to undesirable levels resulting in negative impacts to forest communities

B6. How can forest fragmentation be reduced in order to maintain connectivity among habitat types?

Why is this issue important? In this Section there is less permanent forest loss due to development than in other parts of the state. However, harvesting and other factors such as road and trail construction, residential development, public utility development, and ongoing sales of large tracts of land by private corporations have resulted in:

- reduced forest patch size
- altered forest composition, structure, and age
- increased forest fragmentation

What are the likely consequences of not addressing this issue?

- continued reduction in forest patch size and loss of large landscape habitat
- reduced biodiversity and ability of the forest to produce a range of forest products
- reduced habitat connectivity and ecologically intact landscapes
- increased corridors for introduction and spread of invasive species

C. Sustainable Harvest of Timber and Non-Timber Forest Products

C1. What is the appropriate timber harvest level on state lands with consideration for the sustainability of all forest resources and trust lands responsibilities? (Largely addressed through STHA process)

Why is this issue important?

- Some cover types in the planning area have pronounced age class imbalances.
- State timber management needs to consistently provide forest products for society.
- Harvest on school trust land is mandated to provide economic benefit to the Permanent School Fund.
- Managing forests in a sustainable manner is a requirement for maintaining the DNR's timber program certification.
- Sustainably managed forests can:
    - support a healthy and competitive timber industry
    - provide the diversity of vegetation types associated with plant and animal species
    - maintain water quality
    - provide a wide array of recreational opportunities

What are the likely consequences of not addressing this issue?

- inability to provide a consistent harvest level over time
- loss of diversity in vegetation types throughout the Section
- reduction or loss of certain animal species in the Section due to loss of associated vegetation conditions
- loss of revenue for the Permanent School Fund
- loss of forestry industry due to lack of resource
- loss of DNR ability to manage forest lands due to loss of forest industry

- loss of DNR's timber program certification

Much of the harvest level decision is made through the STHA process. Other aspects of management that are related to harvest levels, such as annual plan additions or habitat projects, are within the scope of the SFRMP.

C2. How should "non-timber forest products" be managed?

Demand for some non-timber forest products has been light, but it is increasing for others.

Why is this issue important? Non-timber forest products (e.g., balsam boughs and decorative trees):

- provide diversification for local economies and are a traditional harvest 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

What are the likely consequences of not addressing this issue?

- unsustainable harvest of these resources
- inadvertent harvest of rare species

D. Biological Diversity

D1. How can management of stands within larger areas of biodiversity significance be designed to maintain or enhance biodiversity and native plant community composition, structure, and function?

Larger areas with biodiversity significance indicate intact ecosystems that support functioning landscapes, healthy plant communities, and balanced wildlife populations.

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 to address landscape-level goals
- the maintenance, enhancement, or restoration of high-quality examples of native plant communities
- potential for addressing biodiversity-related goals of the DNR and other landowners

What are the likely consequences of not addressing this issue?

- degradation of existing biodiversity and ecosystem function
- loss of opportunities for maintaining or restoring ecological patch relationships
- loss of ecosystem resilience in a changing climate
- loss of native plant community characteristics and components

D2. How will within-stand structural complexity (e.g., vertical, leaning, and horizontal structure, stem size and density, coarse woody debris, and pit and mound micro-topography) be retained and/or restored where natural succession pathways are cut short?

Why is this issue important?

- Within-stand structural complexity supports a variety of plant and animal species and promotes regeneration of some tree species.
- Current practices tend to reduce within-stand structural complexity and diversity.

What are the likely consequences of not addressing this issue?

- loss of composition and structure necessary to sustain native plant and animal species
- loss of regeneration sites for some species
- loss of native tree species diversity within forest communities
- loss of native plant community composition, structure, and function
- loss of associated wildlife

E. Rare Features

E1. How will rare plants and animals, their habitats, and other rare features be protected 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.
- DNR Department-wide direction acknowledges DNR's role in advocating for the maintenance and protection of habitat for rare features throughout the state, regardless of ownership.
- The DNR is obligated to protect endangered, threatened, and special concern (ETS) species and their habitats.
- The DNR is required by third-party certification (Forest Certification) to ensure that any management within high conservation value forest (HCVF) sites enhances or maintains the high conservation value(s) associated with the site.

What are the likely consequences of not addressing this issue?

- rare species extirpation at the local and state level
- rare species declines leading to listing status changes
- rare species habitat loss or degradation
- loss of diversity at the species (genetic), community, and/or landscape level

F. Wildlife

F1. How can vegetation management address the needs of game and nongame species?

Why is this issue important?

- Forest management changes habitat for wildlife game and nongame species.
- 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:
    - economic vitality of forest and tourism industries
    - maintenance of recreation opportunities for the public
    - health of wildlife species and populations
- Loss of important habitat types is a concern for a number of species, including listed and special concern species. (e.g., larger diameter aspen for fisher/marten cavity needs, loss of effective winter conifer cover for wintering deer.)

What are the likely consequences of not addressing this issue?

- loss of wildlife (game and nongame) habitat
- loss of forest bird habitat can result in loss of forest insect and disease control
- loss or reduction of species or populations associated with declining habitat types
- economic losses resulting from a decline in recreational activity associated with wildlife
- social losses because of a decline in enjoyment of cultural values associated with wildlife
- additional species listed as ETS-affecting future management options

G. Watersheds including Riparian and Aquatic Areas

G1. How will the impacts of vegetation management on surface waters (wetlands, streams, and lakes) be addressed?

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, as well as the overall diversity of wildlife and plant species found in a watershed.
- Management activities may result in impacts to permanent wetlands adjacent to upland stands. For example, young forest in the adjacent landscape can lead to faster and increased water runoff.
- 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.

- While Minnesota Forest Resource Council's (MFRC's) *Voluntary Site-Level Guidelines* serve as the DNR minimum standard for protections/mitigations related to surface waters, applying site-level guidelines without considering site-specific and landscape conditions may not be adequate to protect surface waters.

What are the likely consequences of not addressing this issue?

- loss or degradation of communities associated with wetlands, streams, and lakes
- loss of associated wildlife and aquatic species
- negative impacts to other values, including water quality and recreation opportunities

G2. How can cumulative impacts to aquatic resources of vegetation management on a watershed/sub-watershed level be addressed?

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-level decisions in this plan.

Why is this issue important?

- Vegetation management activities may affect watershed or sub-watershed hydrology.
- Failure to consider the cumulative impacts of vegetation management within a watershed scale to aquatic resources could result in increased run-off and stream bank erosion, more conspicuous run-off events, less stable flows, and reduction of habitat for aquatic organisms.

H. Timber Productivity

H1. How can timber productivity on state lands be increased?

Why is this issue important?

- Minnesota's forests provide a range of environmental and economic services.
- Timber sales are the means by which 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.

What are the likely consequences of not addressing this issue?

- reduction in timber products available in the Section
- loss of ability to sustainably provide forest products over time
- reduced revenues to the Permanent School Fund

- loss of forest product industries throughout the state due to a reduction in forest products quality and availability

I. Disturbance Impacts on Forest Ecosystems

I1. How will disturbances, including negative impacts of forest insects, disease, and wildlife on forest ecosystems be addressed?

Why is this issue important?

- Insects and diseases can reduce timber production and lumber grade, and increase fire hazard.
- They can promote a diversity of tree species and forest structure and generate dead wood, which provides important habitat components and soil nutrients.
- Widespread pest outbreaks outside their natural range cause high levels of tree mortality and can have significant ecological and economic consequences.
- Aggressive control attempts may result in an imbalance in native insect populations.
- Inadequate control may negatively affect timber volume, aesthetics, and recreational enjoyment of the forest.
- Undesirable increases in certain wildlife populations can have adverse impacts, including browsing and grazing by wildlife (herbivory).

What are the likely consequences of not addressing this issue?

- loss or degradation of forest products or regeneration due to forest insects, disease outbreaks, or herbivory
- loss or reduction of important ecosystems or ecosystem processes
- increased occurrence of non-native invasive species
- negative impacts to native plant communities

I2. How will non-native invasive species threats/invasions be addressed?

Why is this issue important?

- Non-native invasives have the potential to displace native species, carry or cause diseases, or disrupt natural community functions.
- We lack effective or practical methods to control invasive species at a landscape scale.
- There are some examples, such as beetles controlling purple loosestrife, of effective controls at a site level.
- It is the DNR's policy, through the Invasive Species Operational Order, to prevent or limit 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.

- Many non-native and invasive species lack effective or practical control methods.
- Increased use of public lands results in greater risk for the transport of invasive species of all kinds.

What are the likely consequences of not addressing this issue?

- permanent changes to native plant and animal communities through invasion or displacement
- degradation of soil and water resources, with cascading detrimental impacts on food sources, habitat, and populations.
- negative economic impacts, including increased control costs, decreased timber revenue, and decreased property values

I3. How will catastrophic natural disturbances be considered 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.
- They may also affect the short-term goals and long-term desired future condition (DFC) goals of this plan.
- Timing and location of catastrophic events are difficult to predict.

What are the likely consequences of not addressing this issue?

- loss of marketable timber available for sale
- increase in fire danger in the vicinity of the catastrophic event
- disruption of opportunities to implement plan goals

J. Climate Change

J1. During this planning period, how should we use vegetation management to address global climate change?

Why is this issue important?

- Minnesota is one of the fastest warming states in the U.S. and temperatures are projected to continue increasing through the end of this century.
- Effects of climate change may include:
    - changes in frequency and intensity of precipitation events and disturbances such as fires and windstorms (blowdown)
    - changes in 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
    - projected negative effects on tree species, such as quaking aspen, black spruce, balsam fir, birch, and jack pine due to soil warming and decreased soil moisture

    - expansion of habitat for some tree species, such as American basswood, eastern white pine, eastern hemlock, and northern red oak
- Forests with lower species and structural diversity are projected to be less resilient to climate change impacts.
- Future management decisions on cover type species appropriate for certain sites will be impacted by climate change.
- Carbon sequestration by forests and wetlands may be affected.

What are the likely consequences of not addressing this issue?

- acceleration and exacerbation of climate change effects to forest communities
- lost opportunity to begin directing management toward mitigating climate change effects on most vulnerable species and native plant communities
- species and community losses
- loss of management opportunities if changes in species populations and ranges are not addressed
- reduced timber production and access to winter management sites
- loss of ecosystem resilience
- reduced habitat for native wildlife and plants

K. Visual Quality

K1. How will vegetation management activities minimize impacts 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.

What are the likely consequences of not addressing this issue?

- a negative experience for the vacationing and recreating public in forested areas of the state
- negative public perception of DNR forest management activities
- increased regulations for vegetation management activities
- reduced vegetation management opportunities due to public opposition

L. Access to State Land

L1. How will access to stands identified for management be provided?

Why is this issue important?

- Access routes provide access for vegetation management activities, insect and disease control, fire response, and recreation.
- Negative effects of forest road development, construction, and maintenance can include:
    - land disturbance
    - loss of acres from the timberland base
    - increased spread of non-native invasive species and undesirable native plants and animals
    - potential conflicts with adjacent private landowners
    - potential for user-developed trails
    - degradation of water quality
    - destruction of fish habitat
    - forest fragmentation
    - impact state-listed plant and animal species

What are the likely consequences of not addressing this issue?

- lost opportunity to have a well thought-out forest access plan to minimize negative effects of access routes

M. Cultural Resources

M1. How will cultural resources be protected 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 cultural or scientific value. To be considered important, a cultural resource generally has to be at least 50 years old. 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, or a pioneer homestead.

Why is this issue important?

- Cultural resources are scarce, nonrenewable features that provide physical links to our past.
- They often possess spiritual, traditional, scientific, and educational values and should be treated as assets.
- In addition to federal and state laws that protect certain types of cultural resources, the *Voluntary Site-Level Forest Management Guidelines* provide information and recommendations to assist private and public land managers in taking responsible actions when cultural resources are encountered.

What are the likely consequences of not addressing this issue?

- Failure to follow the recommended management practices to protect cultural resources could result in permanent loss of or damage to the cultural resource.

N. Balancing Vegetation Management Needs with Legal requirements

N1. How will various state and federal legal requirements be included in the planning process?

Why is this issue important? Vegetation management takes administrative land status and other relevant statutes into consideration.

- The DNR is mandated by congress to manage school trust lands for the long-term economic benefit of the Permanent School Fund.
- Wildlife habitat management and protection is mandated by statute and funding requirements for acquired Wildlife Management Area (WMA) lands.

What are the likely consequences of not addressing this issue?

- failure to follow mandates and legislative intent may be a violation of federal or state law
- loss of timber program certification due to failure to comply with legal requirements

Chapter 3: Forest Types and Management Direction

Introduction

The planning team developed general direction statements (GDSs) and strategies in response to the final list of issues in Chapter 2 and defined desired future condition (DFC) goals where appropriate. An issue may be addressed through one or more GDSs, and some GDSs address multiple issues. Goals and strategies for state-administered forest lands in this plan were developed in consideration of the MFRC Northeast Regional Landscape Committee's desired outcomes, long-term goals, and strategies for forest lands and ecosystem types in the northeast landscape region.

General Direction Statements (GDS)

About GDSs:

- follow direction provided in state statutes and rules, and Department policies, guidelines, and management direction
- take into account team members' expert knowledge in their fields
- make recommendations for forest change such as increasing, decreasing, maintaining, or protecting a condition, output, or quality
- GDSs and associated strategies are grouped under 12 forest resource management categories. Some categories have several GDSs to address the associated issues while others have only one
- strategies in each GDS are suggested ways to achieve the general direction

Desired Future Conditions (DFC)

- DFCs are long-term (50+ years) goals for the desired condition of DNR-administered forest lands in the Section
- DFC goals were identified where we currently have the ability to measure and quantify progress
- examples include cover type acres, age class distributions, and amounts of young and old forest
- 50-year DFCs in relation to cover type conversion are given to aid in visualization of current goals and do not necessarily represent the goals of future planning periods

Role of Department Guidance Documents, Policy, and Management Recommendations

In addition to DFCs, general direction statements, 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 all these directives as they apply to individual site-level decisions.

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

- Is treatment consistent with current DNR policies and guidelines?

- Does the design meet MFRC *Voluntary Site-Level Guidelines*?
- Does site-level treatment advance landscape-level goals?
- Is the decision appropriate to the NPC? Is it consistent with the ECS silvicultural interpretation?
- Is the stand a good candidate for meeting plan conversion goals?
- Do planned actions account for Species of Greatest Conservation Need and ETS species?
- If appropriate, have climate change adaptation strategies been implemented?
- Is this land school trust land? If yes, follow direction in Op Order 121.
- Is the site in a MOA? If yes, is treatment consistent with MOA guidance documents?
- Are on-the-ground decisions considering STH direction and volume targets?

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, goals for forest composition and within-stand diversity in this section of the plan are to maintain cover type diversity on the landscape, convert cover types, and increase within-stand diversity where appropriate. This section concludes with a description of each cover type.

GDS 1A: Maintain diversity of cover types.

GDS-1A Strategies

- Retain cover types appropriate to native plant communities (NPCs).
    - For NPC-appropriate species, including suitability projections under climate change, refer to the *Suitability of Tree Species by Native Plant Community* table on the DNR website.
    - To learn more about NPCs typically found in this Section and their silviculture interpretations, refer to the *Field Guide to Native Plant Communities of Minnesota: The Laurentian Mixed Forest Province* and the DNR website.
- Convert cover types where appropriate (Table 3.2).
    - Determine sites and species appropriate for conversion during site visits and native plant community evaluations.
- Consider strategies to help increase resilience to climate change.
    - Increase the component of species which are projected to increase due to climate change.
- When conversion is desirable, options available include:
    - Allow some stands to convert through natural succession with or without harvest.
    - Artificially convert some stands through mechanical site preparation, prescribed burning, planting, or seeding.
    - Selectively harvest some stands to facilitate movement toward the desired cover type and within-stand composition.

Table 3.2: Current cover type acres and goals for the first decade and 50-year planning period. Conversion goals decided by the SFRMP team are given where appropriate (see Cover Types section below for more information on how the team determined conversion goals).

Cover Type	Current Cover Type Acres	Conversion Acres (first plan decade)	Conversion Acres (50-year DFC)	Final Cover type Acres
Aspen/balm-of-Gilead	198,270	-4,856	-24,280	173,990
Birch	29,394	-735	-3,675	25,719
White cedar	32,865	957	4785	37,650
Jack pine	24,349	274	1370	25,719
White spruce	22,511	530	2650	25,161
Red (Norway) pine	33,772	2326	11,630	45,402
Northern hardwoods	13,407	647	3235	16,642
Black Spruce - upland	6150	150	750	6800
White pine	9302	654	3270	12,572
Oak	456	53	265	721

*Goals may not be fully achieved due to conditions and other influences such as funding but are desirable targets.

*50-year DFCs here and under specific cover types are given to aid in visualization of cover type conversions. They do not necessarily represent additional conversions in future planning periods.

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

GDS-1B Strategies

- Continue to use the *Field Guide to the Native Plant Communities of Minnesota: the Laurentian Mixed Forest Province* and associated ECS silvicultural interpretations to classify stands to NPC and inform silvicultural prescriptions.
- Retain components of various growth stages in stands.
- Utilize available climate change projection information to inform decisions on species to reserve, favor regeneration of, or introduce into stands.
    - Consider projected increase or decline of species habitat 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).
    - Consider 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 site-level guidelines.

GDS-1C: Maintain or increase species, age, and structural diversity within some 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 selective harvesting to encourage diversity of species, ages, and stand structures. Selective harvesting is a silvicultural tool that can reserve species, age classes, and structural components while harvesting part of the stand.
- Meet or exceed the MFRC *Voluntary Site-Level Guidelines* designed to maintain a diversity of species, age, and structure within a stand.
- Retain tree species, stand structure, and ground layer diversity within stands when prescribing timber stand improvement, rather than managing for one species.
- Take advantage of opportunities to diversify stands when prescribing intermediate treatments.
- Maintain amount of older forest as directed by the Department.
- Use harvest systems or methods that protect advance 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 needed moisture and light requirements of the seedlings.
- Identify some stands where succession is allowed to occur to encourage development of within-stand diversity. Movement to the next successional stage may be achieved with or without harvest.
- Increase and/or maintain target species by reserving from harvest, 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, and artificial or natural seeding.
- Manage planted and seeded stands to represent the array of NPCs and variation with 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

- Some plant communities can naturally exhibit low species diversity. Low species diversity can be natural and has occurred historically in peatlands and in association with large-scale disturbances, particularly fire.
- Encourage fruit and mast-producing species.

Cover Types

The following cover type management guidelines provide a summary of current conditions and future management direction for each of the major cover types that occur within the NSU. They provide guidance on 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 and policy.

Some cover types have management split based upon site index.

Some cover types include conversion goals (desired trends, not exact targets), which the SFRMP team developed considering:

- documented and modelled native plant communities
- historical forest composition, disturbance regimes, and range of natural variation
- wildlife habitat associations
- forest insects and diseases
- increased availability of certain forest products (e.g., sawtimber)
- projected tree suitability under projected long-term climate change conditions
- recreational values

The following cover type information contains basic information for cover types within the NSU Section. Further general silvicultural information can be found on the DNR's silvicultural webpage. Additional scientifically based silvicultural options may be considered on a site-level basis to meet goals, including but not limited to: site-level specific goals such as MOAs, species-specific guidelines, and conversion goals. Additional silvicultural information sources can be used. Follow current departmental policy when deciding upon silvicultural options.

Broadly, management strategies for cover types fall into two categories: even-aged and uneven-aged. Even-aged cover types are shade intolerant and are usually managed primarily as a single age cohort to allow even light distribution. Some stands within these cover types are thinned periodically to enhance individual tree growth, forest health, and within-stand diversity. Across the landscape, the even-aged cover types are managed with the goal of moving the aggregate of all stands, through normal rotation age (NRA) or economic rotation age (ERA), toward balanced age class distributions.

Uneven-aged cover types are more shade tolerant and are managed within each stand for both a range of cohorts and species diversity. Thinning can be achieved by a variety of selection methods that improve individual tree growth and enhance within-stand diversity. Uneven-aged cover types are not managed for balanced age class distributions across the landscape but are managed to enhance within stand diversity and composition and improve wood quality. No age class charts are given for uneven-aged cover types for this reason.

Common management approaches by cover type.

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			✓
Black spruce-upland		✓					

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. Ash and lowland hardwood native plant communities occur along water features or in depressions where the water table is generally within reach of plant roots.

Current Acres: 16,646 acres in the NSU (approximately 2.9% of state-managed forest acres)

Future Direction and Goals

- Increase within-stand diversity.
- Increase resilience of sites to emerald ash borer (EAB).
- Maintain forested conditions of ash sites in the wake of EAB.

Strategies

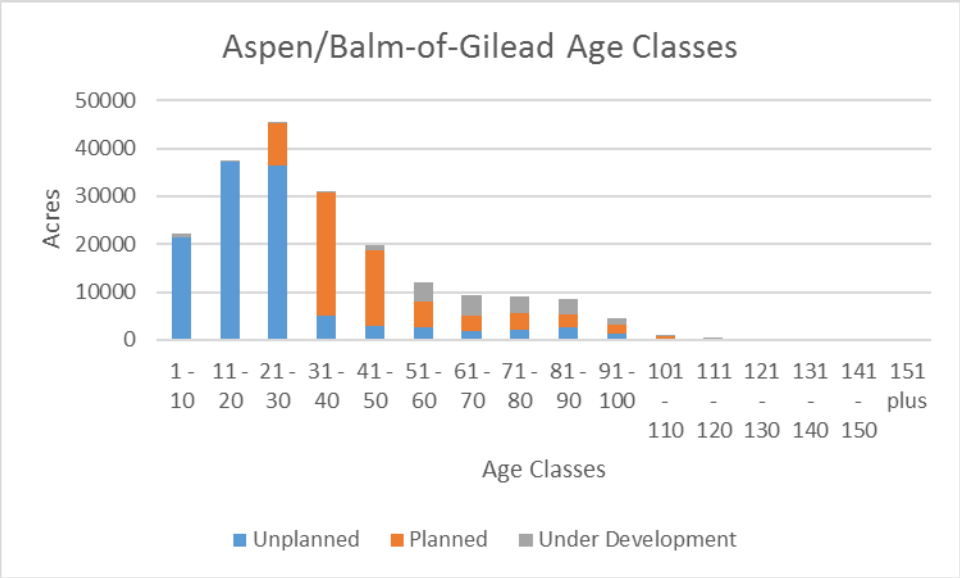
- Follow Department and divisional guidance on managing ash to address threat of emerald ash borer, including:
    - maintain an ash component in all stands, but reduce the size and number of ash
    - promote non-ash species

Special Concerns

- Emerald ash borer (EAB) is a threat to the retention of ash species.
- Loss of wet forest from swamping out and conversion to non-forested cover types.

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 managed similarly. Aspen/BG dominated native plant communities in the NSU are typically dominated by mesic to wet-mesic forests with a mixture of hardwood species and some conifers in the canopy and understory.



Current Acres: 200,508 acres in the NSU (approximately 34.9% state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 193,414 acres (2.5% decrease)
- 50-year DFC: 173,990 acres (12.5% decrease)
- Move toward balanced age class distribution up to rotation age, and include policy directed amounts above rotation age.
- Increase within-stand diversity.

Strategies

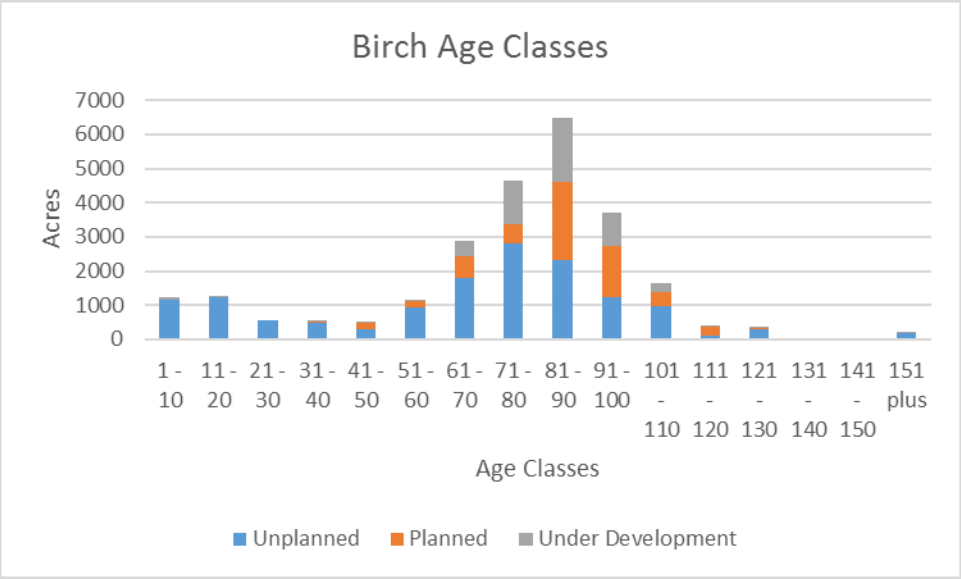
- Clearcut with reserve is the common prescription if desiring to regenerate aspen.
- Convert approximately 4,856 acres (24,280 acres over five plan periods) utilizing NPC suitable species.
    - Convert 2.5% aspen to other cover types to address NPC goals and climate change projections in this planning period.
    - Determine sites and species appropriate for conversion by field visits and NPC.
- Maintain the diversity of species where they occur in aspen stands.
- Increase northern hardwoods, including birch and oak, or conifers including white pine, white spruce, red pine, and upland white cedar as appropriate to NPC.

Special Concerns

- Conversion is challenging due to aggressive suckering. Other prescriptions may be considered to allow conversion.
- Insect and disease concerns include:
    - stem decay and butt rot in wounded trees
    - white trunk rot as aspen ages
    - decline following tent caterpillar defoliation in stressed stands
    - *Hypoxylon* cankers and *Saperda* stem borer mortality in low-density stands or stand edges
    - preferred host for gypsy moth
- Long distance to market may challenge management efforts for some stands.

Birch

The birch (Bi) cover type includes paper birch and, to a limited extent, yellow birch in NSU. Birch is often found with some conifers in the canopy and understory. It is often mixed with other hardwood species. Birch can be found on mesic to dry sites.



Current Acres: 29,394 acres in the NSU (approximately 4.5% state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 28,659 acres (2.5% decrease)
- 50-year DFC: 25,719 acres (12.5% decrease)
- Move toward balanced age class distribution to the extent possible.
- Increase within-stand diversity.
- Conversion goal away from birch is lower than the current natural succession trend, so maintaining birch stands is appropriate for most sites.

Strategies

- Generally, a clearcut method is used to regenerate paper birch.
- A variety of methods can be used to regenerate yellow birch; however, seeds require decaying coniferous nurse logs or exposed mineral soil to sprout.
- Consider opportunities to convert A/BG cover type to Bi cover type where site appropriate.
- Increase northern hardwoods, including birch and oak, or conifers, including white pine, white spruce, red pine, and upland white cedar where they already occur or in appropriate NPCs.

Special Concerns

- Balancing Bi age classes may not be attainable due to small number of cover type acres and marketability concerns.

Northern Hardwoods

Northern hardwood (NH) dominated plant communities in the NSU usually occur on upland sites with moist soils in settings protected from fire. Natural, mature NH stands are comprised of mixed species.

Current Acres: 13,675 acres in the NSU (approximately 2.4% state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 14,054 acres (5% increase)
- 50-year DFC: 16,642 acres (25% increase)
- Move toward a regulated size-class structure within stands.
- Improve timber quality.

Strategies

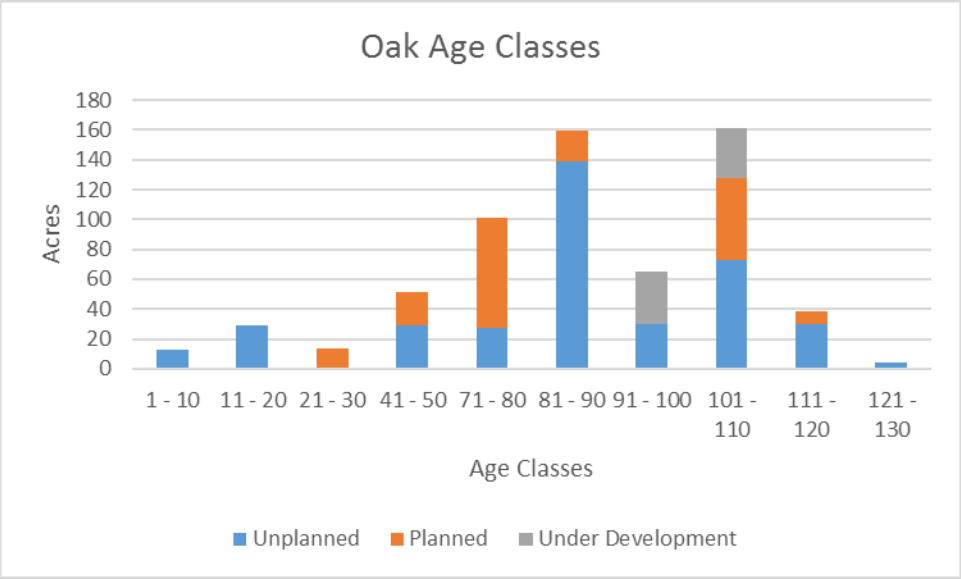
- Generally, uneven-aged and gap management is used to regenerate NH and manage species composition.
- Convert approximately 647 acres (3,235 acres total over five plan periods) of the aspen/balm of Gilead/birch cover type to NH cover type.
    - Gradually convert from aspen dominated stands to more diverse stands with additional hardwood trees.
- Increase diversity of species where opportunities exist
- Increase oak and maintain birch and basswood in mixed stands where appropriate

Special Concerns

- If left to naturally succeed, 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 all oak species. Natural, mature oak stands range from nearly pure oak to mixed stands. Oak species are commonly found as a component of other cover types such as aspen, birch, northern hardwoods, and lowland hardwoods (bur oak).



Current Acres: 435 acres in the NSU (approximately 0.08% state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 509 acres (11.5% increase)
- 50-year DFC: 721 acres (57.5% increase)
- Move toward desired balance among age classes.
- Maintain age and species composition within stands.
- Increase oak cover type where appropriate for climate change adaptation.

Strategies

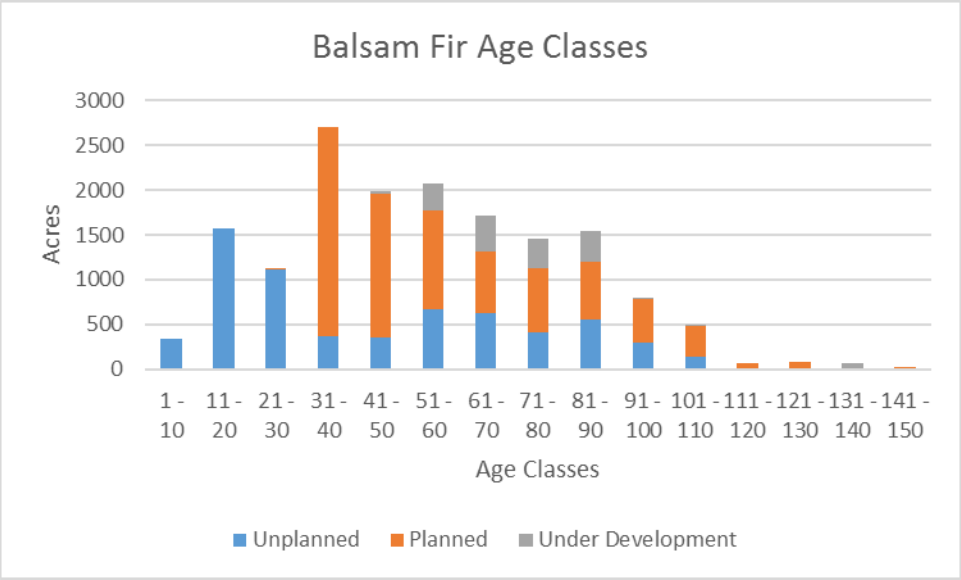
- Generally, use appropriate regeneration method depending on advance regeneration:
    - if there is enough advance regeneration, use clearcut method
    - if there is insufficient advance regeneration, typically use shelterwood harvests
    - group selection is a silvicultural strategy which may be considered
- Increase oak components in aspen and NH cover types.

Special Concerns

- If allowed to succeed, shade-tolerant species such as maples will increase in abundance in oak stands.
- Considering climate change and market forces, some aspen stands may gradually include a greater component of oak.
- Regeneration may require browse protection.

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.



Current Acres: 16,034 acres in the NSU (approximately 2.8% state-managed forest acres)

Future Direction and Goals

- Desired within-stand composition is mixed forests, including long-lived conifers and upland hardwoods appropriate to NPC.
- Move toward balanced age class distribution.
- Manage balsam fir as a component of other mixed species cover types.

Strategies

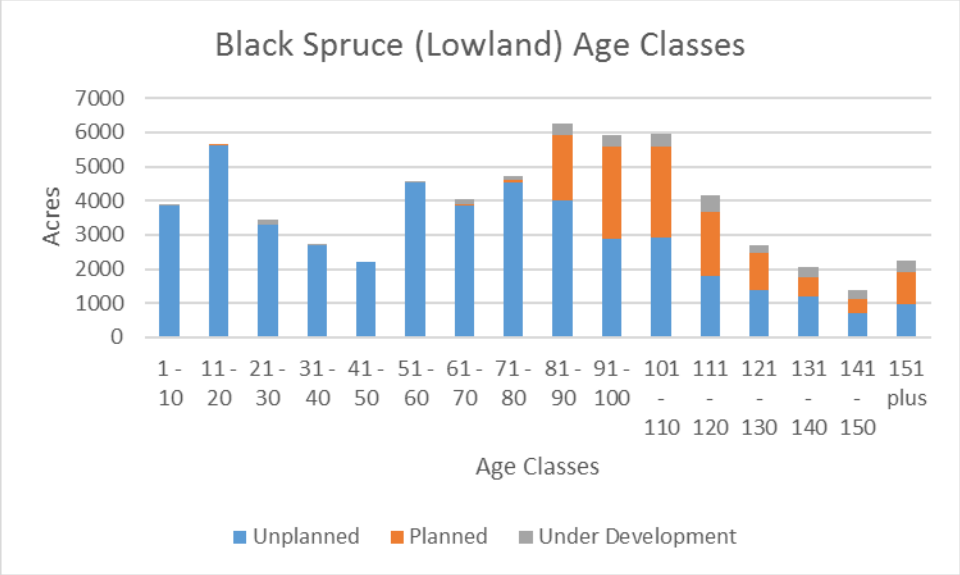
- Manage BF generally as even-aged for pulpwood and bolts.
- Some BF stands may be managed unevenly for a variety of purposes.
- Use intermediate treatments to control species composition and speed up stand development.
    - Best results from release treatments in young, vigorous stands (approx. 6-10 feet tall).

Special Concerns

- Spruce budworm
    - Emphasize regeneration of WS rather than BF in the understory.
    - Increase abundance of non-host tree species such as pines and hardwoods.

Black Spruce (Lowland)

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



Current Acres: 61,786 acres in the NSU (approximately 10.7% state-managed forest acres)

Future Direction and Goals

- Move toward balanced age class distribution.
- Maintain species diversity within BSL stands.

Strategies

- Maintain secondary component species such as tamarack, white cedar, balsam fir, and paper birch. This can be accomplished through:
    - reserving seed trees, islands or clumps of mature trees, and advance regeneration
    - harvesting to promote sprouting of deciduous species
- Utilize natural or artificial seeding to regenerate BSL stands after harvest.

Special Concerns

- BSL grows slowly and may have reduced vigor in some NPCs, especially on sites compacted by harvest operations.
- Concerns over climate change impact on season of operability, limiting management opportunities to a shorter period of frozen ground conditions to reduce rutting and compaction concerns.
- In wetter lowland sites, large black spruce clearcuts may result in raised hydrology and seeding regeneration failure (swamping out).
- Eastern dwarf mistletoe. Strategies generally used to limit spread to regenerating stands:
    - Remove all live black spruce greater than 5 feet tall in clear cuts.

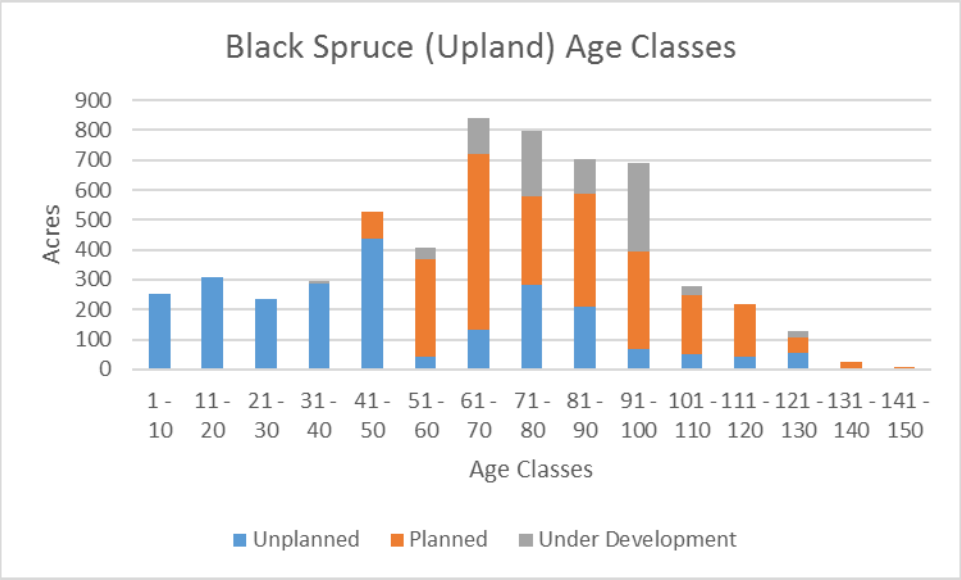
- Distribute slash for prescribed burns evenly across the site.
- Design timber sale boundaries to include a 2-chain (132 foot) buffer of non-infected black spruce around mistletoe pockets.
- Consider alternative goals and reserves in dwarf mistletoe mitigation decisions.

To reduce dwarf mistletoe infection in newly regenerating stands:

- Use prescribed fire or winter shearing to remove all residual infected trees if they are not removed during timber harvest.
- Regenerate densely stocked stands of black spruce to slow spread and reduce damage.
- BSL may be challenged under some projected climate change scenarios.

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.



Current Acres: 5,718 acres in the NSU (approximately 1% of state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 6,300 acres (2.5% increase)
- 50-year DFC: 6,800 acres (12.5% increase)
- 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.
    - Nutrient poor sites with feathermoss seedbeds are excellent locations to maintain and increase BSU as a cover type, especially where seed trees are present.
- Perpetuate and increase black spruce when found in JP stands by creating a seedbed for reserved upland black spruce expansion.

Jack Pine

The jack pine (JP) cover type is generally managed as an even-aged cover type for pulpwood and bolts, and to support wildlife habitat and biodiversity. Younger stands tend to be dominated by jack pine, and as stands transition to older growth stages.

Current Acres: 24,195 acres in the NSU (approximately 4.2% of state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 24,623 acres (1.1% increase)
- 50-year DFC: 25,719 acres (5.5% increase/decrease)
- Move toward a more balanced age class structure.
- Desired within-stand composition is relatively pure jack pine in younger growth stages. As stands mature, other species may increase depending on NPC.

Strategies

- Convert approximately 274 acres (1,370 acres over five plan periods total) of A/BG/Bi cover types to JP cover type in appropriate sites, including FDn12, FDn22, and FDn33.
- Perpetuate and increase black spruce when found in JP stands by creating a seedbed for reserved upland black spruce expansion. Sites classified as FDn32 may be suitable.

Special Concerns

Older stands are at high risk for significant mortality due to jack pine budworm outbreaks. Outbreaks occur at 6-12 year intervals and usually last 3-4 years in a location. Suggestions to address jack pine budworm include:

- Maintain age class diversity to minimize mortality.
- Salvage budworm killed trees. Pre-salvage if intended products include dimensional lumber.
- Minimize “edge” when designing timber sales to decrease severity of budworm impact.

- Regenerate jack pine from local seed sources to preserve natural diversity of drought tolerant populations.
- Jack pine is expected to be challenged under some projected climate change scenarios.

Red (Norway) Pine

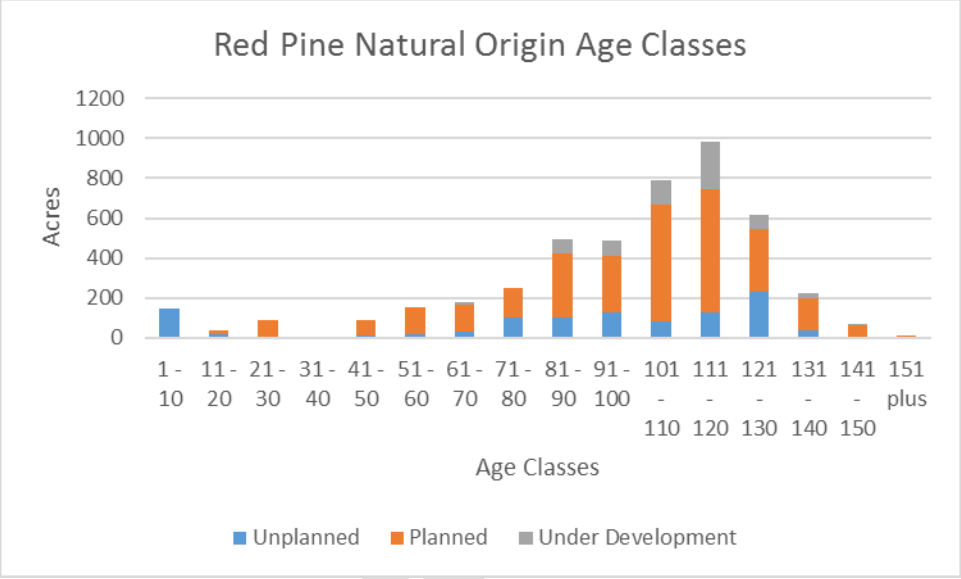
Red pine (RP) on DNR-administered timberlands is treated as two distinct cover types. MN DNR has completed an economic analysis of rotation ages that resulted in direction for the red pine cover type on MN DNR lands. Planted stands are managed using an economic rotation age (ERA). Natural origin stands are managed using normal rotation age (NRA). Natural origin stands are managed to reflect a more natural age class distribution, with a final harvest followed by a regeneration strategy mimicking creation of a natural origin stand.

Special Concerns

- Shoot blight-Follow current Department guidance
- Bark Beetles-Follow current Department guidance

Red (Norway) Pine – *Natural Origin*

Red pine dominated NPCs in the NSU are typically dry to mesic forests that range from nearly pure stands to mixtures with other conifers and hardwood species, especially aspen and birch. Currently, natural origin red pine stands have been identified to five different native plant community classes, within which nine discrete NPC types and subtypes can be described.



Current Acres: 4,629 acres in the NSU (13.3% of total red pine acres; planted and natural origin red pine together represent approximately 6.1% of state-managed forest acres)

Future Direction and Goals

- Move toward a more balanced age class structure.
- 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.

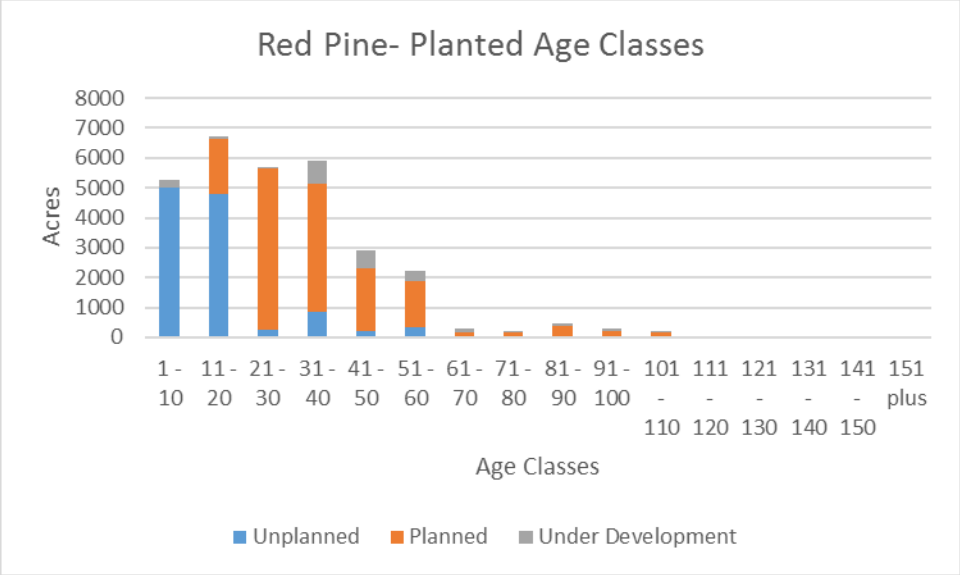
Strategies

- Follow current department guidance in reference to red pine management.

- Thinning in natural origin stands should maintain or increase within-stand diversity, normally 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 interpretations.
    - Consider incorporating variable density thinning or other techniques to meet biodiversity or habitat objectives. For example, thin 20 percent of the stand to 60 BA, 60 percent to 90 BA, and skip thinning in 20 percent to encourage within-stand diversity.
    - 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.
- Consider the following recommendations when regenerating red pine:
    - Use natural regeneration in natural origin stands when opportunities arise.
    - Scarify to encourage natural seeding of red pine and other species.
    - Consider maintaining within-stand diversity during site preparation and herbicide use.
    - 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.
    - 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.
- Consider potential impacts of bark beetles during intermediate harvest in red pine (see below).

Red (Norway) Pine – *Planted*

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



Current Acres: 30,190 acres in the NSU (86.7% of total red pine acres; planted and natural origin red pine together represent approximately 6.1% state-managed forest acres)

Future Direction and Goals

- Move toward a more balanced age class structure for classes between 0 years and economic rotation age.
- Manage for poles and high-value sawtimber products.
- Increased biological diversity and wildlife habitat.
- Diversified stands as they age.
- Increased within-stand structure to maintain or improve wildlife habitat and biodiversity.

Strategies

- Convert approximately 2,326 acres (11,630 acres over five plan periods total) of A/BG/Bi types to RP cover type.
- Manage predominantly as an even-aged cover type.
- Use thinning to increase future tree growth, quality, and vigor, and to obtain the desired composition of the stand. Recommendations are:
    - Consider 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 growth of desirable understory species.
- To regenerate RP, use clearcut or clearcut with reserves. Use the following considerations:

    - When site prepping and using herbicide, consider maintaining within-stand diversity.
    - Scarify to encourage natural seeding of red pine and other species.
    - Scarify and artificially seed red pine and/or other species.
    - 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.
- Use shelterwood when converting to white pine.
- Reserve biological legacies such as large, healthy, live trees, decadent trees, snags, logs, and other coarse woody debris.

Stagnant Spruce

Stagnant spruce (Sx) is not considered a commercial cover type; however, some harvest occurs for decorative spruce tops. Tree tops from 1 ½ to 6 feet in length are cut from selected trees, which grow new tops from lateral branches over time. Harvest level varies with tree size and quality, and industry product specifications. In most stands, selective 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.

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 less than 23, meaning that when trees are 50 years old, they are 22 feet tall or less.

Balancing the Sx age class distribution is not a goal of this plan.

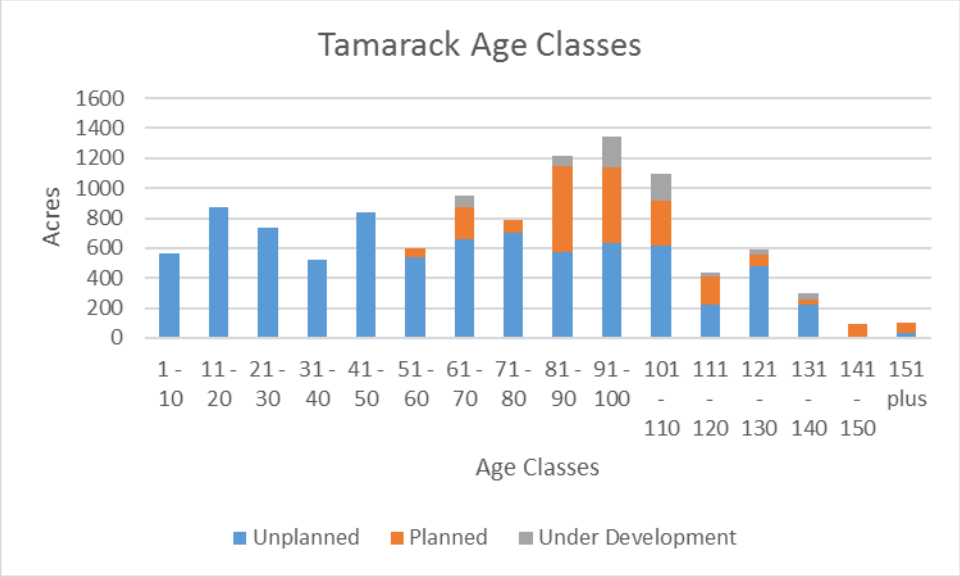
Current Acres: 30,357 acres in the NSU (approximately 5.3% state-managed forest acres)

Special Concerns

- Peatland forests are characterized by saturated groundcover that is sensitive to rutting and compression by equipment. Consider low-impact equipment.

Tamarack

Natural, mature tamarack (T) stands range from pure or nearly pure stands to mixed stands. Secondary species in the cover type include black spruce, balsam fir, cedar, and birch. Typical tamarack dominated NPCs include WPw63 and APn81. The T cover type is managed primarily by even-age methods for pulpwood, while providing forest wildlife habitat and biodiversity.



Current Acres: 11,050 acres in the NSU (approximately 1.9% state-managed forest acres)

Future Direction and Goals

- Move toward balanced age class distribution
- Maintain T acres on the landscape and increase upland tamarack

Strategies

- Harvest, leaving seed trees, in advance of Eastern larch beetle (ELB). Leaving approximately 10 tamarack per acre is recommended for successful seeding.
- Increase tamarack within other cover types and on upland sites as appropriate
- Maintain secondary component species of T stands where possible by:
    - reserving seed trees, reserve islands, clumps of mature trees, or advanced regeneration
    - artificial seeding may be an option for species such as black spruce and cedar

Special Concerns

- Eastern larch beetle (ELB)
    - Consider pre-salvage or salvage harvest when stands are currently infested or are dying due to infestation
    - Consider retaining a minimum of 5-10 live tamarack per acre as seed trees.
    - Where opportunities exist, regenerate high site index stands ahead of ELB infestation.

White Cedar

White cedar (WC) is long-lived and is the climax species in many 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, but grows best on sites with the following characteristics:

Lowland

- well decomposed peat derived from woody plants or sedges
- pH of 6.5 – 7.8
- good water movement
- ground water high in minerals

Upland

- constant soil moisture supply
- somewhat poor to well-drained soils
- good aeration
- medium to fine textures high in calcium

White cedar is managed as an uneven-age cover type. Balancing WC's age class distribution is not a goal of this plan.

Current Acres: 32,066 acres in the NSU (approximately 5.6% state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 33,822 acres (3% increase)
- 50-year DFC: 37,650 acres (15% increase)
- Increased abundance of white cedar as a component of other cover types.
- Emphasize WC in deer wintering areas.

Strategies

- Maintain or increase acreage of WC stands used as thermal cover areas by deer.
- Maintain or increase white cedar as a component of other forest cover types.
- Manage stands as multi-age and mixed-species stands.
- Consider increasing the amount of strip and patch cuts in WC stands to increase age class diversity.
- Protect regeneration from browse.

Special Concerns

- Browsing by deer, mice, and snowshoe hare may limit the ability to increase or maintain WC stands.

White Pine

White pine (WP) occurs as pure stands and as a component of many other upland cover types in NSU. In this plan, a stand belongs to the WP cover type if it contains greater than 33% white pine by volume or basal area.

Current Acres: 9,570 acres in the NSU (approximately 1.7% state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 9,956 acres (7% increase)
- 50-year DFC: 12,572 acres (35% increase)
- Maintain age and species composition within stands.
- Move toward balanced age class distribution.

Strategies

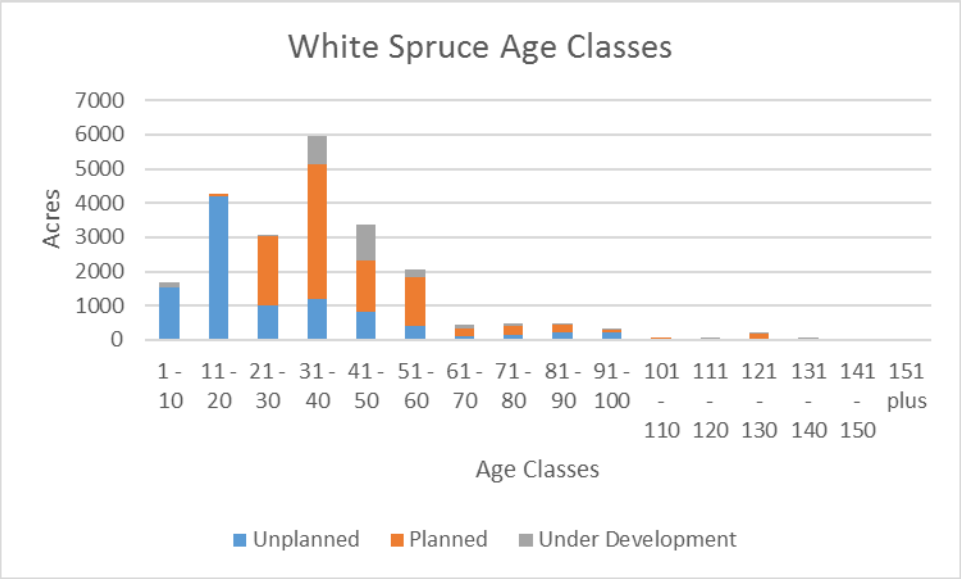
- Manage white pine stands to maximize potential for white pine regeneration in the understory.
    - White pine abundance can be encouraged by selective thinning in appropriate stands.
- Convert approximately 654 acres (3,270 acres over five plan periods total) of A/BG/Bi cover types to WP cover type.
    - Assess 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.
- Increase amount of white pine occurring as a component in mixed stands as appropriate to NPC.

Special Concerns

- Difficult recruitment due to browse by deer in some areas.
- White pine blister rust has affected tree growth and regeneration in northern Minnesota.
    - Seedlings and saplings often die, especially if planted in open plantations.
    - Establish white pines under an overstory to prevent dew formation on needles.
    - Tend seedlings and saplings once established using pathological pruning.

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. White spruce occurs as mixed stands in the FD and MH native plant communities and is considered an excellent competitor in FDn43 and MHn44 NPCs. 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: 22,527 acres in the NSU (approximately 3.9% state-managed forest acres)

Future Direction and Goals

- 10-year DFC: 23,041 acres (2.5% increase)
- 50-year DFC: 25,161 acres (12.5% increase)
- Increase species and structural diversity in planted WS stands.
- Move toward balanced age class distribution for WS.

Strategies

- Convert approximately 530 acres (2,650 acres over five plan periods total) of A/BG/Bi cover types to WS/BF cover types in appropriate sites.
- Manage natural-origin WS as multi-age and mixed species stands. Recommendations include:
    - Retain some supercanopy trees in patches or clumps at each treatment.
    - 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.
- Manage planted WS as normal rotation stands on an even-aged basis for pulpwood, bolts, and sawtimber products when appropriate.

- After final harvest, convert plantation WS stands to mixed species, structurally diverse stands using NPC information to select the most appropriate species.

Special Concerns

- Spruce budworm and yellow-headed spruce sawfly
  - Reserve trees may mitigate impacts from sawfly by providing partial overstory shade.
  - When regenerating WS stands, reduce balsam fir, the preferred budworm host.
  - Increase abundance of non-host tree species such as pines and hardwoods.
- Needlecast diseases and other insects (e.g., spruce weevil, spruce beetle, etc.)
  - Plant WS seedlings under a light overstory of aspen or aspen/birch to discourage insect pests that cause seedling mortality and impact height growth.
- Thinning damage to the shallow root system of WS
  - Thin only when ground is frozen and snow is present.
  - Conduct first thinning before 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.

Upland Brush

Upland brush is a non-commercial cover type dominated by deciduous brush species. Without management intervention, upland brush types generally will not regenerate to a commercial timber stand for many decades. They often are created after a stand-level disturbance, age-related decline of a formerly commercial species, insect or disease outbreaks, browse pressure, or significant failure in regeneration in a plantation. Follow Department direction on maintaining upland brush.

Upland brush types have high value as forage and cover for moose, and creation or maintenance of a small amount of acres in the type may be considered to enhance habitat for moose and other species.

Future Direction and Goals:

- Create or maintain some upland brush acres to provide habitat for moose and associated species.

Strategies:

- Delineate inclusions of upland brush cover types larger than 5 acres within the range of moose.
- Identify stands to be considered for upland brush management.
- Mowing, shearing, prescribed burning, or other methods may be considered to manage upland brush sites.

Special Concerns:

- While most of the implementation of strategies in the plan are completed by the Division of Forestry, upland brush is largely to be maintained by the Division of Fish and Wildlife.

3.2 Harvest Levels

GDS-2A: Provide a sustainable supply of timber.

Sustainable treatment levels were developed using a harvest-scheduling model through STHA, considering the following factors among others:

- age class imbalances for even-age managed cover types
- representation of young and old forest
- varying goals based on administration and land status (ex: Forestry land, Fish and Wildlife land, school trust land)
- supply of timber
- varying criteria for uneven-age management and thinning in addition to even-age management
- forest growth and sustainability
- forest health concerns
- expected future market and stand conditions
- incorporating intermediate treatments to achieve a variety of goals in conjunction with harvests

10-year treatment levels may vary above or below the sustainable level until age classes are balanced; however, the long-term goal is to provide a relatively stable supply of timber from state lands. STH model considerations were complex in nature and cannot be fully described here. See STH documentation for further details.

Field visits of selected stands may result in timber harvest, inventory alteration (i.e., correcting or updating forest inventory data), forest development without harvest, forest development with harvest, or deferring treatment (treat in a future planning period).

GDS-2A Strategies

In addition to modelled stand selection for STHA, the following strategies will contribute to providing a sustainable timber supply over time:

- Assess stand viability and visit stands with the greatest potential to lose volume over time.
- Consider SFRMP goals when proposing annual plan additions (APAs).
    - Annual plan additions are stands or portions of stands discovered during normal, day-to-day management activities, which warrant treatment (i.e., Insect and disease or salvage) and are not on the stand exam list.
- Consider potential biomass harvest consistent with MFRC guidelines where appropriate.
    - Biomass could be available as tops and limbs from roundwood harvests.
    - Non-commercial forest and brushlands may have potential for biomass harvest.

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

Non-timber forest products include decorative materials, foods, herbs, medicinal materials, and specialty items.

Special product permits or informal timber sales are issued at the field level 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

- Consider known traditional gathering areas of special 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

Biological diversity, forest composition, and spatial distribution of forest patches are influenced by many factors, 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 for each tree species to compete alters the make-up of the forest.

Natural disturbance: In conjunction with insects and disease, windthrow and wildfire were once the primary natural disturbance factors affecting forest stands; alteration of the type and frequency of fires since European settlement has helped to shape the current forest.

Past timber harvesting and land management practices: In the early 20th century, timber harvesting practices and large wildfires in some portions of Minnesota 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.

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.

Current forest management practices: Recent state forest management plans, and forest management plans in general throughout Minnesota, have been targeting some percentage of early successional cover types for conversion to later-successional cover types and mixed-forest stands.

Wildlife browse: Some species (e.g., deer, hare, porcupine, beaver, and other rodents) can affect the health of trees or regeneration success. Some species of trees (e.g., white pine, white cedar, and oaks), as well as other forest plants, may require protection from browse damage to thrive/survive.

Invasive species: Invasive plants, animals, and disease 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, or displace native trees and plants.

Climate Change: Various climate change projections suggest that over time, some common tree 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, 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: Provide older forest across the landscape to account for timber products, wildlife habitat, and ecological diversity.

Conditions ranging from stands over rotation age for a cover type to stands designated as old-growth represent mature to old forest on the landscape. These conditions are created or maintained in many ways on DNR administered land and other ownerships in the NSU landscape:

- Designation of old-growth stands and old forest management complexes (OFMCs).
- Accounting for older forest across ownerships during DNR planning (see below).
- Volume offered targets considered desires for retention of older forest (e.g., not all stands are selected at their rotation age within the plan period).
- A portion of the stands selected during stand selection do not result in a treatment some of these represent older forests.
- Management regimes on non-trust FAW administered lands and some types of non-trust MOAs include longer rotation ages.
- Contributing to older forest characteristics and legacies through application of site-level guidelines.
- Consider biodiversity that depends upon older forests.
- Some forest stands on DNR administered lands (e.g., state parks and SNAs) that are not in the management pool.
- Other stands that are not in the management pool include inoperable stands, representative sample areas (RSAs), and stagnant conifers, among others.
- Statewide allowance for 2.5% older aspen (>60 years old) through the STHA harvest level decision and resulting stand selection.
- Soft conversions from shorter to longer-lived species.
- Allow some forests to age to develop quality high-value forest products.
- Allow some stands to age to increase cover type diversity.

In addition, the DNR plans to use an adaptive approach to monitor and manage forest age classes, including older forest, across ownerships at a statewide level. How this will occur is still evolving, but the following is known:

1. The Section Forest Resource Management Plan (SFRMP) original desired percentage of older forest is applied as a benchmark across all ownerships
2. Forest age class distributions across all ownerships and on DNR-administered timberlands are periodically monitored.
3. DNR forest age class management may be adjusted, if necessary, in response to changing conditions across all ownerships.

Table 3.3: Subsection Old Forest Benchmarks across all ownerships

Subsection % Old Forest Benchmark*

Cover Type	North Shore Highlands	Border Lakes	Toimi Uplands	Laurentian Highlands	Nashwauk Uplands
Aspen	11	11	11	11	12
Birch	14	14	14	14	12
Jack Pine/BSU	9	9	9	9	12
Balsam Fir	9	9	9	9	9
BSL High SI	10	10	10	10	15
BSL Medium SI	10	10	10	10	13

*Numbers reflect previous plan effective older forest (over standard rotation age) goals as applied in old forest adequacy analysis.

* Due to varying levels of confidence and coverage of that data in the NSU Section, precise comparisons of all forest benchmarks were difficult to derive. The Department strives to monitor and improve the data available for analyzing the current status.

GDS-3A Strategies

- If DNR identifies discrepancies between current and benchmark percentage of old forest across ownerships, communicate the issue through appropriate channels. (Done during monitoring and assessment)
- Allow some stands to naturally succeed to long-lived cover types, with or without the use of harvest.
- Maintain designated old-growth stands.
- Manage Old Forest Management Complexes (OFMCs) according to DNR policy.
- Use silvicultural treatments that retain old forest components in some stands.
- Consider the old forest contribution to habitat and biodiversity when making decisions to add and offer unplanned wood for harvest.

GDS-3B: Maintain or enhance vegetation conditions associated with known SGCN occurrences.

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. Key Habitats are habitats most important to the greatest number of SGCNs. For more information, refer to Minnesota's Wildlife Action Plan and the Rare Species Guide on the DNR website.

GDS-3B Strategies

- Consider SGCN habitat needs and key habitats in vegetation management.
- Consider new SGCN and key habitat locations and data as they are collected.
- Manage SMAs consistent with their association with SGCNs and Key Habitats.
- Consider climate change adaptation strategies to maintain resilient habitats for wildlife.

GDS-3C: Maintain or increase size of existing patches on state lands over time, with consideration of natural spatial patterns.

In this plan, a patch is a type of MOA intended to reduce forest fragmentation and increase connectivity. Patches are made up of one or more adjoining stands that are relatively homogenous in structure, primarily in height and density, and are similar in vegetation cover and age.

- Patches can be categorized as old, intermediate, and young within cover types.
- Patch sizes range from small (less than 40 acres) to large (greater than 640 acres).
- Patches 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 of patches within this plan is to set the stage in the short-term (10 years) to improve the distribution of patch sizes and age classes across the landscape over the long term (50 years).

GDS-3C Strategies

- Review and incorporate MOA plan in management activities.
- Maintain existing large patches.
- Group harvest activities to maintain or create new large patches.
- Increase the "age window" for harvesting adjacent stands to maintain or create new large patches (harvesting at younger or older ages than normal).
- Increase the size of 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 in MBS sites of high and outstanding biodiversity significance.

Minnesota Biological Survey (MBS) sites contain intact native plant communities, populations, and/or concentrations of rare species; critical animal habitat; and/or functional landscapes representative of pre-European settlement Minnesota.

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
- native plant community rarity, condition, and size
- landscape context
- integrity of ecological functions (such as natural water-level fluctuations, disturbance dynamics, and habitat continuity)

More information about MBS, including background, definitions, and maps, is available on the DNR website. Staff should be familiar with site reports and the most recent direction in addressing MBS sites in management activities.

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 were ranked.

- Consider measures to maintain or minimize the loss of characteristics upon which high and outstanding MBS Sites are based.
- Consider the broader context and significance of the MBS site as a whole when assigning management objectives and designing silvicultural prescriptions.
- Emulate the within-stand composition, structure, and function of NPC growth stages when managing stands in outstanding and high MBS sites.
- 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.
- MBS categories were considered in identifying High Conservation Value Forests (HCVF). Consider current DNR policy on HCVF when making management decisions.
- DNR personnel across divisions should inform other landowners of the significance of MBS sites, their biodiversity objectives, and management options for addressing them as opportunities arise.

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

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

The DNR has a leadership role in the administration and application of MN rare species statutes and associated rules. Available information on rare species in MN is available at the rare species guide website.

GDS-3E Strategies

- Provide DNR staff access to the Natural Heritage Information System (NHIS).
- Incorporate new rare features inventory information as it becomes available.
- Consult the rare features database (NHIS) when planning management activities.
- Coordinate with division partners to avoid impacts to state-protected species and species of special concern.
- In stand management decisions, consider rare species in the context of current Department guidance.
- Coordinate with division partners to consider climate change implications on ETS habitat.

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

Minnesota's native plant communities have been assigned statewide and global conservation status (S-rank, G-rank) that reflect the risk of elimination of the NPC at these levels. This ranking system is based on methodology developed by the conservation organization NatureServe. Some G-ranks differ from S-ranks. The S-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

More information on status ranks, including a complete list of S-Ranks by NPC, is available on the DNR website.

In addition to conservation status ranks, NPC condition ranks indicate the ecological integrity 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.

GDS-3F Strategies

- Coordinate with EWR staff to determine treatments that will protect, maintain, or enhance occurrences of rare NPCs.

- Look for appropriate opportunities to maintain or improve the condition rank of rare NPCs during management.
- Maintain high-quality rare NPCs for their value as refugia and biological legacies into the future.

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

Growth stages are successional stages within a native plant community class that develop over time following an initial stand-establishing disturbance. Plant and animal species utilize various growth stages in different ways.

This SFRMP does not establish acreage goals for growth stages by ecosystem type or native plant community. However, staff are encouraged to apply the following strategies to maintain/increase representation of NPC growth stages on state lands:

GDS-3G Strategies

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

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

The 0-30 year age group of aspen, balm-of-Gilead, birch, and jack pine cover types represents 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.

GDS-3J Strategies

- Move aspen, balm-of-Gilead, paper birch, and jack pine cover types toward a balanced age class structure.
- In the birch cover type, there are currently very few acres in the 0-30 age group. Plan management activities to regenerate paper birch to well-stocked, young paper birch conditions.
- Maintain young, early successional forest in a variety of patch sizes for associated species.

3.4 Wildlife Habitat

GDS-4: Provide a variety of habitat types and 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 recreational, economic, and inherent values. Both natural events and forest vegetation management have the potential to positively or negatively affect wildlife species. This SFRMP includes GDSs and strategies aimed at minimizing negative impacts of forest management on wildlife species and their habitats in the Section and, where possible, maintains and enhances the habitat of wildlife species that occur there. Broadly, this plan and the management it directs address wildlife using the following approaches:

- **Coarse filter approach** – management of cover types, age classes, and patches as described in this plan supplies a variety of habitat types, and spatial arrangement of those habitat types, associated with the diversity of wildlife species in the section.
- **Meso filter approach** – strategies in this plan provide structural elements important to a variety of wildlife within habitat types, such as snags, that are not addressed through the coarse filter.
- **Fine filter approach** – individual species needs are addressed through department policies and guidelines.

Providing a diversity of forest characteristics is necessary to support wildlife species with different habitat requirements. This plan maintains a diversity of cover types for wildlife. The age classes provided for wildlife will generally be in the younger range, but this plan ensures that some older age classes will exist.

GDS-4 Strategies

Many other GDSs and their strategies pertain to wildlife needs, including those focused on:

- Old forest
- Young forest
- Age class distributions
- Patch size and spatial patterns
- Riparian and aquatic habitat
- Biodiversity
- SGCN and ETS species

Below are additional strategies specific to wildlife:

- Manage to retain the integrity of riparian areas and protect seasonal and permanent wetlands.
- Provide for the needs of species that depend on perches, cavity trees, bark foraging sites, and downed-woody debris through the application of site-level guidelines and other opportunities as possible.
- Apply DNR policies, guidelines, and recommendations as found in Forest Management Direction Documents for management of wildlife species' habitats.
- Consider the habitat needs of migratory bird species, particularly ground nesters and old forest obligates, that have shown long-term population declines.
- Provide for the needs of species associated with conifer stands and mixed conifer/hardwood stands.
    - Increase acres of long-lived conifer cover types through active management, allow some stands to naturally succeed to conifer types, or increase mixed forest conditions in some stands through selective harvesting.
- Provide site-specific benefits for wildlife species through Management Opportunity Areas.
- Opportunities to increase stand resiliency to climate change will also address the adaptability of wildlife habitat.
- Manage Priority Open Landscape Areas for the benefit of wildlife species.

- Where possible, continue informal management activities to address the habitat needs of various wildlife within the NSU Section. Some of these have included:
    - deer and moose thermal cover
    - lynx critical habitat

3.5 Riparian and Aquatic Areas

The management of riparian areas can influence water quality and temperature, erosion rates, deposition of woody debris into water bodies, and diversity of fish, wildlife, and plant species found in and near water bodies. DNR personnel check the application of guidelines for management of riparian areas adjacent to lakes, streams, rivers, and permanent open water ponds when managing within riparian areas.

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

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

GDS-5A Strategies

- Retain a relatively continuous forest cover for the protection and maintenance of aquatic habitat types, aesthetics, recreation, and forest products.
- Consult with Fisheries on management within the RMZ on designated trout streams.
- Maintain/increase water quality and habitat for Lake Sturgeon within the St. Louis River watershed
- Manage to maintain forest, particularly older conifers, in riparian areas to provide shade, coarse woody debris, and leaf litter input.
- Emphasize conifers where appropriate and discourage aspen and birch in the RMZ of designated trout streams.
- Conserve shoreline beauty for recreational use of public lands in northern Minnesota by following the Little Shipstead-Newton-Nolan Act.
- 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: Forest management on state lands adequately protects wetlands and seasonal ponds.

Wetland areas include lowland forested areas, lowland brush and lowland grass cover types, and seasonal ponds. The areas provide hydrologic buffering and species habitat diversity. They are protected using different site-level forest management 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 Voluntary Site-Level Guidelines.
- Check the application of wetlands and seasonal pond guidelines as a part of stand exam review, timber sales supervision, and inspections.
- Maintain conifers in and around wetlands and vernal pools.

GDS-5C: Forest management activities on state land consider the health of a watershed or sub-watershed.

Watersheds are accounted for at a variety of scales in making management decisions within Department goals. Maintaining healthy watersheds and water quality involves consideration of all lands within a watershed.

GDS-5C: Strategies

- Discuss watershed needs during local efforts such as:
    - stand selection
    - annual coordination
    - joint site visits
- Consider other management activities on all ownerships within a particular watershed when determining management activities on a particular site.
- Consider timing of management activities throughout a watershed.
- Consider local watershed planning efforts to help ensure forest management contributes to healthy watersheds and water quality.
- Modify prescriptions to account for watershed needs.
- Move towards long-term goals to address watershed needs.
    - cover type conversions where appropriate
    - presence of long-lived conifers on site, especially within designated trout stream watersheds
- Coordinate with adjoining landowners, when possible, to manage within a watershed.
- Where feasible, maintain or exceed 40% of any watershed in forests over 15 years old.
- If needed and allowable under Department policies and guidance, consider exceeding MFRC voluntary site-level guidelines to address watershed needs.

3.6 Timber Productivity

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 designated rotation ages. This is largely accomplished through modeled stand selection.
- Use site preparation, inter-planting, release from competition (e.g., herbicide application or mechanical/hand release), and tree protection.

- Apply selective harvest treatments and thinning.
    - Seek opportunities to increase tree quality, promote understory development and biodiversity of a stand, and increase forest health.
    - Some uneven-aged managed cover types may be initially treated through even-aged methods to improve long-term stand age structure and timber quality.
    - Some even-aged managed cover types may use uneven-aged prescriptions to meet various goals.
- Minimize use of pesticides (herbicides, insecticides, etc.). Follow operational standards to control competing vegetation or forest insects and diseases on state lands.
- 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. For example:
    - Avoid damage to residual trees during harvest or thinning operations.
    - Minimize compaction and rutting by determining the acceptable operating season.
- Manage certain stands for large diameter, high-quality products by retaining adequate stocking and basal area.

3.7 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.

Forest management will not attempt to eliminate native insects and diseases or their processes from the landscape, but rather to 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. At acceptable levels, they promote a diversity of tree species and generate important elements of forest structure that are important as habitat and in nutrient cycling, such as snags and coarse (large) woody debris. Consideration of native and non-native insects and diseases in forest management planning and activities can significantly reduce or avoid many adverse economic and environmental impacts to 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 methods possible to ensure success.
- Apply recommended strategies from DNR forest health specialists as appropriate.
- Follow Department guidance to minimize the spread of invasive species.
- Provide information and training to equipment operators and tree fellers 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.
- Use fire as a tool in appropriate situations to prevent or control insect and disease outbreaks.

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. Solutions require an understanding of the dynamics of herbivory, seasonal wildlife movements, population structure, population control tools and their effectiveness, and proven repellents or exclusion methods. The management strategies below attempt to minimize adverse impacts.

GDS-7B Strategies

- Consider the potential for wildlife impacts to 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.
    - In riparian areas, favor tree species less palatable to beavers.
- Focus forest regeneration efforts in areas less likely to be negatively affected by wildlife.
    - Avoid unprotected plantings of susceptible species near known deer concentration areas.
    - Avoid planting susceptible species in locations surrounded by vegetation types preferred by ungulates without some plan for protection from browsing.
- Use mitigation techniques on sites where damage from wildlife is anticipated.
    - Use targeted, rather than stand-wide, competition control.
    - Seed or plant more heavily to account for expected mortality.
    - Plant susceptible species away from the edge of the site.
    - Use protective measures such as fenced enclosures, bud capping, repellents, tree shelters, etc.
    - Seed or plant a mix of species rather than a single species.
- When deciding what to regenerate, consider species or stock sources that are less palatable to wildlife.

3.8 Climate Change

GDS-8: Using best-available science, manage state lands to help forests adapt to the effects of and mitigate global 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 the limit 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. Management is based on our current knowledge and will be adjusted based on future research findings.

Although the effects of climate change during the planning period on forest vegetation at the section scale are uncertain, the following strategies will help forests adapt to the projected effects of climate change.

GDS-8 Strategies

- Maintain or increase species and structural diversity.
- Maintain connectivity that allows the migration of plants and animals.
- Maintain forest health and vigor to maximize potential adaptation to climate change.
- Evaluate site conditions with respect to climate change when selecting tree species for regeneration.
- Consider the concept and benefits of carbon sequestration in forest management decisions.
- 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.
- Retain refugia for plant and animal species in areas where topographic extremes create local microclimates that buffer climate change.
- Enhance genetic diversity in planting and seeding.

3.9 Visual Quality

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 impacts of forest management activities to the visual quality of the site during and after management activities.

GDS-9 Strategies

Application of MFRC *Voluntary Site-Level Guidelines* satisfies this GDS, including:

- Minimize visibility of harvest areas by limiting the apparent size of the harvest area.
- Avoid management operations during periods of peak recreational use whenever possible.
- Locate roads and trails to minimize visibility from nearby vantage points, such as scenic overlooks, streams, and lakes.
- Encourage long-lived species and other visually important species (e.g., paper birch) along high visual quality identified roadways. This will minimize the frequency of management activities. It will also provide larger-crowned, larger-diameter trees that improve forest aesthetics.
- Reduce visual penetration with appropriate curves in the road alignment.

3.10 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.

GDS-10 Strategies

- Thoughtfully plan access routes:
    - Use existing access routes where possible.

    - Control access to limit conflicts with recreation.
    - Eliminate unnecessary access routes.
    - Minimize timberland area lost to road development.
- Cooperate with other forest 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 reserved or deferred areas, if possible (LCOG, Old-Growth).
    - If the only reasonable access to stands to be treated is across reserved/deferred areas, then strive to minimize impacts.
    - Avoidance of ETS species during access route planning and development

3.11 Cultural Resources

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 *Voluntary Site-Level Forest Management Guidelines* provide information and recommendations to assist private and public land managers in taking responsible actions when cultural resources are encountered.

GDS-11 Strategies

- Stand exam lists and fish and wildlife management projects are reviewed by DNR archeologists or SHIPO. Recommendations for mitigation are implemented as part of sale design.
- Establish positive, continuing, and respectful communications with Tribal Nations on conservation, natural resource, and land management issues. Refer to Operation Order 129.

3.12 Natural Disturbance Events

GDS-12: Promptly evaluate and determine the 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 for public review will be used.

GDS-12 Strategies

- The Department will evaluate large-scale (1,000's to 10,000's of acres) disturbance events to determine appropriate action.
    - Assess extent and significance of the event on forest lands in the Section.
    - Recommend forest management actions.
    - Analyze effects on volume offered targets.
    - Cooperate in assessment and implementation of management actions with other agencies and landowners, when possible.
    - Internal communications protocol:
        - Initial notification/Call to action: Responsible land manager calls meeting of decision makers of all affected divisions within the first few days after initial assessment.
        - Follow up and evaluation: complete a multi-discipline After Action Review at request of regional manager.
- Local land managers will evaluate and determine appropriate actions for small-scale (10s – 100s of acres) disturbance events and take the appropriate action needed to address the situation.

Appendix A: Summary of Issues and General Direction Statements

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

Issue	GDS 1A	GDS 1B	GDS 1C	GDS 2A	GDS 2B	GDS 3A	GDS 3B	GDS 3C	GDS 3D	GDS 3E	GDS 3F	GDS 3G	GDS 3H	GDS 4	GDS 5A	GDS 5B	GDS 5C	GDS 6	GDS 7A	GDS 7B	GDS 8	GDS 9	GDS 10	GDS 11	GDS 12	Cover Types
A1	X	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								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				X					
G2														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. Age Class Distribution & Growth Stages

A1. What are the desired age class and growth stage distributions of forest types across the landscape?

A2. What are the appropriate amounts, types, and distribution of older forest?

A3. What are the appropriate amounts, types, and distribution of young, early successional forest?

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

B1. How should we address biodiversity, forest health, and productivity goals through management of forest composition, structure, representation of growth stages, within-stand diversity, spatial arrangement of vegetative types, and native plant community distributions in the Section?

B2. Which tree species should be represented within forest communities in the Section?

B3. How will imperiled and highly imperiled native plant communities in the Section be maintained or enhanced?

B4. How can we use intensive management of forest communities when necessary, while retaining some of the characteristics of natural stand-replacement disturbance events?

B5. How can management on state lands better reflect natural landscape patterns (the size and configuration of growth stages and types resulting from broad-scale natural disturbances) in the Section?

B6. How can forest fragmentation be reduced in order to maintain connectivity among habitat types?

C. Sustainable Harvest of Timber and Non-Timber Forest Products

C1. What is the appropriate timber harvest level on state lands with consideration for the sustainability of all forest resources and trust lands responsibilities? (Largely addressed through STHA process)

C2. How should “non-timber forest products” be managed?

D. Biological Diversity

D1. How can management of stands within larger areas of biodiversity significance be designed to maintain or enhance biodiversity and native plant community composition, structure, and function?

D2. How will within-stand structural complexity (e.g., vertical, leaning, and horizontal structure, stem size and density, coarse woody debris, and pit and mound micro-topography) be retained and/or restored where natural succession pathways are cut short?

Rare Features

E1. How will rare plants and animals, their habitats, and other rare features be protected in the Section?

F. Wildlife

F1. How can vegetation management address the needs of game and nongame species?

G. Watersheds including Riparian and Aquatic Areas

G1. How will the impacts of vegetation management on surface waters (wetlands, streams, and lakes) be addressed?

G2. How can cumulative impacts to aquatic resources of vegetation management on a watershed/sub-watershed level be addressed?

H. Timber Productivity

H1. How can timber productivity on state lands be increased?

I. Disturbance Impacts on Forest Ecosystems

I1. How will disturbances, including negative impacts of forest insects, disease, and wildlife on forest ecosystems be addressed?

I2. How will non-native invasive species threats/invasions be addressed?

I3. How will catastrophic natural disturbances be considered in vegetation management decisions?

J. Climate Change

J1. During this planning period, how should we use vegetation management to address global climate change?

K. Visual Quality

K1. How will vegetation management activities minimize impacts on visual quality?

L. Access to State Land

L1. How will access to stands identified for management be provided?

M. Cultural Resources

M1. How will cultural resources be protected during vegetation management activities on state-administered lands?

N. Balancing Vegetation Management Needs with Legal Requirements

N1. How will various state and federal legal requirements be included in the 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 species, age, and structural diversity within some stands.

2. Harvest Levels

GDS-2A: 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: Provide older forest across the landscape to account for timber products, wildlife habitat, and ecological diversity.

GDS-3B: Maintain or enhance vegetation conditions associated with known SGCN occurrences.

GDS-3C: Maintain or increase size of existing patches on state lands over time, with consideration of natural spatial patterns.

GDS-3D: Maintain or enhance vegetation conditions associated with existing biodiversity significance factors in MBS sites of high and outstanding biodiversity significance.

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

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

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

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

4. Wildlife Habitat

GDS-4: Provide a variety of habitat types and 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 critical habitat for fish, wildlife, and plant species.

GDS-5B: Forest management on state lands adequately protects wetlands and seasonal ponds.

GDS-5C: Forest management activities on state land consider the health of a watershed or sub-watershed.

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: Using best-available science, manage state lands to help forests adapt to the effects of and mitigate global 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 the appropriate response to natural disturbance events on state land.

Appendix B: 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., northern forest owl MOA).

The information on adopted MOAs is available on the DNR's SFRMP intranet page (click to expand NSU when there). Individual MOA templates can be downloaded from the links.

Management Opportunity Area Documents:

- Deer Management Area (DMA)
  - Corner Lake
  - Elephant Lake
  - Leveaux
  - North Pelican Lake
  - North Shore
  - Pelican River
  - Rat Root
  - South Pelican Lake
- Landscape MOA (LAND)
  - Lake County Fisheries
- Moose Management Area / Large Block (MMA)
  - Finland
  - Lima Green
  - Stump River
  - Swamp River
- Old Forest Management Complex (OFMC)
  - Amundsen Lake
  - Art Lake
  - Ash River
  - Beatrice Lake
  - Beaver River
  - Bower Lake
  - Bright Star
  - Egge Ridge
  - Honeymoon Trail
  - Hovland Woods North
  - Hovland Woods South
  - Johnson Lake
  - Mud Creek
  - Niles Bay
  - North Arm
  - Pike Mountain

    - Rogers Lake
    - Sand Lake Peatland East
    - Sand Lake Peatland South
    - Sand Lake Peatland West
    - Sand Point
    - Spring Beauty
    - Sullivan Lake
    - Swamp River
    - Thunderbird Lake
- Open Landscape (OLMA)
    - Mervin
- Patch (PATCH)
    - Amundsen Lake
    - Ash River
    - Beatrice Lake
    - Biondich Camp
    - Bright Star
    - Buhl
    - Dunka River
    - Giants Ridge
    - Headwaters Peatland
    - Hovland Woods
    - Kettle Lake
    - South Ridge Beaver River
    - Spur End Fen
    - Sullivan Lake
    - The Grade
    - Thunderbird
    - Tofte Heights
- Ruffed Grouse Management Area/Small Block (RGMA)
    - Birch Hill
    - Caribou Lake
    - Dale Honer
    - Devil Track
    - Echo Lake
    - Kadunce River
    - McNiven
    - Moose Walk
    - Nelson Creek
    - Paradise Lake
    - Pelican Lake
    - Pelican River North
    - Peloquin
    - Pendant Lake
    - Shannon River
    - St. Louis River
    - Wills Lake

Pilot Management Opportunity Area Documents:

- Baptism River Forest Interior Pilot MOA
- Big Lake Upland Lowland Habitat Pilot MOA
- Silver Island Upland Lowland Habitat Pilot MOA

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 forest lands for timber management, fish and wildlife habitat improvement, fire control, and a variety of recreational activities. Also, see Forest road.

Acre: An area of land containing 43,560 square feet, roughly the size of a football field, or a square 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 10 years, into which the age range of trees or forest stands is divided for classification or use.

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

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

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

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

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

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

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

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

Biodiversity Significance: The relative value, in terms of size, condition and quality, of native biological diversity for a given area of land or water. (Adapted from: Guidelines for MBS Statewide Biodiversity Significance Rank): The Minnesota Biological Survey (MBS) uses a statewide ranking system to evaluate and communicate the biodiversity significance of surveyed areas (MBS sites) to natural resource professional, 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 animals like 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 Forest Inventory Module (FIM).

Cord: A pile of wood four feet high, four feet wide, and eight feet long, measuring 128 cubic feet, including bark and air space. Actual volume of solid wood may vary from 60 to 100 feet cubic feet, depending on 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 inches and contain 133 cubic feet. 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, historical structure, historical 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 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 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 10 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): 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 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 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 where 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 individual tree or groups of trees mortality or blowdown. 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 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 of 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 the landscape 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): 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 cannot 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, wind storms, 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 from 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-forest land: Land that has never supported forests, and land formerly forested where use for timber management is precluded by development for other uses such as crops, improved pasture, residential areas, city parks, improved roads, and power line clearings.

Nongame species: In this plan, nongame species include all animal species that are not hunted, trapped, or game fish (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 older forest whenever its age exceeds the normal rotation age established for that cover type.

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

Old Forest Management Complex (OFMC): Represents an area of land surrounding designated old-growth forest stand(s) and their associated special management zones that are managed to complement and support the values of the designated old-growth forest.

Old-growth forests: Forests defined by age, structural characteristics, and relative lack of human disturbance. These forests are essentially free from catastrophic disturbances, 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 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, 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 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 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 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), 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 the 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 (i.e., 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 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 saw timber.

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

Snag: A standing dead tree.

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

Special Management Area (SMA): An area that receives alternate modeling during stand selection and different treatment during management to account for values 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. 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 10 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, numbers 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 visit, prescriptions may change for some stands because of new information on the stand or its condition.

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

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

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

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

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

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

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. 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 a 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 forest lands 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, and cedar, offsite aspen, or non-forest land.

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 cable 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 closely 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.