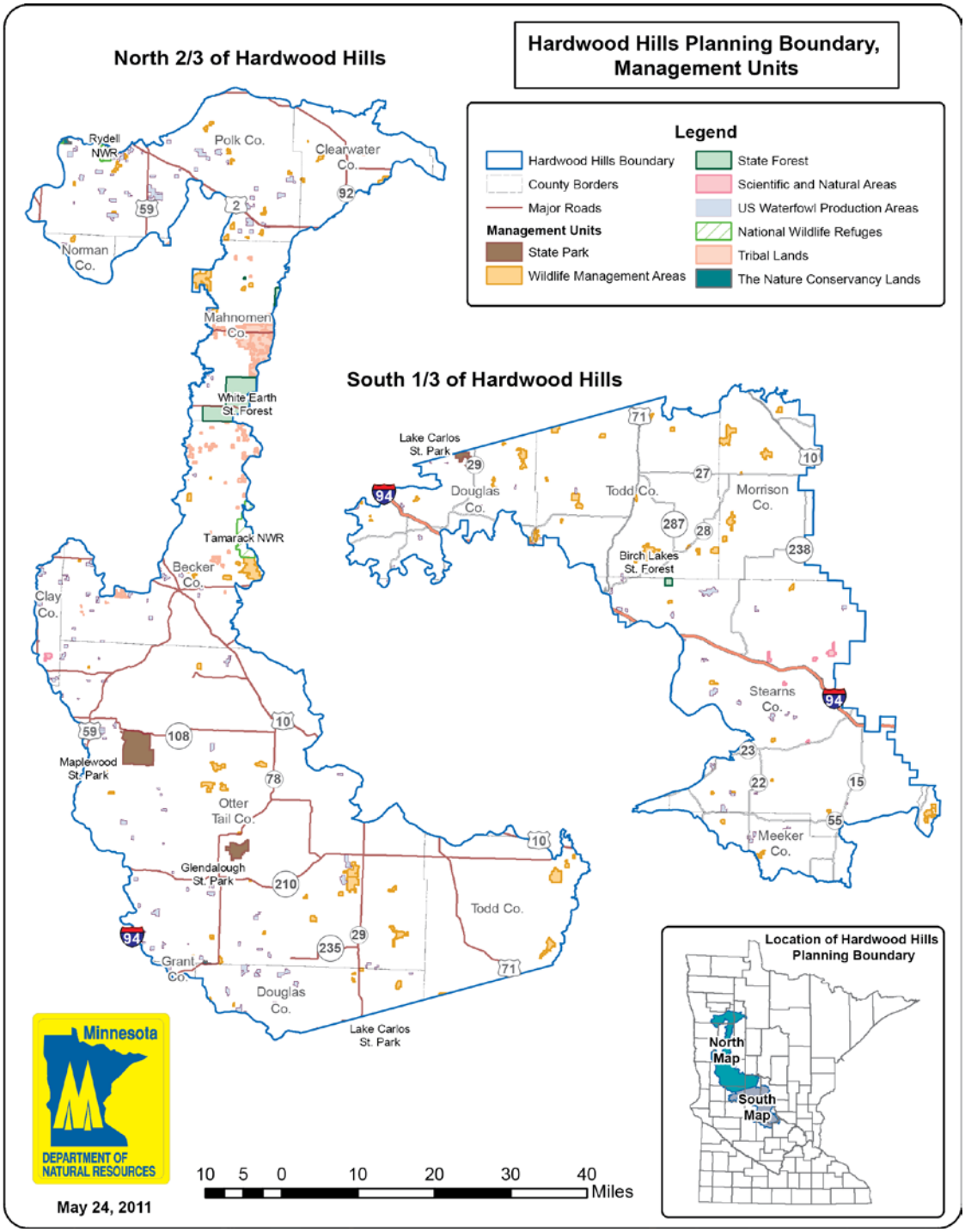
Hardwood Hills Subsection Forest Resource Management Plan

(HH SFRMP)

Preliminary Assessment – Final

8/4/11



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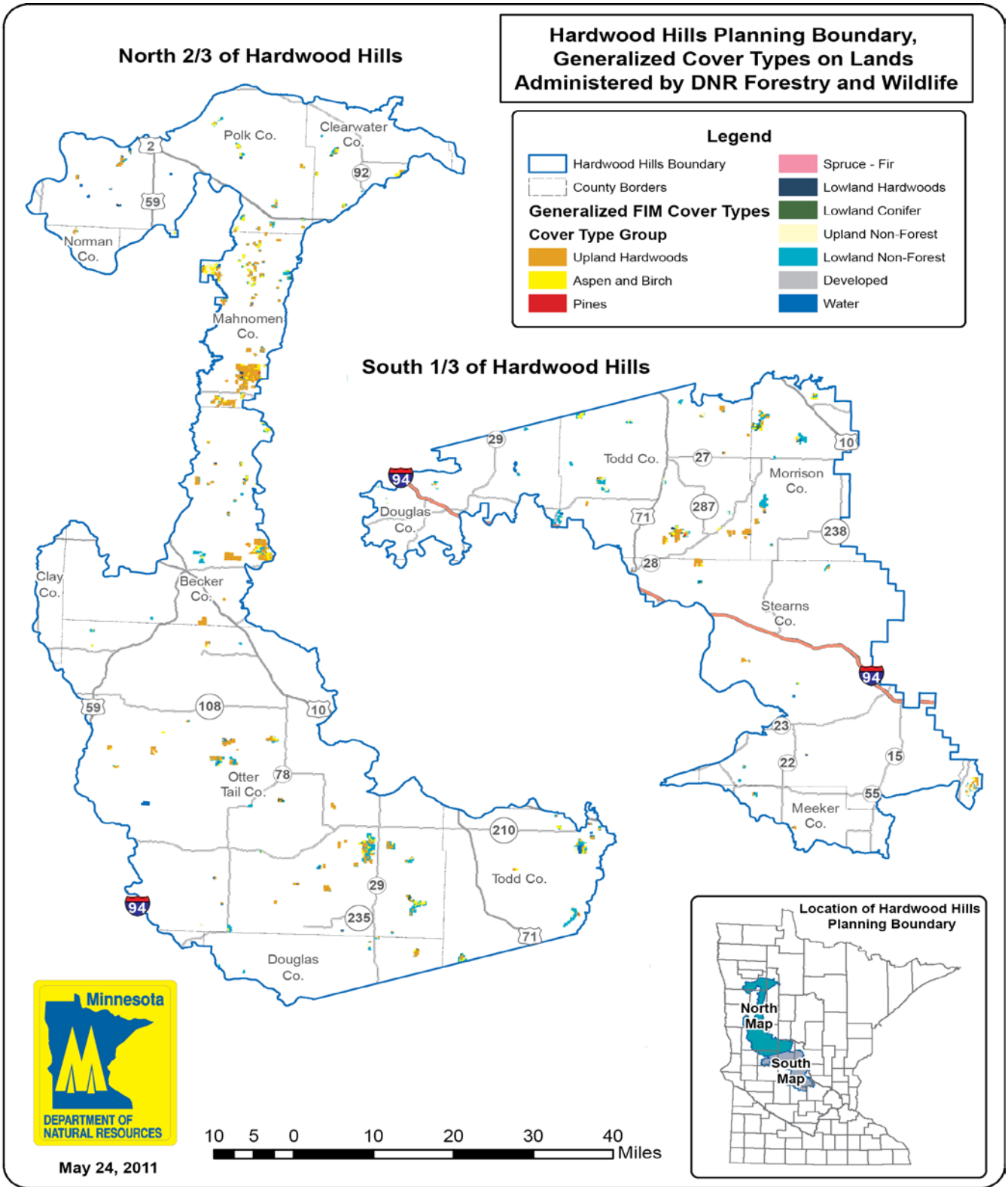
***Note**: A basic set of large format color maps showing subsection characteristics is available for viewing at DNR Bemidji Region Forestry Office: 2115 Birchmont Beach Road N.E.; Bemidji, Minnesota 56601 and the DNR Central Office:500 Lafayette Road; St. Paul, Minnesota 55155 (Forestry, 5th Floor).*

This report is available on the DNR Web site at:
www.dnr.state.mn.us/forestry/subsection/hardwoodhills/index.html

Maps in this chapter depict information for an area within a "planning boundary." This boundary is designed to closely approximate the subsection while capturing data summary and planning efficiencies by using survey or jurisdiction lines in some cases.

Printed documents will be available for review at the Minnesota DNR Northwest Region Headquarters at 2115 Birchmont Beach Road N.E., Bemidji, Minnesota, and on compact disk by request to Pat Matuseski at (218) 308-2381 or pat.matuseski@state.mn.us.

Map i: Hardwood Hills Subsection Generalized Forest Cover Types on DNR-Administered Lands Covered by this Plan



Color maps may be viewed as PDF files on the Hardwood Hills Subsection Forest Resource Management Plan (SFRMP) Web site at:
www.dnr.state.mn.us/forestry/subsection/hardwoodhills/index.html

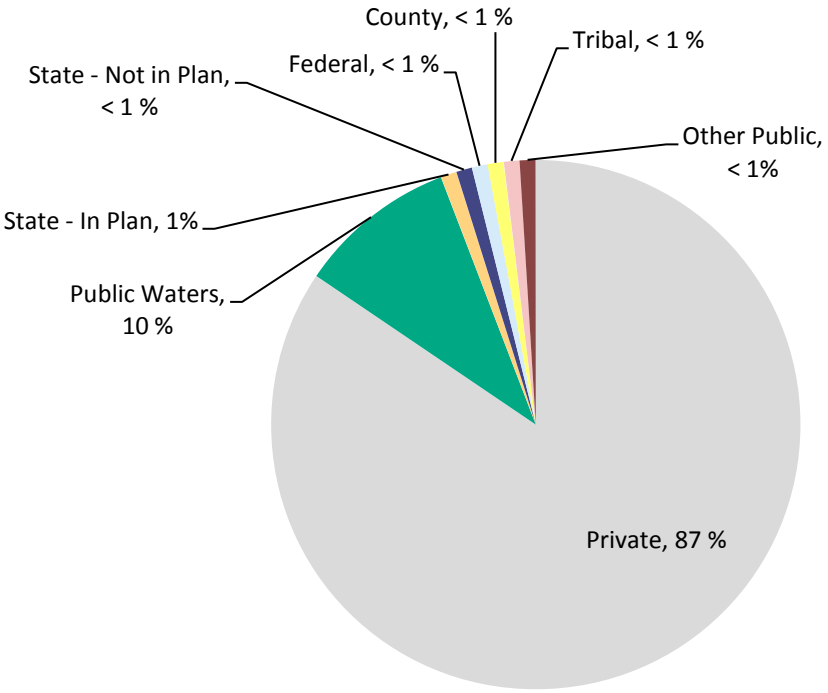
Brief Description of the Planning Area

This Subsection Forest Resource Management Plan (SFRMP) process considers state forest lands especially those administered by the Department of Natural Resources (DNR), Divisions of Forestry, and Fish and Wildlife – Wildlife Section in the *Hardwood Hills Subsection*. This subsection covers approximately 3.5 million acres in an area from near Clearbrook in the northwest to near Mentor in the northeast, and from near Paynesville in the southwest to near Clearwater in the southeast. (See *Map i*) For more detailed land descriptions, refer to chapters 1 through 3.

Recreation and agriculture are the major uses of land in this subsection. Public agencies (state and federal) administer approximately 2.5 percent of the land with the state portion being approximately 57,000 acres or 1.6 percent. Approximately 18,019 acres of the state land is forest and woodlands and will be considered for the resource management objectives in this plan. Other cover types on Forestry or Wildlife lands totaling 27,000 acres are non-forested and may be considered to meet other resource management objectives. Other state lands (approximately 14,000 acres) such as State parks and Scientific and Natural Areas (SNAs) will not be managed under this plan, however these areas may contribute to some of the plan goals.

In addition, the federal government owns approximately 30,000 acres (less than one percent) that are managed by the U.S. Fish and Wildlife Service including Tamarac National Wildlife Refuge, Rydell National Wildlife Refuge and numerous Waterfowl Production Areas (WPAs). Becker, Clearwater, Douglas, Mahnomen, Meeker, Morrison, Otter Tail, Polk, Stearns, Todd, and Wright counties administer approximately 20,000 acres (less than one percent). Private owners control approximately 3.0 million acres (87 percent). There is no industrial forest land in this subsection, however, Verso Paper Co. out of Sartell has an active leasing program with private landowners for hybrid poplar plantations on agricultural lands. For more details about land ownership, refer to Chapter 2.

Chart i: Hardwood Hills Subsection Land Administration



Based on the Gap Analysis Program (GAP) classification completed by the DNR Division of Forestry using satellite imagery of all lands in the subsection, 17 percent of the land area (non-water) is covered by forest. Based on the DNR forest inventory of timberland that will be considered in this plan; the aspen/balm of Gilead (5,274 acres, 32.5%), northern hardwoods (4,532 acres, 28%), and oak (4,732 acres, 29.2%) cover types comprise the vast majority of the subsection's timberlands under state ownership. For details about cover types, refer to Chapter 3.

Subsection Forest Resource Management Planning

Introduction

For many years, the Minnesota Department of Natural Resources (DNR) directed timber harvesting on lands it administered through five- to 10-year forest resource management plans developed for each of its administrative forestry areas. Opportunities for public involvement were limited in the development and review of these timber management plans.

In response to growing public interest in DNR timber management planning, the DNR Subsection Forest Resource Management Plan (SFRMP) process was designed to provide a more standardized, formal process and opportunities for increased public involvement. In addition, it is based at the subsection level of the DNR's ecological classification system (ECS) rather than DNR administrative areas as in the past (i.e., DNR area forestry boundaries).

The SFRMP process is divided into two phases. In Phase I, the subsection team will identify important forest resource management *issues* that need to be addressed in the subsection plan and *assess* the current forest resource conditions in the subsection. In Phase II, the subsection team will develop recommended strategies to address these issues and help shape the desired future forest composition goals and stand-selection criteria. The DNR will seek public input during Phase II (i.e. draft plan development) of the SFRMP process.

Goals for the Planning Effort

SFRMP will constitute DNR planning for *vegetation management* on state forest lands administered in the subsections by the Division of Forestry and Section of Wildlife. The focus of this effort will be:

- **Identifying a desired future forest composition (DFFC)** for 50 years or more. Composition could include the amount of various cover types, age-class distribution of cover types, and their geographic distribution across the subsection. The desired future forest composition goals for state forest lands in the subsections will be guided by assessment information, key issues, general future direction in response to issues, and strategies to implement the general future direction.

- **Identifying forest stands to be treated over the next 10-year period.** SFRMPs will identify forest stands on DNR Forestry- and Wildlife-administered lands that are proposed for treatment (e.g., harvest, thinning, regeneration, and re-inventory) over the 10-year planning period. Forest stands will be selected using criteria developed to begin moving DNR forest lands toward the long-term DFFC goals. Examples of possible criteria include stand age and location, soils, site productivity, and size, number, and species of trees. Many decisions and considerations go into developing these criteria and the list of stands proposed for treatment. Examples include:

  1) Identifying areas to be managed as older forest or extended rotation forest (ERF);
  2) Identifying areas to be managed at normal rotation age;
  3) Identifying areas for various sizes of patch management;
  4) Management of riparian areas and visually sensitive travel corridors;
  5) Age and cover-type distributions;
  6) Regeneration, thinning, and prescribed burning needs. and,
  7) Identifying Ecologically Important Lowland Conifers (EILC) and Old Forest Management Complexes (OFMC's).

The DNR will select management activities (including "no action") that best move the forest landscape toward the DFFC goals for state forest lands.

Consistent with state policy (Minnesota Statutes 89A), the SFRMP process will pursue the sustainable management, use, and protection of the state's forest resources to achieve the state's economic, environmental, and social goals.

Process
The objectives of the DNR SFRMP process are:

- To effectively inform and involve the public and stakeholders;
- To complete the process in each ecological classification system (ECS) subsection within a reasonable amount of time (the target is to complete a SFRMP plan in 12 months);
- To conduct a process that is reasonable and feasible within current staffing levels and workloads; and,
- To develop plans which are credible to most audiences and enable good forest management.

Experience, new information, new issues, changing conditions, and the desire to broaden the focus of SFRMP in the future will demand a flexible and adaptable process. The plans will need to be flexible to reflect changing conditions. The SFRMP process will provide for annual reviews by DNR planning teams for the purpose of monitoring implementation and determining whether plans need to be updated to respond to unforeseen substantial changes in forest conditions.

DNR subsection teams will include staff from the DNR Divisions of Forestry, Fish and Wildlife, and Ecological and Water Resources and other agency staff as needed. These subsection teams will have primary responsibility for the work and decision-making involved in crafting subsection plans.

The subsection team will invite managers of adjacent county, federal, tribal, private and industrial forest lands to provide information about the condition of their forest lands and future management direction. This information will help the DNR make better decisions on the forest lands it administers. In the Hardwood Hills Subsection, the goals, strategies, and coordination efforts of the Minnesota Forest Resources Council (MFRC) West Central Landscape Committee will be considered and/or incorporated into the SFRMP.

In the first phase of the SFRMP process, the subsection team will 1) identify important forest resource management issues that will need to be addressed in the subsection plan and 2) develop an assessment of the current forest resource conditions in the subsection. The assessment document developed by the team will consider at least eight basic elements:

- Land use and cover
- Administration and ownership
- Forest composition and structure
- Historic harvest and silvicultural practices
- Ecological information
- Forest insects and disease
- Wildlife species and trends
- Forest and habitat fragmentation (preliminary analysis completed but not included in this assessment; this information will be included in the next step of the plan).

In Phase II of the SFRMP process, the subsection team will 1) finalize the issues, 2) determine general future direction in response to the issues, 3) develop strategies to implement the general future direction, 4) identify DFFC goals, 5) develop the stand-selection criteria for determining the stands and acres to be treated over the next 10 years, and 6) seek and consider public input on the proposed direction, strategies, etc. identified in the draft plan.

Relationship of SFRMP to Other DNR Planning Efforts

While the SRFMP process focuses on developing vegetation management plans for state-administered forest lands within the subsection, it does not operate in a vacuum. SFRMP teams do their best to stay connected to other state, federal, and even local planning efforts affecting the subsection, particularly as they relate to management direction, decisions, and products that can assist in determining appropriate vegetation management direction on DNR lands. The following sections highlight a number of efforts that that SFRMP teams need to be aware of in order to incorporate relevant information, management direction, and products in the SFRMP process.

1. Off-Highway Vehicle (OHV) Planning Process

The DNR completed a major OHV planning process in 2008. The process began with a statewide road and trail inventory effort on DNR and county lands in the state. This inventory process was completed in 2005 and the resulting road/trail inventory maps are available for consideration in the SFRMP process. This road/trail inventory is most useful when SFRMP teams work to identify new access needs for proposed vegetation management.

These OHV system plans were developed for each state forest within DNR Division of Forestry administrative areas. During the OHV system planning process, area OHV system planning teams classify state forests for OHV use and identify roads, trails, and areas open to OHV use. Area planning teams are responsible for leading a separate public input process for each OHV system plan.

While the SFMRP process does not include OHV system planning, SFRMP teams need to consider existing OHV trails and OHV system plans (where available), as well as other recreational trails and facilities, in making decisions on forest stand management next to these facilities and in determining new access needs. Likewise, OHV system plans should consider management direction and the results of stand selection (e.g., large patch areas, areas where temporary access is preferred, areas where new access is needed) developed through the SFRMP process.

For more information about the OHV planning process, visit the DNR Web site at http://www.dnr.state.mn.us/input/mgmtplans/ohv/designation/index.html.

2. Minnesota State Park Unit Planning Process

The SFRMP process will not address the management of DNR forest lands within the boundaries of state parks. The management of state parks (i.e., facilities and natural resources) is established via a separate state park planning process. Individual state park management plans address a park's ecological and recreational role in the context of the surrounding ecological community subsection(s) and its role in furthering Conservation Connection objectives. Park plans document existing natural and cultural resource conditions, and future management objectives. Existing recreational use and recreation trends are assessed, and a balance of sustainable recreational opportunities is recommended.

State park plans are developed through an open public process. The plan recommendations are developed through extensive involvement by interested citizens, recreation and resource management professionals,

and elected officials with local, regional, and statewide responsibilities. Usually this involvement is coordinated through a series of advisory committee meetings, area team meetings, public open houses, news releases, internet web site information, and review opportunities.

The SFRMP process should consider state park plans in making decisions on forest stand management adjacent to state parks. Likewise, state park plans need to consider the vegetation management direction and objectives in SFRMPs. Additionally, the SFRMP process should consider the role of state parks in the subsection in meeting desired future compositions and associated goals (e.g., biodiversity, wildlife habitat, community types, etc.).

For more information on state park management planning, contact the Division of Parks and Recreation Planning, Public Affairs and MIS manager at 651-259-5578 or toll free at 1-888-646-6367.

3. Incorporating Biodiversity Considerations in SFRMP

Biological diversity is defined in statute as the "variety and abundance of species, their genetic composition, and the communities and landscapes in which they occur, including the ecological structure, function, and processes occurring at all of these levels." Protecting areas of significant biodiversity is consistent with state policy (Minnesota Statutes 89A) to pursue the sustainable management, use, and protection of the state's forest resources to achieve the state's economic, environmental, and social goals.

The DNR SFRMP process provides an immediate opportunity to incorporate biodiversity considerations in planning for forest systems on DNR lands. Ecological Resources staff provide ecological information pertinent to managing for biodiversity to each of the subsection forest management teams (e.g. Minnesota County Biological Survey data, Natural Heritage information, Scientific and Natural Area biodiversity management techniques experience). SFRMP direction in addressing issues and developing strategies, desired future forest compositions, and ten-year lists of stands to be treated will reflect consideration of this information and the current, best understanding of how to manage for biodiversity.

In the future, the DNR will enhance and expand in partnership with affected stakeholders, biodiversity management planning efforts. However, the DNR's immediate focus is to incorporate biodiversity consideration into the SFRMP process.

4. Wildlife Plans and Goals

SFRMP plans are not wildlife habitat plans. Their implementation, however, affects forest habitats and consequently, wildlife distribution and abundance. Because state forest management under a multiple-use policy requires the consideration of wildlife habitat, several wildlife plans are considered during the SFRMP process.

a) Division of Fish and Wildlife Strategic Plan

The Minnesota DNR's Division of Fish and Wildlife Strategic Plan has recently established population and or harvest objectives for many of the state's wildlife species that are hunted and trapped. These objectives have been determined by a variety of processes that involve some level of stakeholder involvement and public review. Population objectives consider both biological and social carrying capacities tempered by economic needs or constraints (e.g., crop depredation). Among other tools, the division establishes annual harvest levels to meet desired wildlife population goals. During SFRMP development, wildlife managers work toward the development of a plan that facilitates achievement of the wildlife population and/or harvest goals for key wildlife species outlined in the division's strategic plan.

b) Division of Fish and Wildlife "Fall Use Plan"
The Division of Fish and Wildlife's *Restoring Minnesota's Wetland and Waterfowl Heritage Plan*, also known as the Fall Use Plan, identifies harvest goals for waterfowl. This plan was consulted for determining extended forest management (ERF) needs for the subsection, as the amount of ERF influences cavity-nesting waterfowl populations.

c) Bird Plans
Several individual bird species plans under the umbrella of the North American Bird Conservation Initiative provide a continental synthesis of priorities and objectives that can guide bird conservation actions. These plans identify species of continental importance, give a continental population objective, identify issues, and recommend actions. Similarly, the North American Waterfowl Management Plan provides long-term trend information and population objectives for waterfowl species. Wildlife managers involved in SFRMP use this information to form their planning recommendations and decisions, particularly as they relate to desired future forest conditions and age-class composition.

d) Comprehensive Wildlife Conservation Strategy

The Minnesota Comprehensive Wildlife Conservation Strategy (CWCS) plan identifies wildlife species that are considered "species in greatest conservation need" because they are rare, their populations are declining, or they face serious threats of decline. The U.S. Congress has mandated that partnerships within states develop a CWCS to manage their "species in greatest conservation need."

The Minnesota plan identifies problems, threats, and opportunities that face the species; it developed 10-year objectives for species populations, habitats, and priority research and information needs, and developed conservation actions that address the 10-year objectives. Wildlife managers use this information to form SFRMP recommendations and decisions.

e) Wildlife Management Area Master Plans (Comprehensive Management Plans)
The Department of Natural Resources prepared comprehensive management plans for the state wildlife management areas with resident managers. The plans include present and projected regional perspectives, resource inventories, and demand and use analyses, as well as acquisition and development plans, cost estimates, and resource management programs. These are ten-year management plans, and will be revised as new management practices develop, new resource philosophies evolve, and new problems are encountered.

f) Management Guidance Documents – Individual Wildlife Management Areas
The intent of Management Guidance Documents is to describe the purpose of individual Wildlife Management Areas (WMAs) and provide basic information to resource managers within the Minnesota Department of Natural Resources (MNDNR). These documents are developed by consolidating several Geographic Information Systems (GIS) and other databases along with input from MNDNR Area Wildlife Staff. These administrative documents include purpose and history of acquisition, habitat emphasis, natural and cultural feature information, facility development, and public access.

5. Forest Certification

Forest Certification is an independent, third-party verification system that evaluates and recognizes sustainable and responsible forest management and procurement practices. Domestically there are two major internationally recognized Forest Certification systems: Forest Stewardship Council (FSC) and the Sustainable Forestry Initiative (SFI).

To become certified, certificate holders must successfully undergo re-certification assessments every 5 years, and annual surveillance audits during each non-reassessment year. Audits must be performed by approved, accredited auditing firms. After each audit, corrective action requests (CARs) are assigned for compliance gaps. The organization seeking or striving to maintain Forest Certification, must respond to, and correct, each compliance gap within the time-frame allowed, generally 3 months to 1 year.

The DNR committed to, and successfully obtained, dual (FSC and SFI) third-party Forest Certification on all MN DNR Forestry and most Division of Fish and Wildlife administered lands in December of 2005. MN DNR currently manages 4.96 million acres of dual certified lands.

SFRMP's Role in Certification

Each certification system establishes standards against which land management organizations seeking certification are assessed. As an important component of DNR's overall "management plan[1]" SFRMPs and the SFRMP planning process provide a number of important contributions towards satisfying certification standards. These include:

- History of past management/land use
- Historic ecological conditions
- Desired future forest conditions (i.e., and related landscape management objectives).
- Short- and long-term harvest levels.
- Monitoring progress towards long-term goals
- Public/stakeholder involvement opportunities

Certification Considerations in SFRMP

Since achieving certification in 2005, multiple issues affecting resource planning and management have emerged out of the Forest Certification standards. Most deal with conserving and protecting various components of biological diversity. Detailed information on such issues can be found on the department's Forest Certification intranet page. The department has been addressing many of these issues outside of the SFRMP process. However, the outcomes from a number of these efforts need to be considered or incorporated into subsequent SFRMPs as either:

- Site-level information - these are site level designations that affect the availability of particular locations for certain types of management. Examples include: representative sample areas (RSAs[2]), new old growth forest designations, and identification of globally imperiled (i.e., G1, G2) native plant communities (NPC).

1 DNR's management plan is a compendium of plans, policies, procedures, guidelines and databases.

2 The FSC-US Standard requires certificate holders to identify ecologically viable representative samples of NPCs to establish/maintain an ecological reference condition or create/maintain an under-represented ecological condition. Management is limited to low impact activities compatible with maintaining/enhancing the protected NPC.

- Landscape-level considerations – these are certification outcomes that affect larger landscape areas (i.e., groups of sites within a subsection) for which unique management direction may be needed. Certification requirements to identify areas to be managed as High Conservation Value Forests (HCVF[3]) have been the most notable product of this nature.

Relationship of SFRMP to Other Landscape Planning Efforts.

1. Minnesota Forest Resource Council (MFRC) Landscape Planning Efforts

The 1995 Sustainable Forest Resources Act (Minn. Stat. Chapter 89A) directed the MFRC to establish a landscape-level forest resources planning and coordination program to assess and promote forest resource sustainability across ownership boundaries in large forested landscapes.

Volunteer, citizen-based regional forest resource committees are central to carrying out the general planning process. Within each landscape region, committees of citizens and representatives of various organizations work to:

- Gather and assess information on a region's current and future ecological, economic, and social characteristics;
- Use information about a region to identify that region's key forest resource issues;
- Plan ways to address key issues in order to promote sustainable forest management within the region; and,
- Coordinate various forest management activities and plans among a region's forest landowners and managers in order to promote sustainable forest management.

The MFRC's North Central, West Central and East Central Regional Landscapes encompass the Hardwood Hills Subsection. Recommended "desired outcomes, goals, and strategies" for the MFRC Landscapes have been completed. These recommendations will be considered and incorporated into the SFRMP process. This information will help the DNR make better decisions on DNR-administered lands and assist in cooperating with management in the larger landscape.

For more information on the MFRC landscape planning and coordination program, visit the MFRC Web site at: http://www.frc.state.mn.us/initiatives_llm_committees.html

2. St. John's Abbey Land Management Plan

St. John's Abbey administers 2,450 acres of land in central Minnesota located in Collegeville Minnesota (approximately 10 miles west of St. Cloud) in Stearns County. St. John's University (SJU) is located within the Abbey's property. The Abbey was established in 1856 and has been active ever since.

The Abbey established a comprehensive land management plan to guide natural resource management activities that occur on their lands in 2001.

For more information on St. John's Abbey's Land Management Plan, visit the plan's web site at: http://www.csbsju.edu/Documents/Arboretum/land_steward/Current%20OSB%20Land%20Management%20PLan.pdf

3 The FSC-US Standard requires certificate holders to identify High Conservation Value Forests (HCVFs) and manage such areas to maintain or "enhance" identified HCVFs. FSC-US broadly defines HCVFs as "areas of outstanding biological or cultural significance." Most sites managed as HCVFs will remain working forests and management direction will be developed via an interdisciplinary consensus process.

3. Rydell National Wildlife Refuge (Rydell NWR) Comprehensive Conservation Plan

Rydell NWR is located in the Prairie Pothole Region of Northwestern Minnesota, between the flat Red River Valley Floodplain to the west and the rolling hardwood forest and lake regions to the east.

This plan articulates the management direction for Rydell NWR and its Management District for the next 15 years (plan completed in September 2001). Through the development of goals, objectives, and strategies, this plan describes how the Refuge and District also contribute to the overall mission of the National Wildlife Refuge System. Several legislative mandates within the National Wildlife Refuge System Improvement Act of 1997, and principles identified in "Fulfilling the Promise" (a strategic vision document for the Refuge System) have guided the development of this plan.

For more information on Rydell NWR's Comprehensive Conservation Plan, visit the plan's web site at: http://www.fws.gov/midwest/planning/rydell/index.html

4. Tamarac National Wildlife Refuge (Tamarac NWR) Comprehensive Conservation Plan

Tamarac National Wildlife Refuge covers 42,724 acres and lies in the glacial lake country of northwestern Minnesota in Becker County, 18 miles northeast of Detroit Lakes. It was established in 1938 as a refuge breeding ground for migratory birds and other wildlife.

This plan articulates the management direction for Tamarac NWR and its Management District for the next 15 years (plan completed in September 2010). Through the development of goals, objectives, and strategies, this plan describes how the Refuge and District also contribute to the overall mission of the National Wildlife Refuge System. Several legislative mandates within the National Wildlife Refuge System Improvement Act of 1997, and principles identified in "Fulfilling the Promise" (a strategic vision document for the Refuge System) have guided the development of this plan.

For more information on Tamarac NWR's Comprehensive Conservation Plan, visit the plan's web site at: http://www.fws.gov/midwest/planning/tamarac/FinalCCP/finalCCP.pdf

5. White Earth Nation

The White Earth Nation was created in 1867. White Earth Nation is Minnesota's largest and most populous reservation, encompassing 1,300 square miles and serving as the homeland for over 20,000 band members. The White Earth Nation stretches across all of Mahnomen County and parts of Becker and Clearwater counties in Northwestern Minnesota. The White Earth Nation has developed goals and objectives to guide vegetation management activities on their lands.

For more information on White Earth nation's goals and objectives for vegetation management, visit their website at: http://www.whiteearth.com/programs/?page_id=382&program_id=8

Application of Statewide Plans and Guidelines

The DNR uses a variety of written vehicles (e.g., policies, guidelines, recommendations, memos, operational orders, agreements) to communicate direction to DNR staff on a range of forest management issues including old-growth forests, inter-divisional coordination, site-level mitigation, rare habitats and species, and accelerated management. Interdisciplinary and external involvement has varied in the development of these direction documents, as have the expectations for their implementation (i.e. must follow, follow in most cases, follow when possible). *Figure i* places a number of DNR direction documents within a defined policy hierarchy that clarifies decision authority and expected actions. This

can serve as a useful reference for the public in understanding the array of forest management guidance available to staff and serve as a starting place for DNR staff to help provide more consistent application across the state.

The following sections highlight several of the more prominent direction documents and their relation to the SFRMP process.

1. DNR Strategic Conservation Agenda 2009–2013 and DNR Directions 2000.
The department's strategic planning documents, *DNR Strategic Conservation Agenda 2009–2013* and *DNR Directions 2000*, provide broad goals, strategies, and performance indicators for forest resources in Minnesota (see DNR Directions 2000, Forest Resources Section in Appendix A and DNR Strategic Conservation Agenda, Forests Section at: http://www.dnr.state.mn.us/conservationagenda/index.html). This broad statewide direction will be used as a platform from which to develop additional complementary/supplemental goals and strategies specific to each subsection.

2. Old-Growth Forest Guidelines
The 1994 DNR Old-Growth Forest Guideline was developed via a stakeholder involvement process that led to consensus on old-growth forest goals by forest type by ECS subsection for DNR lands. Following the completion of the guideline, the DNR undertook and completed an old-growth nomination, evaluation and designation process for DNR lands. The latest information on old-growth forest policy and results can be found at: http://www.dnr.state.mn.us/forests_types/oldgrowth/policy.html

Old-growth stand designation has been completed statewide and additional old-growth designation is not part of the SFRMP process. The primary significance of old growth in the SFRMP process is determining how DNR forest stands adjacent to and connecting adjacent old growth stands will be managed (e.g., as extended rotation forests, part of large patches, scheduling of harvest, conversion to other forest types, etc.). If not done prior to the SFRMP process, old forest management complexes (see Old-Growth Guideline Amendment #5) will be identified in conjunction with the SFRMP process.

3. Extended Rotation Forest Guideline
The 1994 DNR Extended Rotation Forest (ERF) Guideline was developed through a previous public and stakeholder input process. The primary purpose of the ERF Guideline is to provide adequate acreages of forest older than its normal rotation age to provide for species and ecological processes requiring older forests. During the SFRMP process, the ERF Guideline is to be applied to landscapes by designating particular areas of forest or stands for ERF management. An area designated for ERF management will include all cover types and age-classes within that designated ERF area.

Normal rotation ages will be established for each forest type managed primarily under even-aged silvicultural systems within the subsection based on site-quality characteristics related primarily to timber production (e.g., site index, growth rates, soils, insect and diseases, etc.). Maximum rotation ages for these forest types will also be established based on the maximum age at which a stand will retain its biological ability to regenerate to the same forest type and remain commercially viable as a marketable timber sale. Final harvest of an ERF stand will occur sometime between the normal rotation age for the cover type and the maximum rotation age. A forest stand is considered to be old forest whenever its age exceeds the normal rotation age for that cover type and is considered "effective ERF."

According to the statewide ERF Guideline, a minimum of 10 percent of the DNR Forestry and Wildlife-administered timberlands within a subsection are to be managed as ERF. No maximum amount is identified in the guideline, although the guideline states it may be appropriate to designate 50 percent or more of DNR timberlands as ERF in some subsections. Determining the amount of DNR timberlands to be managed as ERF within each subsection involves consideration of wildlife habitat needs, visual and riparian corridors, and implications for timber production (both quantity and quality). The condition and future management of other forest lands in the subsection (i.e., other DNR and non-DNR lands) are considered to the extent possible in determining the amount of designated ERF on DNR timberlands.

4. Minnesota Forest Resource Council's (MFRC) Voluntary Site-level Forest Management Guidelines

The MFRC's *Voluntary Site-Level Forest Management Guideline*s establish integrated forest resource management practices intended to provide cultural resource, soil productivity, riparian, visual, water quality, wetlands, and wildlife habitat protections in a balanced approach. These guidelines were developed through a collaborative statewide effort and received extensive input during development from stakeholders, DNR staff, and other agency staff. The DNR adopted and strongly endorses the *Voluntary Site-Level Forest Management Guidelines* developed through that collaborative process. These guidelines are the standard in managing DNR lands, i.e., they are not voluntary on DNR-administered lands. As the department standard, departures from the guidelines will not be proposed in SFRMPs for entire subsections or geographic areas within subsections. There is flexibility and various options are available in application of the guidelines, but departures from the guideline standards need to be documented on a site-by-site basis. If departures above or below guideline recommendations (e.g., recommended minimums for riparian management zone [RMZ] width and residual basal area in the RMZ) are made, they will be documented during the timber sale appraisal and forest development processes.

5. DNR Forest-Wildlife Habitat Management Guidelines

DNR forest-wildlife habitat management guidelines provide direction to DNR wildlife and forestry staff for integrated management on state-administered lands. The guidelines were last revised in 1985. As such, some portions of the guidelines are out-of-date. Some areas of the guidelines overlap with the MFRC site-level forest management guidelines. MFRC site-level guidelines will prevail when they overlap with DNR forest-wildlife habitat management guidelines. Species-specific sections of the guidelines that are still considered current are relevant in the SFRMP process in determining management around known species locations (i.e., eagles nests) or in the management of areas for particular types of habitat (e.g., open landscapes, ruffed grouse management areas, deer yards, etc.).

6. DNR Interdisciplinary Forest Management Coordination Framework

The DNR Interdisciplinary Forest Management Coordination Framework is a policy to ensure effective and timely coordination between the Divisions of Forestry, Fish and Wildlife, and Ecological and Water Resources as a means to improve decision-making and achieve sustainable forest management. The scope of the framework is focused on the coordination of the planning and implementation of fish and wildlife, and forestry management practices primarily on lands administered by the divisions of Forestry, and Fish and Wildlife.

Figure i: Grouping of DNR Direction Documents by 3-level Hierarchy

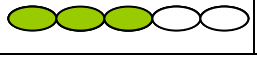
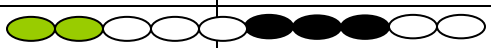
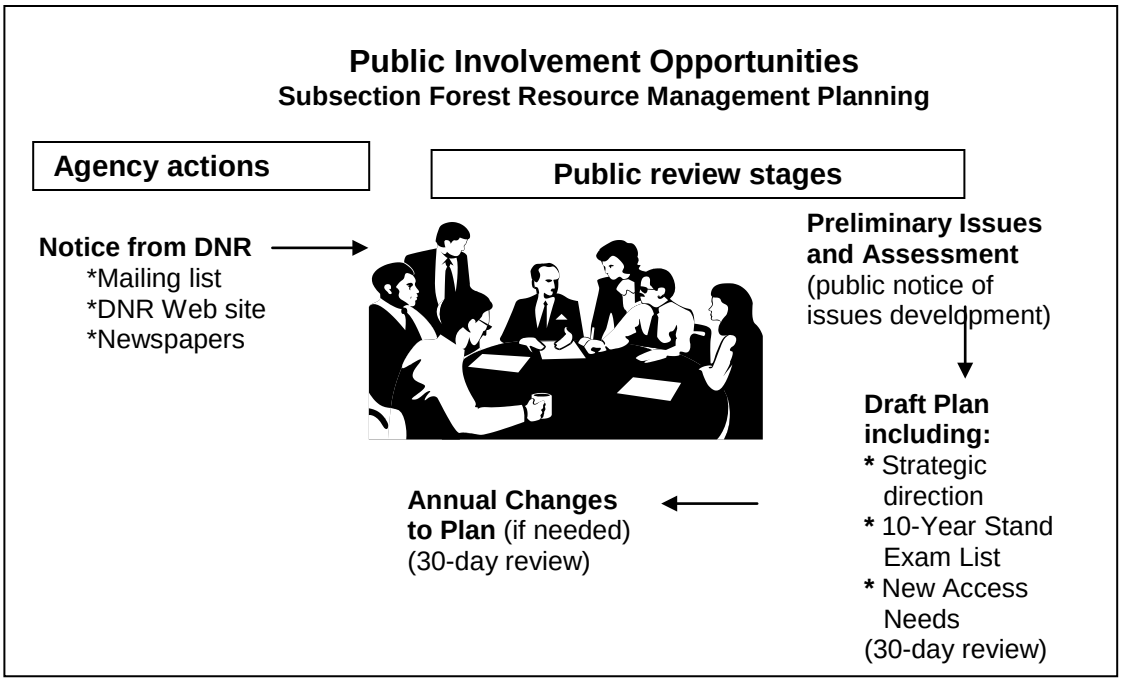
Nomenclature	Who Developed	Level of Review	Expectations	Departure Authority
Policies				
Old Growth Forest Guideline	DNR			No departures allowed
ERF Guideline	DNR			No departures allowed
Forest/Wildlife Coordination Policy	DNR			No departures allowed
WMA Policy	Wildlife			Region - Interdisciplinary
SNA Est. & Admin. Op. Order	Eco Resources			No departures allowed
MFRC Site-Level Guidelines	MFRC			Field appraiser w/ documentation
ID and Mgmt of EILC	CO/FRIT			Region - Interdisciplinary
Guidelines				
Rare Species Guides	Eco Resources			Known locations: Area ID Otherwise: field appraiser w/ doc.
Covertype Mgmt. Recommendations	SFRMP Teams			Field appraiser w/ documentation
NE Region Wood Turtle	NE Region (For, Wild, Trails)			Region - Interdisciplinary
Decorative Tree Harvest Guidelines	Forestry			Area - Interdisciplinary
Accelerated Management	Forestry			Area - Interdisciplinary
Gypsy Moth Mgmt. Guidelines	Forestry/Dept. of Agr.			Field appraiser w/ documentation
For/Wild Habitat Guidelines	Wildlife/Forestry			Area - Interdisciplinary
Integrated Pest Management	Forestry			Field appraiser w/ documentation
Silvicultural Mgrs. Handbooks	NCES, Forestry			Field appraiser w/ documentation
NE R. Grouse Mgmt. Areas	Wildlife			Area - Interdisciplinary

Figure i (continued)

Recommendations			
Goshawk Considerations	Eco Resources		Known locations: Area - Interdisciplinary Otherwise, document use
MCBS H/O Biodiversity	Eco Resources		Consider if site conditions differ from FIM
ECS Field Guide Interps.	Eco Resources/Forestry		Field appraiser w/ documentation
MCBS Rare NPC	Eco Resources		Known locations: Area - Interdisciplinary Otherwise, document use
Red-Shouldered Hawk	Eco Resources		Known locations: Area - Interdisciplinary Otherwise, document use
Four-toed Salamander	Eco Resources		Known locations: Area - Interdisciplinary Otherwise, document use
Black-throated Blue warblers	Eco Resources		Document use
Seasonal ponds	Eco Resources		Document use
Boreal owl guidelines	Eco Resources		Known locations: Area - Interdisciplinary Otherwise, document use
Botrychium guidelines	Eco Resources		Known locations: Area - Interdisciplinary Otherwise, document use

KEY	
	Must follow; no departures
	Expected to follow; documented & approved departures OK
	Expected to follow to the degree possible
	Recommended in usual circumstances; departures OK based on site conditions
	Recommended when opportunities and conditions suitable
	Incorporate if possible
	Broad external technical & public
	Broad public/stakeholder
	Limited public/stakeholder
	Department ID review
	Local ID team review
	Division review w/ peer technical input
	Division review

Figure ii: Public Involvement Opportunities



Public involvement will, at a minimum, occur through:

- Public notice of the start of the planning process and release of the preliminary assessment information (via the DNR's Web site).
- A public comment period to review the draft plan and strategic direction (i.e., general direction, forest management strategies, and desired future forest conditions (DFFCs) proposed by the DNR to address identified issues) along with the 10-year list of stands proposed for treatment and associated new access needs.
- Public review and comment on proposed plan revisions.

SFRMP planning documents will be available at DNR area forestry offices, selected public locations, and the DNR Web site: http://www.dnr.state.mn.us/forestry/subsection/index.html

Summary information will be available upon request to: Pat Matuseski via mail at 2115 Birchmont Beach Road N.E.; Bemidji, Minnesota; 56601 or by call (218)308-2381. Additionally, requests for information may be submitted via e-mail at pat.matuseski@state.mn.us.

Looking Toward the Future

While the initial focus of SFRMP is on forest composition and vegetation management, the intention is for its scope to broaden in the future. Changes in this direction will likely be incremental as the process becomes more familiar to DNR staff and the public. The likely progression in future years will be to include other aspects of forest land management on DNR lands (e.g., recreation facilities/systems, land acquisition/sales) and other DNR Forestry programs including private forest management and fire management. A subsequent step may be to include lands administered by other units of DNR (i.e., Fisheries, Parks, etc.), making this a department-wide plan that is not limited to Forestry and Wildlife land.

SFRMP Process Table

The Hardwood Hills Subsection team is in the initial stages of the SFRMP process. The team has developed the preliminary issues and assessment information and is now providing notice of the start of the SFRMP planning process. An opportunity for public review and comment on the draft plan that will be developed in the SFRMP process will occur in the future.

Table i: Public Involvement and Process Timelines

Subsection Forest Resource Management Planning Steps	Public Notification/Participation	Public Comment Period	Length of Step[4]
I. Preparation to Begin the Planning Process • Assemble initial assessment information and data sets. • Designate team and facilitator, and conduct team training.	• DNR develops mailing list of public/ stakeholders. • Establish web-site for subsection.	n/a	Complete prior to official start of process
II. Assessment and Issue Identification ***(CURRENT STAGE)***	• Inform the public of planning efforts, schedule, and how and when they can be involved. • Provide public notice of the start of the planning process. • Provide preliminary assessment on the DNR's Webpage.	n/a	90 days
III. Develop Draft Plan a. Strategic Direction (GDSs, Strategies, DFFCs to address issues and Stand Selection Criteria) **b.** Draft Stand Examination List and New Access Needs	• Mail summary to mailing list. • Provide complete maps and documents in key locations and on Web/CD. • Identify SFRMP contacts for questions. • Offer meetings by appointment	30 days	270 days (9 months) Note: This step begins prior to finalizing the assessment document.
IV. Finalize Plan • Planners summarize public comments and DNR responses. • Present revised plan to Department for Commissioner's approval. • Commissioner approves final plan & posts written notice in state register.	• Inform public of final plan. • Provide summary of public comments and how DNR responded. • Provide final plans in key locations and on Web/CD. • Mail plan summaries to mailing list.	None	75 days
Total*			360 days (12 months)

4 Time frames for process steps include public review/comment period

Issue Identification

One of the first steps in the SFRMP process is to identify issues that the plans will address. SFRMP teams will use assessment information; local knowledge; and existing plans, policies, and guidelines; to help identify issues relevant to the scope of the plans. Subsection teams will begin with the common set of issues developed from previous SFRMP plans. These common SFRMP issues will then be refined and supplemented based on subsection-specific conditions and considerations.

What Is an SFRMP Issue?

A SFRMP issue is a natural resource-related concern or conflict that is directly affected by, or directly affects, decisions about the management of vegetation on lands administered by the Minnesota DNR Division of Forestry and Division of Fish and Wildlife. Relevant issues will likely be 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 issues for a SFRMP will be whether the issue can be addressed in whole or substantial part by vegetation management decisions on DNR-administered lands.

What Is Not a SFRMP Issue?

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, SFRMP will not address recreation trails system issues or planning. However, aesthetic concerns along existing recreational trail corridors can be a consideration in determining forest stand management direction in these areas. Another example is wildlife populations; the plan will establish wildlife habitat goals but not goals for wildlife population levels.

Each issue needs to consider four pieces of information:

- What is the issue?;
- Why is this an issue? (i.e. What is the specific threat, opportunity or concern?);
- What are the likely consequences of not addressing this issue?; and,
- How can this issue be addressed by vegetation management decisions on DNR-administered lands?

Preliminary Issues

The following pages contain the preliminary issues identified by the subsection team. These issues were developed based on the common issues from previous SFRMP plans, general field knowledge of department staff, and by reviewing forest resource information for the subsections. The next step of the SFRMP process will determine how vegetation management on DNR-administered lands will address these issues.

The Hardwood Hills Subsection team has begun identifying important issues in the subsection that should guide forest planning. A preliminary issues list was developed to stimulate thought on issues that may impact forest planning in the subsection.

This plan will provide guidance for forest management on state lands for the next 10 years and establish goals for the next 50 to 100 years. The Hardwood Hills Subsection team will be identifying any additional issues that affect the subsection and could be mitigated or avoided by forest planning and vegetation management.

Preliminary Issues

A. How should the age-classes of forest types be represented across the landscape?

- **Why is this an issue?**

Representation of all age-classes and growth stages, including old-forest types, provides a variety of wildlife habitats, timber products, and ecological values over time.

- **How might DNR vegetation management address this issue?**

Vegetation management can provide for a balance of all forest types and age-classes.

- **What are possible consequences of not addressing this issue?**

A forest without representation of all age-classes and growth stages exposes itself to: 1) Increased insect and disease problems, 2) Loss of species with age-specific habitat requirements, and 3) Loss of forest-wide diversity. Such a forest would also provide a boom-and-bust scenario for forest industries that depend on an even supply of forest products.

- **Other considerations?**

What other factors ought to be considered with this issue?

B. What are appropriate mixes of vegetation composition, structure, spatial arrangement, growth stages, and plant community distribution on state lands across the landscape?

- **Why is this an issue?**

This is an issue because different users and stakeholders have differing opinions concerning what are the highest values within a forest and highest priority uses and management. This issue is tailored/constrained by the limited acreage of state lands, their wide distribution across the subsection, and large portions of this acreage having land status legal constraints.

This is also an issue because the Hardwood Hills Subsection is a transitional system, with many species and communities at the edges of their ranges, and because most of the complex mosaic of communities are gone due to land-use changes and loss of natural processes.

Additionally, DNR is a small minority landholder on this landscape and does not influence most of the adjoining lands and their management.

- **How might DNR vegetation management address this issue?**

DNR can develop vegetation management strategies that produce effects similar to natural disturbances and can begin to restore certain species and conditions that were once more prevalent. Further, the DNR can attempt to accommodate as many forest users as is ecologically sound given the limited state land base in the subsection.

- **What are possible consequences of not addressing this issue?**

1) Loss of wildlife habitat and associated species; 2) increase in invasive exotics; 3) loss of biodiversity and sustainability; 4) simplification of stand and landscape communities; 5) loss of ecologically intact landscapes; 6) loss of the ability to produce a diversity of forest products, e.g., saw timber, balsam boughs and other non-timber products, and tourism; and, 7) decreased resilience to climate change.

- **Other considerations?**

What other factors ought to be considered with this issue?

C. How can we address the impacts of forest management on riparian and aquatic areas including wetlands?

- **Why is this an issue?**

Riparian and aquatic areas are critical to fish, wildlife, and certain forest resources.

- **How might DNR vegetation management address this issue?**

The Minnesota Forest Resources Council's (MFRC's) site-level guidelines are the DNR's standard for vegetation management in riparian areas. At the site level, managers may want to exceed those guidelines. When planning vegetation management adjacent to aquatic and riparian areas, managers should consider specific conditions associated with each site such as soils, hydrology, desired vegetation, and consider enhancements to the MFRC guidelines.

- **What are possible consequences of not addressing this issue?**

Failure to consider vegetation management that affects riparian and aquatic areas could result in: 1) Increased run-off and erosion; 2) More conspicuous run-off events; 3) Less stable stream flows; and, 4) Negative impacts to water quality, fisheries, and wildlife habitat.

- **Other considerations?**

What other factors ought to be considered with this issue?

D. How can DNR develop new forest management access routes that minimize damage to other forest resources?

- **Why is this an issue?**

Routes are necessary to access forest stands identified for management during the 10-year planning period. These routes provide access for a variety of forest management activities and recreation. Negative impacts include costs, land disturbance, losses to the timberland base, increased spread of invasive exotic species, potential for user-developed trails, and habitat fragmentation.

- **How might DNR vegetation management address this issue?**

Using existing access routes or closing access routes after forest management activities have been completed might meet needs while minimizing negative impacts.

- **What are possible consequences of not addressing this issue?**

Not planning for access needs could result in: 1) Unfulfilled management goals; 2) Poorly located access routes; 3) Negative impacts on wildlife habitat; and, 4) Excessive costs for development, maintenance, and road closure.

- **Other considerations?**

What other factors ought to be considered with this issue?

E. How might we maintain or enhance biodiversity, native plant community composition, and retain within-stand structural complexity on actively managed stands where natural succession pathways are cut short?

- **Why is this an issue?**

Areas of biodiversity significance provide reference areas to help us evaluate the effects of management on biodiversity. Forest management has altered the rate and direction of natural change. Some current practices tend to reduce within-stand structural complexity and diversity of vegetation.

- **How might DNR vegetation management address this issue?**

DNR will incorporate management techniques that maintain or enhance biological diversity and structural complexity into vegetation management plans

- **What are possible consequences of not addressing this issue?**

1) Degradation of existing biodiversity and ecosystem function; 2) Fewer opportunities for maintaining or restoring ecological relationships; 3) Reduction of species associated with declining habitat; 4) Economic losses due to loss of site capability to maintain desired species, and, 5) Social and economic losses resulting from a decline in recreational activity associated with wildlife viewing and hunting.

- **Other considerations?**

What other factors ought to be considered with this issue?

F. How might we provide habitat for all wildlife and plant species and maintain opportunities for hunting, trapping, and nature observation?

• Why is this an issue?
Forest wildlife species are important to society. A wide range of factors, from timber harvest to development, influence wildlife species and populations.

• How might DNR vegetation management address this issue?
DNR can select vegetation management techniques that provide a variety of wildlife habitats and ecosystem functions.

• What are possible consequences of not addressing this issue?
1) Reduction of some types of wildlife habitat; 2) Reductions of species associated with declining habitats; and, 3) Economic and social losses resulting from a decline in recreational activity associated with wildlife viewing, hunting, and aesthetics.

• Other considerations?
What other factors ought to be considered with this issue?

G. How might we address the impacts on forest ecosystems from forest insects and disease, invasive species, nuisance animals, herbivory, global climate change, and natural disturbances such as fires and blowdowns?

- **Why is this an issue?**

All of the above-mentioned processes can impact the amount of forest land harvested and regenerated during the 10-year planning period. They can also influence the long-term desired future forest composition (DFFC) goals of the subsection plans.

- **How might DNR vegetation management address this issue?**

DNR can design flexibility into the plan to deal with specific stands that are affected by these processes.

- **What are possible consequences of not addressing this issue?**

1) Reduced timber volume and recreational enjoyment of the forest; 2) Long-lasting change to native plant and animal communities; and, 3) Increased fire danger.

- **Other considerations?**

What other factors ought to be considered with this issue?

H. What are sustainable levels of harvest for timber and nontimber forest products?

- **Why is this an issue?**

Some cover types have pronounced age-class imbalances. Demand for nontimber forest products, e.g., balsam boughs and decorative trees, have been increasing.

- **How might DNR vegetation management address this issue?**

The DNR can develop a 10-year harvest plan for state lands in these subsections that promotes a balance of all age classes for all even-aged cover types and propose regulations to protect some nontimber species.

- **What are possible consequences of not addressing this issue?**

1) Possible unsustainable harvest of these resources; 2) Adverse impact to wildlife habitat and native plant communities; and, 3) Unintended harvest of rare species.

- **Other considerations?**

What other factors ought to be considered with this issue?

I. How can we increase the quantity and quality of timber products on state lands?

- **Why is this an issue?**

The demand for timber has increased, while demand for other forest values has also increased. Minnesota's forest industry requires a sustainable and predictable supply of wood.

- **How might DNR vegetation management address this issue?**

Vegetation management planning can identify forest stands for treatments that will increase timber productivity (e.g., harvesting at desired rotation ages, thinning, control of competing vegetation, and reforestation to desired species and stocking levels).

- **What are possible consequences of not addressing this issue?**

1)A less-predictable or unsustainable supply of timber would be available for logging and the forest products industry, likely resulting in higher procurement, chemical, and waste management costs; and, 2)Wood and wood product imports might increase from countries that have fewer environmental controls, effectively exporting U.S. environmental issues.

- **Other considerations?**

What other factors ought to be considered with this issue?

J. How can we implement forest management activities and minimize impacts on visual quality?

- **Why is this an issue?**

Scenic beauty is the primary reason people choose to live or use their recreation and vacation time in or near forested areas.

- **How might DNR vegetation management address this issue?**

DNR managers will continue to follow Best Management Practices (BMPs) for visual quality and identify areas that may need additional mitigation strategies**.**

- **What are possible consequences of not addressing this issue?**

Not addressing this issue may result in a negative experience for the public living, vacationing, and recreating in our forests.

- **Other considerations?**

What other factors ought to be considered with this issue?

K. How will land managers achieve desired results and continue to uphold various state and federal statutes?

- **Why is this an issue?**

Divisions within the DNR must follow legal mandates, while fulfilling both department and division missions. For example, State Trust Fund lands must generate income for various trust accounts under state law, and timber sales are currently the primary tool for this process. Wildlife habitat management and preservation, not timber sales, is the mandate for acquired Wildlife Management Area (WMA) lands.

- **How might DNR vegetation management address this issue?**

Vegetation management will take administrative land status and relevant statutes into consideration during the planning process.

- **What are possible consequences of not addressing this issue?**

Failure to follow these mandates and legislative intent may be a violation of federal or state law.

- **Other considerations?**

What other factors ought to be considered with this issue?

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

- **Why is this an issue?**

Cultural resource sites possess spiritual, traditional, scientific, and educational values. Some types of sites are protected by federal and state statutes.

- **How might DNR vegetation management address this issue?**

DNR managers will continue to have all vegetation management projects reviewed for known cultural resources. They will survey unidentified sites and if cultural resources are found, modify the project to protect the resource. If cultural resources are discovered during a project, the project will be modified to protect the resource.

- **What are possible consequences of not addressing this issue?**

Loss or damage to cultural resources.

- **Other considerations?**

What other factors ought to be considered with this issue?

M. How can we ensure that rare plants and animals, their habitats, and other rare features are protected in this subsection?

- **Why is this an issue?**

Protecting rare features (endangered, threatened, and special concern species) is a key component of ensuring species, community, and forest-level biodiversity in this subsection.

- **How might DNR vegetation management address this issue?**

The Minnesota County Biological Survey (MCBS) has been completed in all counties in the subsection, with the exception of Clearwater and Beltrami Counties where surveys are currently being conducted. DNR managers will check the Rare Features Database for the location of known rare features in this subsection. The needs of rare features will be addressed in the management plan.

- **What are possible consequences of not addressing this issue?**

1) Loss of rare species at the local and state level; 2) Rare species/habitat declines leading to status changes; 3) Rare habitat loss or degradation; and, 4) Loss of biodiversity at the species, community, and/or landscape level.

- **Other considerations?**

What other factors ought to be considered with this issue?

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CHAPTER 1

Land Cover

Hardwood Hills Subsection

Notes relating to this chapter:
Color maps and graphs may be viewed as PDF files on the Hardwood Hills Subsection Forest Resource Management Plan (SFRMP) Web site at:
www.dnr.state.mn.us/forestry/subsection/hardwoodhills/index.html

Maps in this chapter depict information for an area within a "planning boundary." This boundary closely approximates the subsection(s) while capturing data summary and planning efficiencies by using survey or jurisdiction lines in some cases.

Printed documents will be available for review at the Minnesota DNR Northwest Region Headquarters at 2115 Birchmont Beach Road N.E., Bemidji, Minnesota, 56601 and on CD by request to Pat Matuseski at (218) 308-2381 or pat.matuseski@state.mn.us.

1.1 GAP Classification

What Is a GAP Classification?
The Gap Analysis Program (GAP) was a project sponsored and coordinated by the Biological Resources Division of the U.S. Geological Survey. The Minnesota DNR participated in this nationwide project. Coordination of GAP activities with neighboring states is done to ensure the development of regionally compatible information.

The GAP Web site defines the project as "… a scientific method for identifying the degree to which native animal species and natural communities are represented in our present-day mix of conservation lands. Those species and communities not adequately represented in the existing network of conservation lands constitute conservation 'gaps.'" The purpose of GAP is to provide broad geographic information on the status of ordinary species (those not threatened with extinction or naturally rare) and their habitats in order to provide land managers, planners, scientists, and policy makers with the information they need to make better-informed decisions. Further information is available at www.gap.uidaho.edu/default.htm.

The basic statewide geographic information systems (GIS) datasets of GAP include land cover, distributions of native vertebrate species, major land-ownership patterns, and land management. Gap analysis is conducted by overlaying vegetation and species richness maps with ownership and management maps so that gaps in the management for biodiversity can be identified. The data layers are developed, displayed, and analyzed using GIS techniques.

Land-Cover Classification
The GAP classification of current vegetation (land cover map), which is a part of the larger project, was produced by computer classification of satellite imagery (Landsat 5 Thematic Mapper imagery) by the Resource Assessment Unit of the DNR Division of Forestry. Units of analysis are divided by Ecological Classification System (ECS) subsections. The minimum mapping unit is one acre.

GAP Land Cover Classification Descriptions for Hardwood Hills Subsection:

Non-Vegetated: Includes developed land types and barren land types. Developed land types include structures and areas associated with intensive land use. Barren land types include land of limited ability to support life and in which less than one-third of the area has vegetation or other cover. Examples of barren types include sand, bare soil, and exposed rock.

Crop and Grass: Includes agricultural and grass land types. Agriculture includes land under cultivation for food or fiber (including bare or harvested fields). Examples include corn, beans, alfalfa, wheat, and orchards. Grasslands are covered by non-cultivated herbaceous vegetation predominated by grasses, grass-like plants or forbs. Examples include cool or warm season grasses, restored prairie, abandoned fields, golf course, sod farm and hay fields.

Shrubland: Includes upland and lowland shrubland types. Upland shrubs include vegetation with a persistent woody stem, generally with several basal shoots, low growth of less than 20 feet and coverage of at least one-third of the land area with less than 10 % tree cover interspersed. Lowland shrubs include woody vegetation, less than 20 feet tall, with a tree cover of less than 10 % and occurring in wetland areas. Examples include willow, alder and stagnant black spruce.

Aquatic Environments: Include areas of open water or marsh type environments. Open water areas are areas of water without emergent vegetation. Marsh type environments include areas with water at, near,

or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation and with soils indicative of wet conditions. Vegetation in emergent or wet meadow types include persistent and nonpersistent herbaceous plants standing above the surface of the water or soil. Examples include cattails, marsh grass and sedges.

Upland Conifer Forest: Includes pine and spruce fir upland forests. Crown closure of the area must be greater than 10%. The coniferous component of the area must be greater than one-third , reaching a mature height of at least 6 feet tall. If deciduous species group is present, it should not exceed one-third of the canopy. Examples include Jack Pine, Red Pine and White Spruce.

Lowland Conifer Forest: Wetlands dominated by woody perennial plants, with a canopy cover greater than 10%, and trees reaching a mature height of at least 6 feet. Examples include stands of coniferous trees consisting of black spruce, northern white cedar and tamarack.

Upland Deciduous Forest: Includes areas whose canopies have predominance (greater than one-third) of trees, reaching a mature height of at least 6 feet tall, which lose their leaves seasonally. Crown closure of the area must be greater than 10%. If the coniferous species group is present, it should not exceed one-third of the canopy. Examples include Aspen, Oak and Maple.

Lowland Deciduous Forest: Wetlands dominated by woody perennial plants, with a canopy cover greater than 10%, and trees reaching a mature height of at least 6 feet. Examples include stands of deciduous trees consisting of Black Ash and Red Maple

Upland Coniferous-Deciduous Forest Mix: Upland areas where deciduous and evergreen trees are mixed so that neither species group is less than one-third (33%) dominant in the canopy. Examples include Aspen/Balsam Fir mixed forest.

Lowland Coniferous-Deciduous Forest Mix: Wetlands dominated by woody perennial plants, with a canopy cover greater than 10%, and trees reaching a mature height of at least 6 feet.

Source: *Upper Midwest Gap Analysis Program Image Processing Protocol, U.S. Department of the Interior, U.S. Geological Survey, Environmental Management Technical Center, June 1998.*

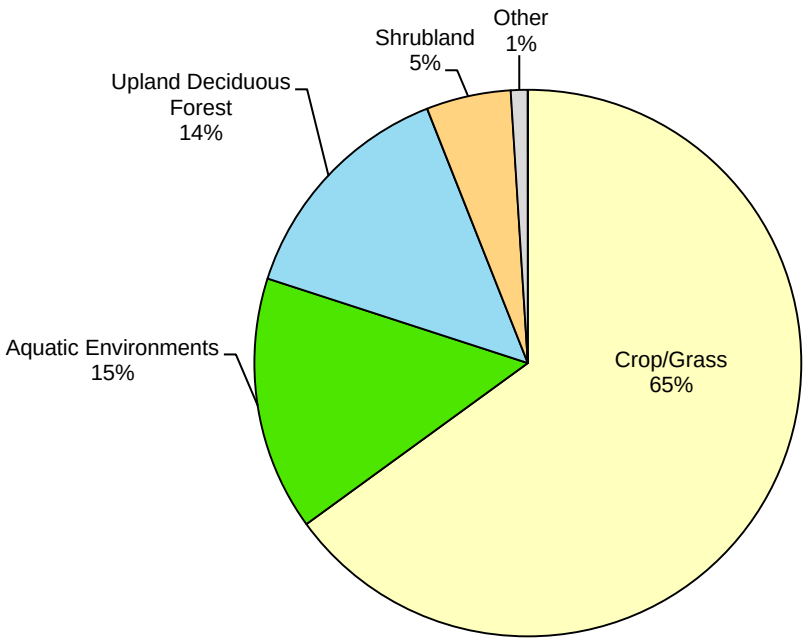
The following table, chart and map show the GAP land-cover classification of the subsection in this plan. Chapter Two of this document contains the land ownership and land management information classification of the subsection in this plan.

Table 1.1: Hardwood Hills Subsection GAP Land Cover Acres and Percentages

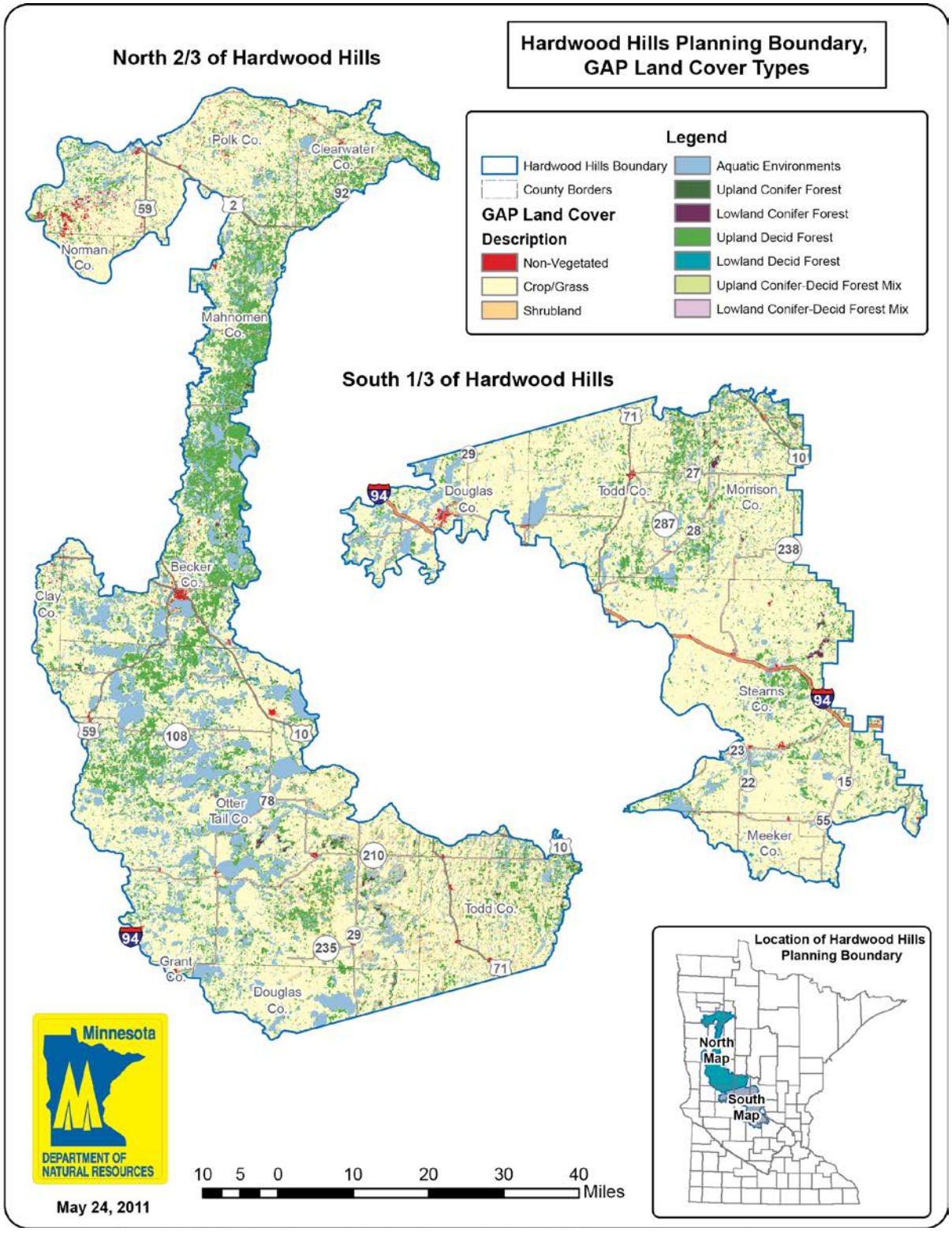
Cover Type	Acres	Percent[1]
Aquatic Environments	517,814	15
Crop/Grass	2,256,492	65
Lowland Conifer Forest	12,516	<1
Lowland Conifer-Deciduous mix	146	<1
Lowland Deciduous Forest	12,275	<1
Non-Vegetated	25,314	<1
Shrubland	164,935	5
Upland Conifer Forest	6,868	<1
Upland Conifer-Deciduous mix	690	<1
Upland Deciduous Forest	483,527	14
Subsection Total	3,480,577	**100**

[1]*Decimal percentages are rounded to the nearest one percent.*

Chart 1.1: Hardwood Hills Subsection GAP Land Cover Percentages



Map 1.1: GAP Land Cover Classification of the Hardwood Hills Subsection



A color version of this document can be found on the Hardwood Hills Forest Resource Management Plan (SFRMP) Web site at: www.dnr.state.mn.us/forestry/subsection/hardwoodhills/index.html

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C H A P T E R 2

Land Ownership and Administration

Hardwood Hills Subsection

2.1 … Land Ownership

Table 2.1: Hardwood Hills Subsection Land Administration
Chart 2.1: Hardwood Hills Subsection Land Administration
Map 2.1: Hardwood Hills Subsection – Land Ownership Map
Map 2.2: Hardwood Hills Subsection – Management Units

Notes relating to this chapter:
Color maps may be viewed as PDF files on the Hardwood Hills Subsection Forest Resource Management Plan (SFRMP) Web site at:
www.dnr.state.mn.us/forestry/subsection/hardwoodhills/index.html

Maps in this chapter depict information for an area within a "planning boundary." This boundary is designed to closely approximate the subsection while capturing data summary and planning efficiencies by using survey or jurisdiction lines in some cases.

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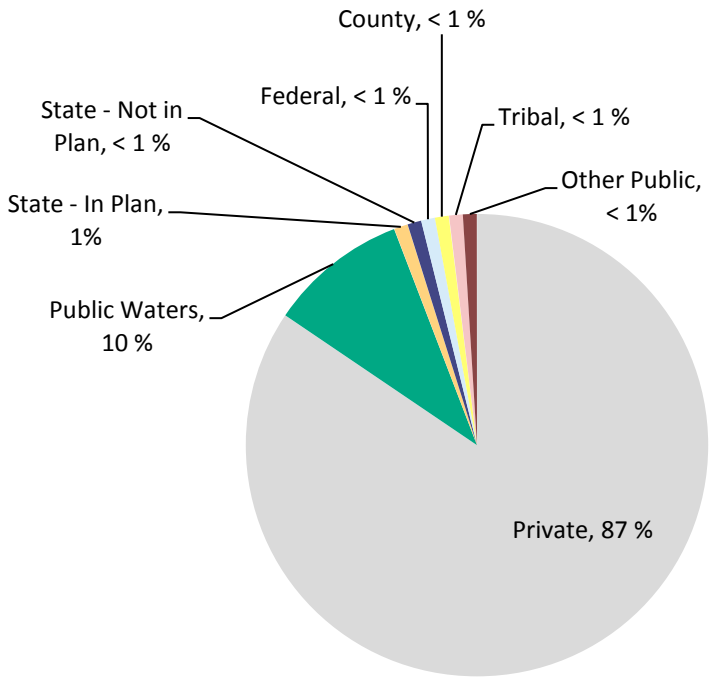
2.1 Land Ownership

Table 2.1: Hardwood Hills Subsection Land Administration

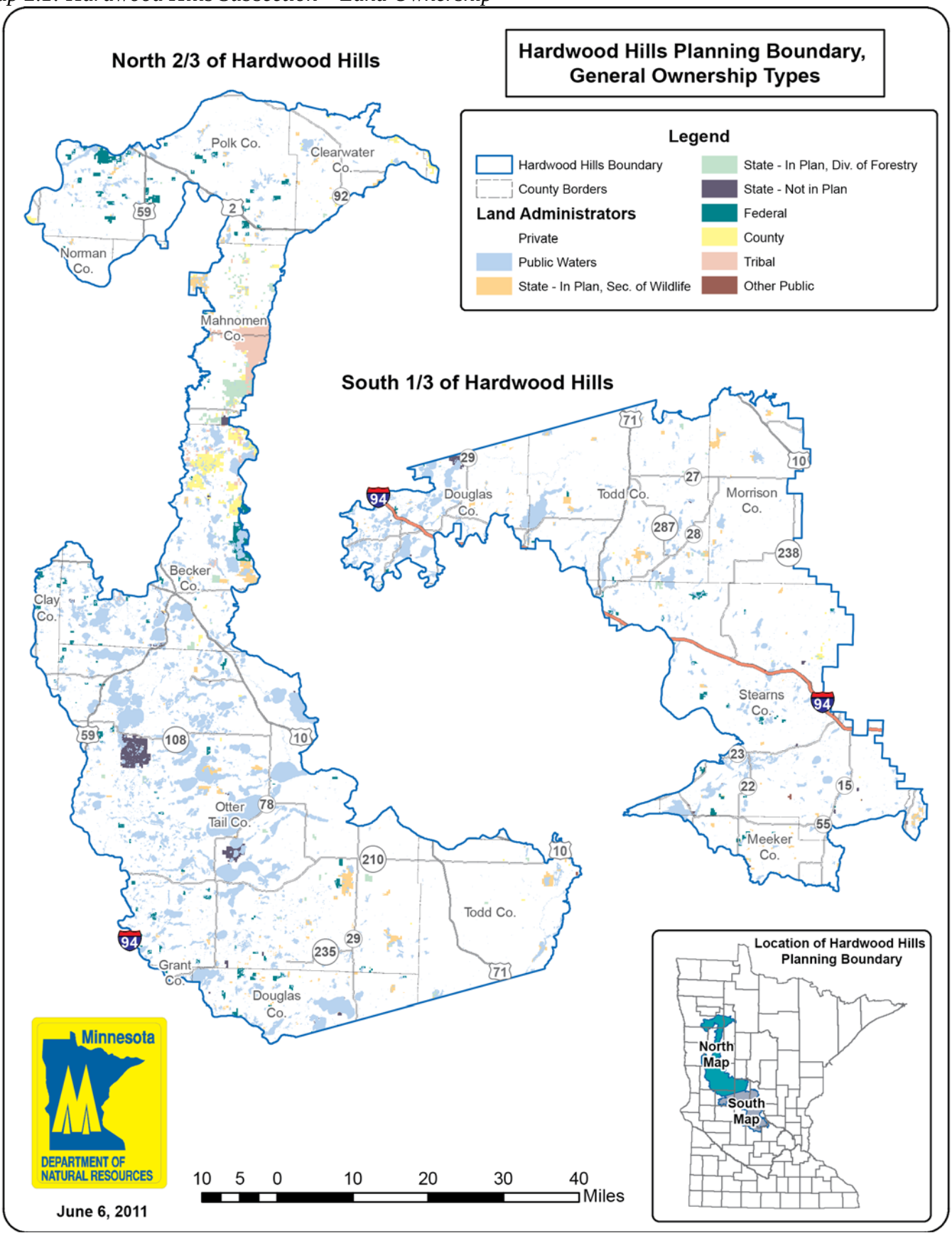
Ownership	Acres	Percent
Private	3,017,571	87%
Public Waters[1]	335,636	10%
State Included in Plan – DNR Forestry	14,911	< 1%
State Included in Plan – DNR Wildlife	28,348	< 1%
State Excluded from Plan[2]	13,953	< 1%
Federal	29,932	< 1%
County[3]	20,195	< 1%
Tribal	19,882	< 1%
Other Public[4]	235	< 1%
Total	**3,480,663**	**100%**

[1] Public waters includes all acres of protected lake basins, including some acres under fee title of public or privately held lands.
[2]State lands excluded from plan – Scientific and Natural Areas, Parks and Trails, Department of Transportation, and Section of Fisheries.
[3] County includes both county fee and county administered state owned tax forfeited lands.
[4] Other public includes city and school districts.

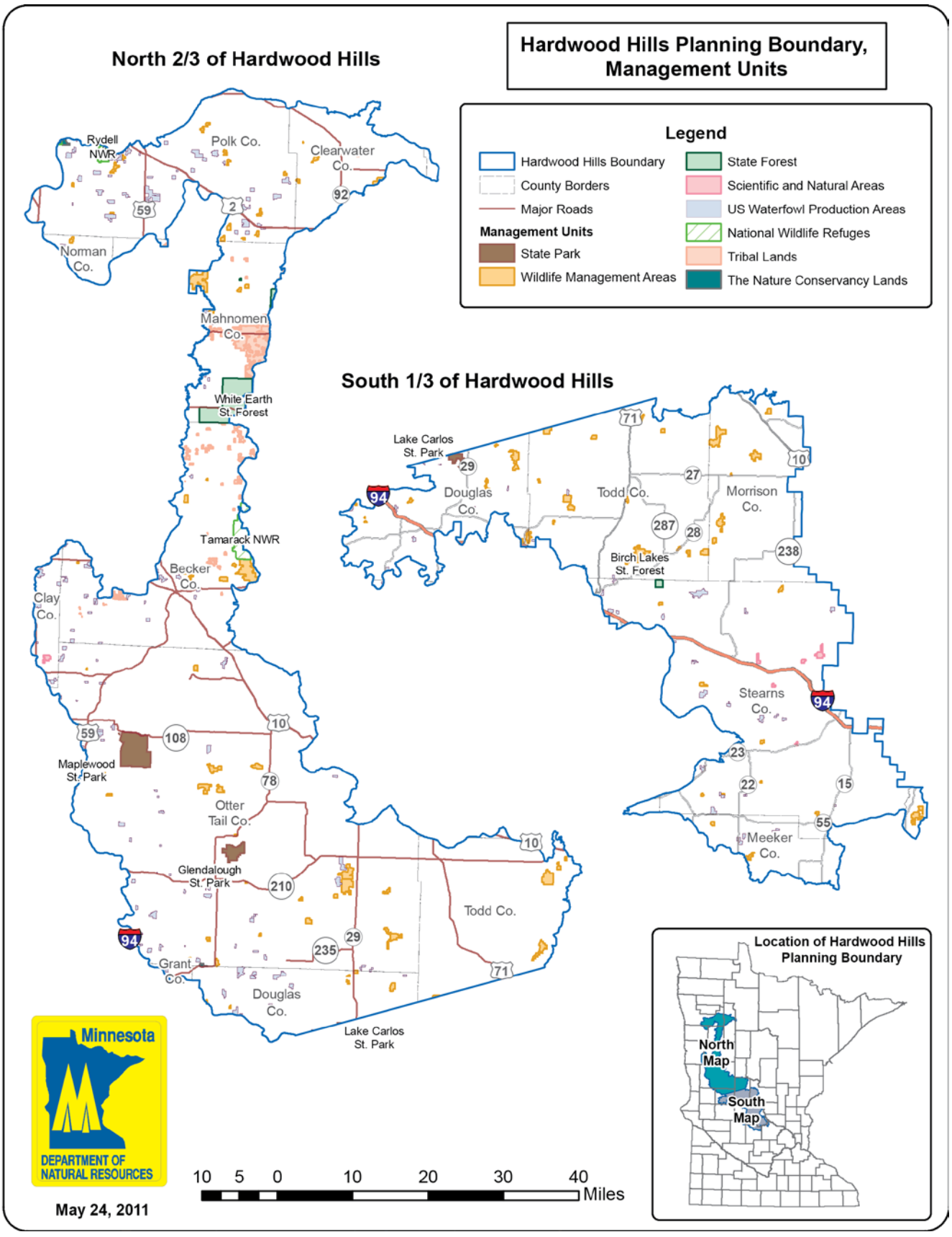
Chart 2.1: Hardwood Hills Subsection Land Administration



Map 2.1: Hardwood Hills Subsection – Land Ownership



Map 2.2: Hardwood Hills Subsection – Management Units



CHAPTER 3

Forest Composition and Structure

Hardwood Hills Subsection

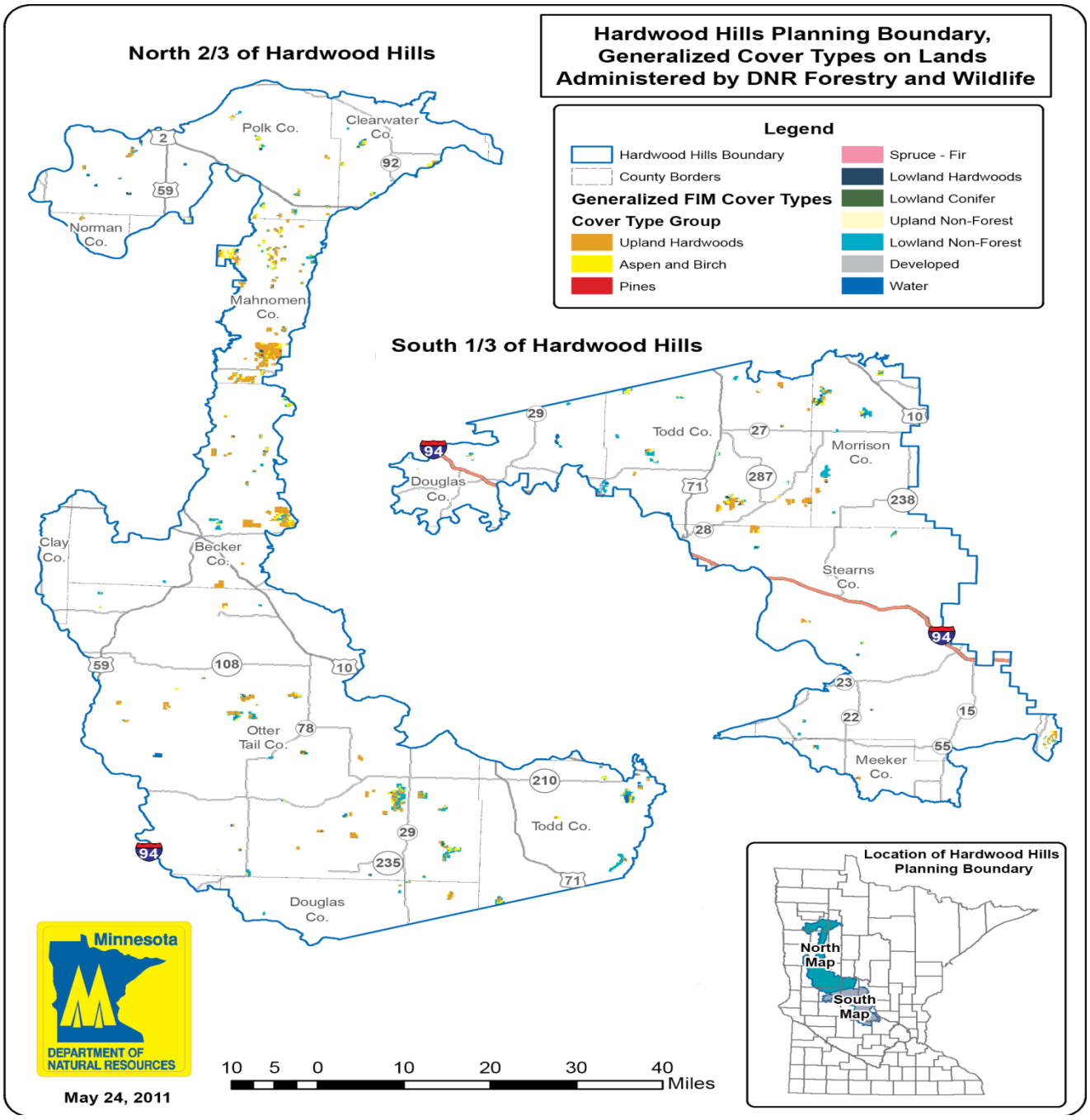
Notes relating to this chapter:
Color maps and graphs may be viewed as PDF files on the Hardwood Hills Subsection Forest Resource Management Plan (SFRMP) Web site at:
www.dnr.state.mn.us/forestry/subsection/hardwoodhills/index.html.

Maps in this chapter depict information for an area within a "planning boundary." This boundary closely approximates the subsection(s) while capturing data summary and planning efficiencies by using survey or jurisdiction lines in some cases.

Printed documents will be available for review at the Minnesota DNR Northwest Region Headquarters at 2115 Birchmont Beach Road N.E., Bemidji, Minnesota, 56601 and on CD by request to Pat Matuseski at (218) 308-2381 or pat.matuseski@state.mn.us.

3.1 Forest Cover-Type Acres on State Land Administered by DNR Forestry and Wildlife

Map 3.1: Hardwood Hills Subsection, Generalized Cover Types on DNR Lands



[1]*Swamp Conifers and Stagnant conifers are consolidated into the lowland conifer cover type for this planning effort.*

Color maps may be viewed as PDF files on the Hardwood Hills Subsection Forest Resource Management Plan (SFRMP) Web site at:
www.dnr.state.mn.us/forestry/subsection/hardwoodhills/index.html.

Table 3.1: Hardwood Hills State Timberland Cover Type Acres by Age-Class

Hardwood Hills State[1] Timberland[2] Cover Type Acres by Age-Class (2011)

Cover Type	1 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60	61 - 70	71 - 80	81 - 90	91 - 100	101 - 110	111 - 120	121 +	Total
Ash-Lowland Hardwoods[3]	0	0	3	19	27	26	116	57	91	41	45	21	12	458
Aspen-Balm of Gilead	1,172	1,088	571	266	401	419	731	498	99	29	0	0	0	5,274
Balsam Fir	0	0	0	0	0	10	9	38	0	0	0	0	0	57
Birch	0	0	4	0	0	0	0	9	0	0	0	0	0	13
Black Spruce-Lowland	0	0	8	0	0	6	5	0	0	0	0	0	0	19
Black Spruce-Upland	2	0	0	0	0	0	0	0	0	0	0	0	0	2
Jack Pine	0	0	18	0	8	26	0	0	0	0	0	0	0	52
Northern Hardwoods	251	10	148	168	54	105	308	1,126	783	641	130	618	190	4,532
Oak	50	2	0	76	48	219	468	1,396	985	835	507	77	69	4,732
Red Pine	7	0	37	38	65	0	0	0	7	0	0	0	0	154
Scotch Pine	0	0	0	11	0	0	0	0	0	0	0	0	0	11
Tamarack	0	29	6	0	53	213	100	57	55	60	37	37	92	739
White Pine	18	13	0	0	0	8	0	0	0	0	0	0	0	39
White Spruce	0	5	9	117	0	0	0	0	0	0	0	0	0	131
Totals	1,500	1,147	804	695	656	1,032	1,737	3,181	2,020	1,606	719	753	363	16,213

1 Includes only Forestry- and Wildlife-administered lands within the planning boundary and is based on Minnesota DNR 2011 Forest Inventory Module (FIM) forest inventory.
2 Timberland is defined as forest land capable of producing timber of marketable size and volume at the normal harvest age, not including lands withdrawn from timber utilization by law or statute (see Appendix D: Glossary).
3 This type includes cottonwood cover type.

3.2 Cover-Type Percent of Total Timberland, 2009 — Hardwood Hills

Table 3.2: State Timberland Cover Type Acres and Percentages

Percent State[1] Timberland[2] Cover Type Acres, 2011
Hardwood Hills Subsection

Cover Type	Acres	Percent
Ash-Lowland Hardwoods[3]	458	2.8%
Aspen-Balm of Gilead	5,274	32.5%
Balsam Fir	57	0.4%
Birch	13	0.1%
Black Spruce-Lowland	19	0.1%
Black Spruce-Upland	2	0.0%
Jack Pine	52	0.3%
Northern Hardwoods	4,532	28.0%
Oak	4,732	29.2%
Red Pine	154	0.9%
Scotch Pine	11	0.1%
Tamarack	739	4.6%
White Pine	39	0.2%
White Spruce	131	0.8%
Total Acres	16,213	100.0%

1 Includes only Forestry- and Wildlife-administered lands within the planning boundary and is based on Minnesota DNR 2009 Forest Inventory Module (FIM) forest inventory.
2 Timberland is defined as forest land capable of producing timber of marketable size and volume at the normal harvest age, not including lands withdrawn from timber utilization by law or statute (see Appendix D: Glossary).
3 Type includes cottonwood cover type.

Charts 3.2.l— 3.2.6 show age-class distribution by cover type for state-administered timberlands (i.e., DNR Forestry and Wildlife lands) for the year 2011. The age class distributions are presented only for the cover types on state-administered timberlands that comprise >1% of the total timberlands cover type acres (i.e. the ash/lowland hardwood, aspen/balm of Gilead, northern hardwoods, oak and tamarack cover types).

Reader's Guide to the Following Assessment Pages

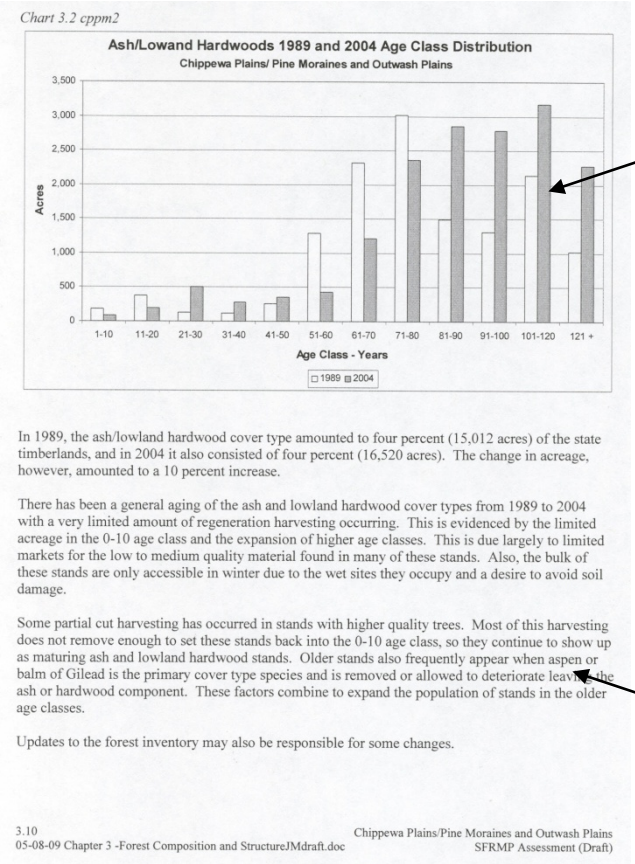


Chart 3.2 cppm2

Ash/Lowand Hardwoods 1989 and 2004 Age Class Distribution

Chippewa Plains/ Pine Moraines and Outwash Plains

In 1989, the ash/lowland hardwood cover type amounted to four percent (15,012 acres) of the state timberlands, and in 2004 it also consisted of four percent (16,520 acres). The change in acreage, however, amounted to a 10 percent increase.

There has been a general aging of the ash and lowland hardwood cover types from 1989 to 2004 with a very limited amount of regeneration harvesting occurring. This is evidenced by the limited acreage in the 0-10 age class and the expansion of higher age classes. This is due largely to limited markets for the low to medium quality material found in many of these stands. Also, the bulk of these stands are only accessible in winter due to the wet sites they occupy and a desire to avoid soil damage.

Some partial cut harvesting has occurred in stands with higher quality trees. Most of this harvesting does not remove enough to set these stands back into the 0-10 age class, so they continue to show up as maturing ash and lowland hardwood stands. Older stands also frequently appear when aspen or balm of Gilead is the primary cover type species and is removed or allowed to deteriorate leaving the ash or hardwood component. These factors combine to expand the population of stands in the older age classes.

Updates to the forest inventory may also be responsible for some changes.

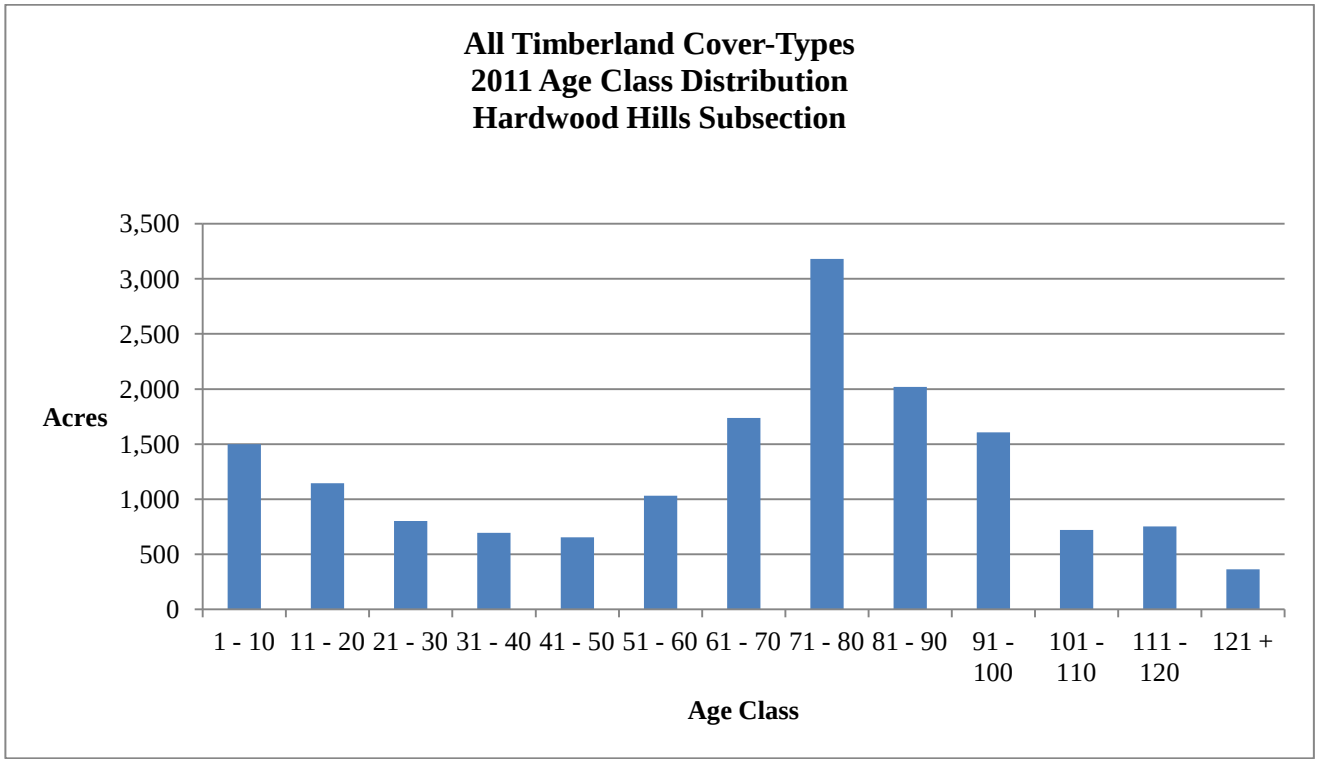
Charts: The charts on the following pages illustrate the age structure of forest cover types today.

Commentary: The commentary sections beneath the charts suggest some of the factors that influence trends in forest age structure and composition. In each case, the first paragraph provides trend information and the following paragraphs describe some of the forces influencing these trends.

Readers should note that the commentary section is *not* intended to be a wholly science-based assessment, but rather, is based on a forestry assessment of conditions and forces influencing the cover types. While the commentary is intended to suggest some likely forces acting on the cover types in this subsection, it should by no means be considered an extensive account of forces acting on these complex forest systems. For example, historic events and practices—such as logging at the turn of the century, ongoing fire suppression, and the 1930s drought—have influenced the forest landscape in this subsection, but have not been discussed in depth here.

Finally, please note that there may be some unresolved professional debates between different natural resource disciplines about the significance of some of the factors influencing the forest cover types described on these pages. These debates are not addressed in the commentary sections. The SFRMP team is seeking public and professional input throughout the plan development process to better inform debaters and enhance management of this subsection in the coming years. The SFRMP planning process is designed to be annually adaptive so additional information and science can be incorporated as it becomes available.

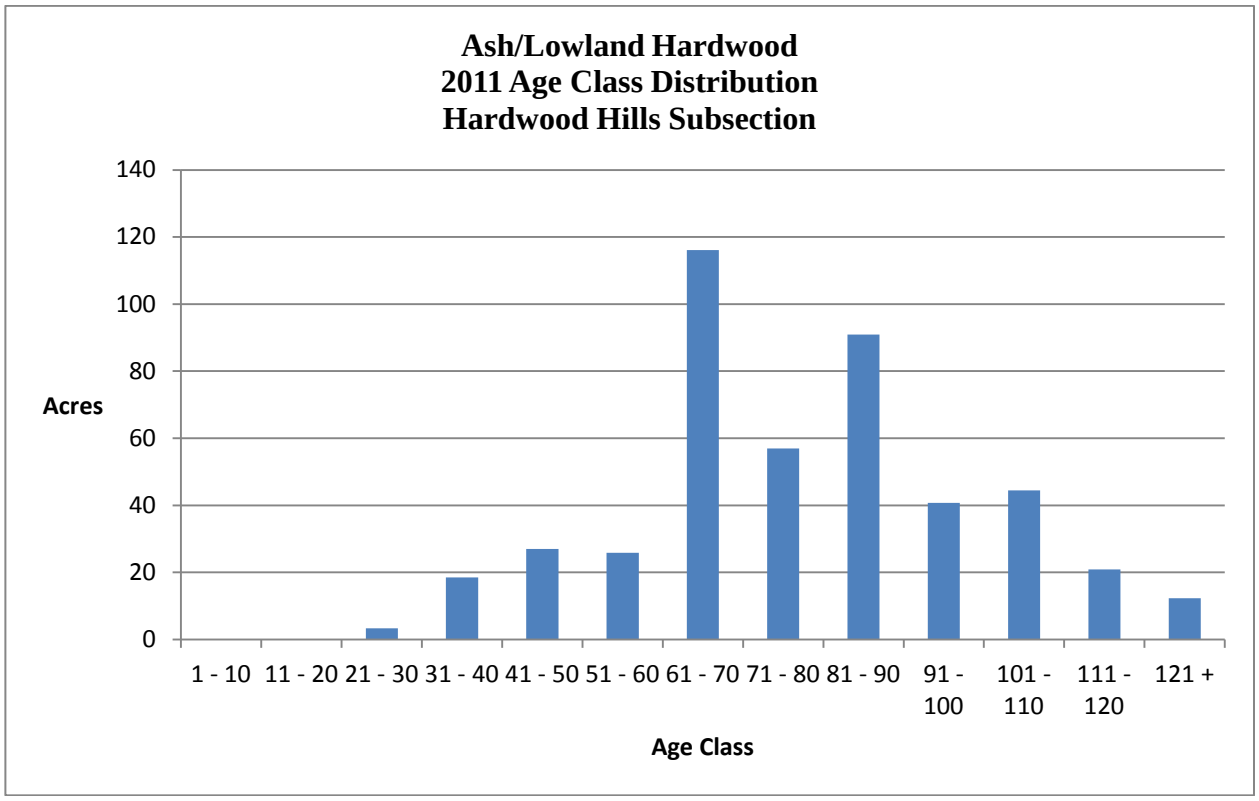
Chart 3.2.1: Age-Class Distribution for all Timberland Cover Types



Source: 2011Minnesota DNR Forest Inventory Module (FIM) database.

This chart shows the acreage of all state owned forestry and wildlife administered timberland cover types in 2011. These cover types encompass an area of 16,213 acres in the Hardwood Hills Subsection.

Chart 3.2.2: Ash/Lowland Hardwoods Age-Class Distribution



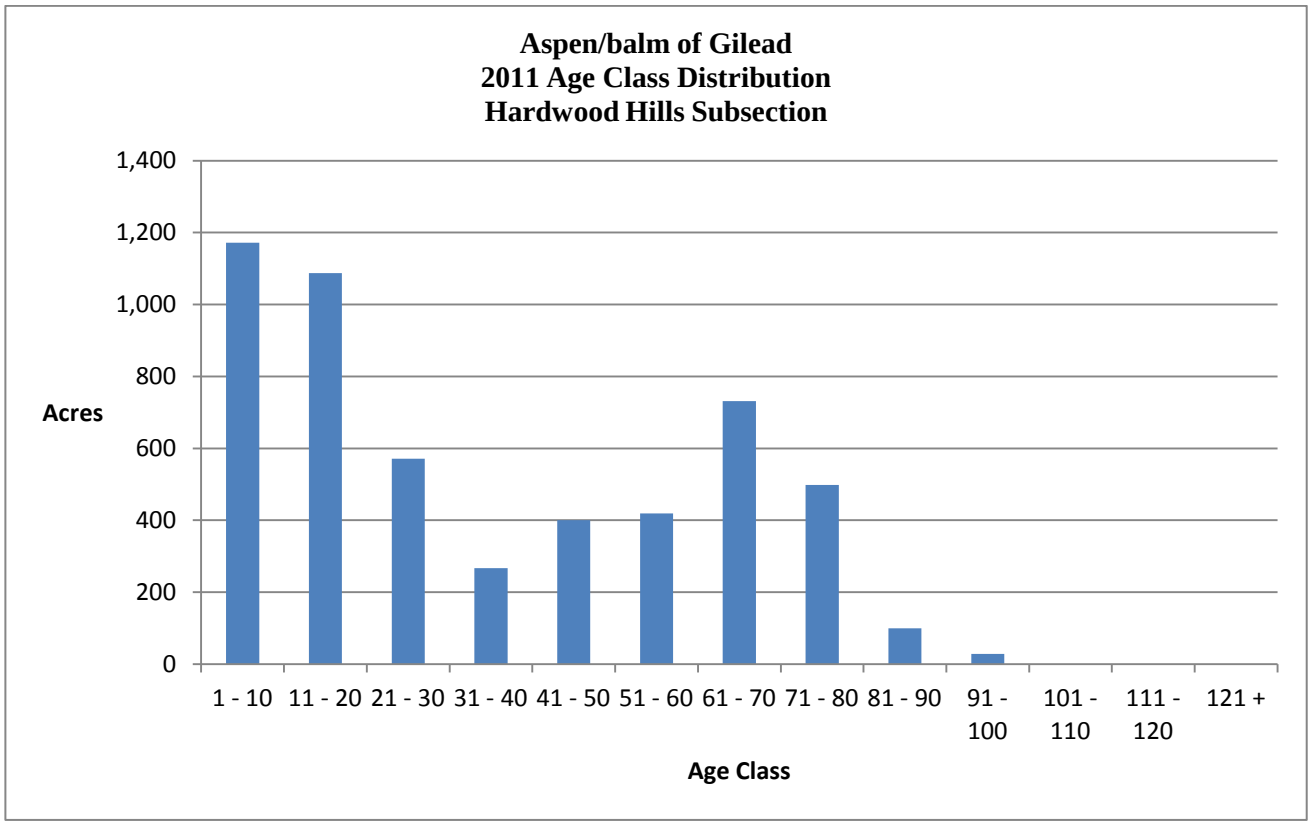
Source: 2011 Minnesota DNR Forest Inventory Module (FIM) database.

The ash/ lowland hardwood cover type has 458 acres or 2.8 percent of the Hardwood Hills Subsection's state timberlands.

There are limited markets for the low- to medium-quality material found in many of these stands. Stands are generally small, with 60% being less than 10 acres in size. The majority of these stands are only accessible in winter due to the wet sites they occupy and a desire to avoid soil damage.

Some partial-cut harvesting has occurred in stands with higher-quality trees. Most of this harvesting does not remove enough to set these stands back into the zero to 10 year age class, so they continue to show up as maturing ash and lowland hardwood stands.

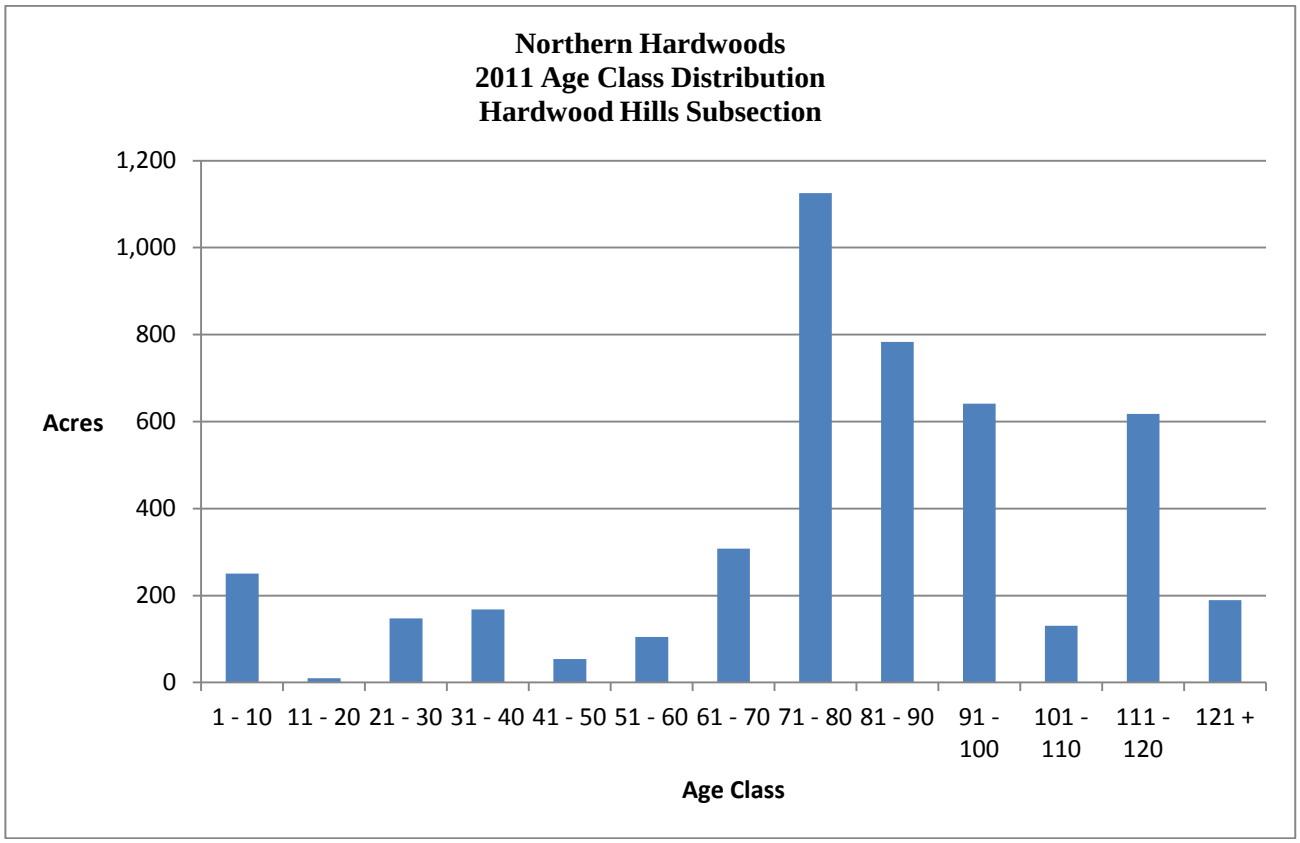
Chart 3.2.3: Aspen and Balm of Gilead Age-Class Distribution



Source: 2011 Minnesota DNR Forest Inventory Module (FIM) database.

The aspen and balm of Gilead cover types comprise one of the major forested cover types on state timberlands within the Hardwood Hills Subsection. In 2011 these cover types occupied 32.5 percent (5,274 acres) of state-administered timberlands in the Hardwood Hills Subsection.

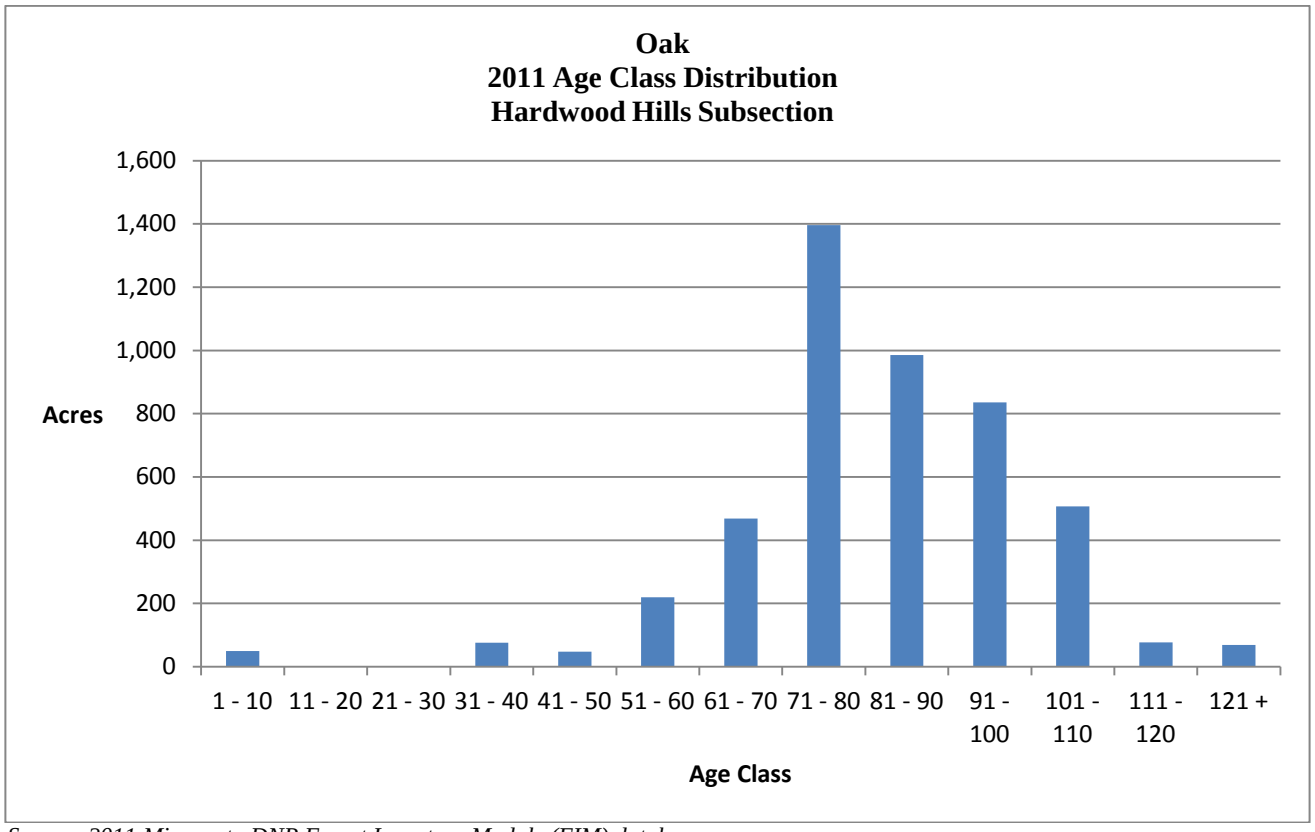
Chart 3.2.4: Northern Hardwoods Age-Class Distribution



Source: 2011 Minnesota DNR Forest Inventory Module (FIM) database.

The northern hardwoods cover type is another of the major forested cover types of state timberlands in the Hardwood Hills Subsection – 28 percent (4,532 acres). This cover type is best described as a mix of hardwood species dominated by sugar maple, basswood, red oak, green ash, aspen, and bur oak. Typical management schemes involve selective harvesting, rarely removing enough trees to set the stand age back to the youngest age classes. This means that these stands continue to show up in the maturing age groups.

Chart 3.2.5: Oak Age-Class Distribution

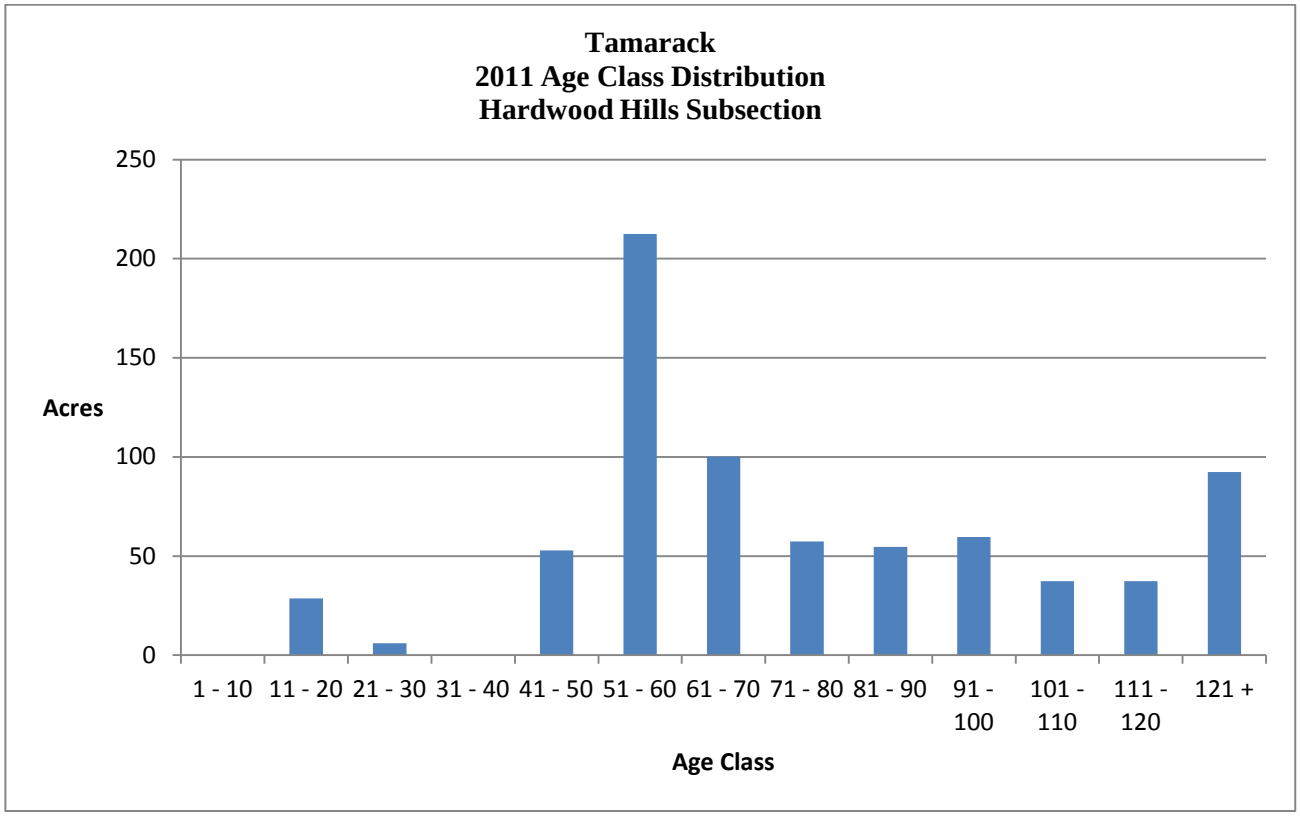


Source: 2011 Minnesota DNR Forest Inventory Module (FIM) database.

In 2011, the oak cover type is the third major cover type of state-administered timberlands in the Hardwood Hills Subsection - 29.2 percent (4,732 acres).

Oak is commonly managed through thinning or patch cutting, which removes volume but does not greatly alter the cover type designation. This contributes to increased acreage in the older age-classes.

Chart 3.2.6: Tamarack Age-Class Distribution



Source: 2011Minnesota DNR Forest Inventory Module (FIM) database.

In 2011, at 4.6 percent (739 acres), the tamarack cover type is widely distributed across state-administered timberlands in the Hardwood Hills Subsection; 75% of the stands are less than 15 acres in size.

3.3 Old-Growth Forests

The DNR's old-growth management goal is to identify and protect the highest quality remaining natural old-growth forest communities on state-administered lands. Old-growth forest stands are defined by age, structural characteristics, and relative lack of human disturbance. These forests are essentially free from catastrophic disturbances and contain old trees (generally more than 120 years old), large snags, and downed trees.

Old-growth forest represents the latter stages of succession in forested ecosystems. Remaining old-growth forests are important for their scientific and educational values, as well as their aesthetic and spiritual appeal. Old-growth forests provide special habitats for native plants, important habitat features for wildlife, and examples of the maximum limits of individual tree and stand production. Because old-growth ecosystems developed for a long time without large-scale disturbance, the study of plants, animals, soils, and ecosystem processes in old-growth stands provides important insights into the natural function of forest ecosystems. Such insights can be crucial for future forest management and for maintenance of biological diversity.

Old-growth designations are based on the 1994 DNR Old-Growth Guidelines. Designation of old-growth stands in the Hardwood Hills Subsection is currently being finalized. Some of the subsection's old-growth boundaries have changed since the goals were established due to revisions of the DNR Old-Growth Guidelines made in 1999. More high quality old growth was found than originally expected, so the designated acreage exceeded the target.

The 1994 goals for acreage and number of sites may be adjusted in the future. If new information becomes available on the extent, quality, and distribution of potential old-growth stands meeting prescribed selection criteria, the goals may be adjusted. If individual stands that appear to meet requirements are discovered on state land during the SFRMP process or in subsequent years, they may be evaluated and given official old-growth status.

The following tables provide information on the 1994 goals and the designated acres in the Hardwood Hills Subsection.

Table 3.3: Designated Old-Growth Acres in the Hardwood Hills Subsection

A total of 1,646 acres are designated as old-growth, and 1,020 acres are pending candidate old-growth acres (status yet to be determined). These acres include all state-administered lands (state parks, SNAs, etc.).

Forest Type	Old-Growth 1994 Acreage Goal	Preliminary Old-Growth Acres Designated[1]	Pending Candidate Old-Growth Acres[2]
Black Ash	20	13	12
Lowland Hardwoods	115	30	11
Northern Hardwoods	395	1,480	498
Oak	160	123	499
Total	**690**	**1,646**	**1,020**

[1] Designated old growth based on review of original evaluations, candidate shapefiles with designations and other corresponding designation information for the original Hardwood Hills Old Growth designation process 2002-2004.

[2] Pending old growth based on review of original evaluations, candidate shapefiles with pending designations and other corresponding information for the original Hardwood Hills Old Growth designation process 2002-2004.

3.4 Historical Forest Composition Compared to Today's Forest – An Estimate

Table 3.4: Historical Forest Composition Comparison

Hardwood Hills Historical Forest Composition Comparison for Extant Forests			
Species	BT	FIA	Magnitude of Change
Ash	1.4	7.6	5.4
Aspen	14.8	21.3	1.4
Balsam Fir	0.2	0.3	2.0
Balm of Gilead	1.4	2.4	1.7
Basswood	4.6	11.4	2.5
Black Spruce	0.2	0.1	-1.6
Box Elder	0.0	1.9	79.0
Bur Oak	28.0	15.4	-1.8
Cherry	0.1	0.2	1.1
Cottonwood/Willow	0.8	0.3	-2.4
Elm	7.5	12.0	1.6
Ironwood	1.6	0.9	-1.7
Jack Pine	0.1	0.2	1.6
Paper Birch	3.1	4.1	1.3
Pin Oak	1.4	0.1	-13.2
Red Maple	0.0	0.6	14.5
Red Oak	10.8	11.0	1.0
Red Pine	0.3	0.4	1.2
Sugar Maple	10.0	6.1	-1.6
Tamarack	10.1	2.7	-3.8
White Pine	2.1	0.3	-8.0
White Spruce	0.5	0.2	-2.9
Yellow Birch	0.0	0.1	4.6

Table Explanation

This table shows the relative abundance of public land survey (PLS) bearing tree (BT) species marked as witness trees in the mid-1800s compared to 1990 Forest Inventory and Analysis (FIA) tree species for extant forests in the subsection. Extant forests in this context are defined as areas that were initially forest at the time of the original public land survey and still were forest in the early 1990s. It provides an estimate of the abundance of certain kinds of tree species before the land was logged and settled, compared to today's forest. Magnitude of change was calculated by comparing FIA data to original bearing trees. For example, a -2.0 in this column represents a 2-fold decline of that tree species since the original public land survey was conducted, while 4.5 would represent a 4.5-fold increase.

Methodology

Relative abundance of BT trees is the percent by tree species identified as BTs in the original land survey records in the subsection. Any general BT trees were apportioned based on known species proportions within the subsection then assigned to a specific species. FIA data were modified to mimic the establishment of a survey corner by recording only one tree in each quadrant of the FIA sampling point

similar to the selection of BT trees in the past. The relative abundance of FIA tree species is based on this estimate. Relative abundance data have been produced at subsection and the LTA (land type association) levels. This assessment includes only the subsection data. The LTA level data can provide land managers more detailed information on where in the larger subsection the composition changes are greater. LTA data can be used to assist in determining where it would be appropriate to attempt restoration of a species, if that is desired, within a subsection.

Summary of Table 3.4

Subsection-level data for the Hardwood Hills should be interpreted with the understanding the data applies only to extant forests. Based on the available data, important species showing a significant increase were ash, basswood, and elm. Bur oak, sugar maple, and tamarack were the only important tree species showing a significant decline. *Note: Where a species is rare in the BT data, the data may not be as reliable.*

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CHAPTER 4

Timber Harvest

Hardwood Hills Subsection

How graphics are labeled:

All charts and tables apply to activities on DNR Division of Forestry and Division of Fish and Wildlife lands ("*DNR lands"*) in the Hardwood Hills Subsection.

Notes relating to this chapter:
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www.dnr.state.mn.us/forestry/subsection/hardwoodhills/index.html.

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Introduction:

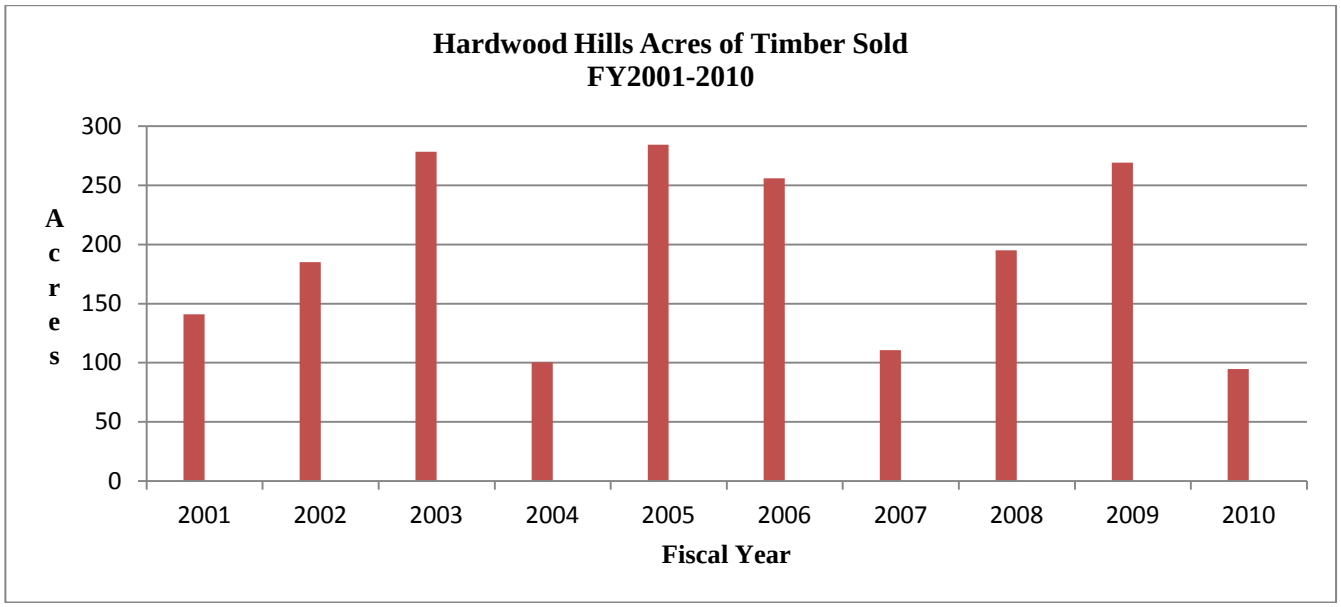
Volume and acres of timber sold is sporadic for the HH Subsection for FY2001-2010. Timber management decisions in the past decade were largely driven by Timber Management Planning Information System (TMPIS) plans until roughly 2003. After that period timber management planning was done via interim plans on an annual basis. During this period of interim planning timber management was more specifically targeted towards wildlife habitat manipulation. Broad forest management goals such as age class distribution and cover type composition were not specifically stated or pursued. In most cases fewer acres were planned annually on interim plans than were planned on TMPIS plans. It is likely that adoption of a subsection plan will result in an increase in the number of acres planned for evaluation annually.

Parcel size, stand size, and predominant cover types have played significant roles in the amount of forest management occurring in the Hardwood Hills subsection. Most of the subsection is located a great distance from the traditional markets of Bemidji, Cloquet Grand Rapids, Sartell and southeastern Minnesota sawmills. The stand size and distance not only have a negative impact on stumpage value but often push offered volume beyond the margin of profitability. It is common for offered volume of northern hardwoods to go un-purchased. In addition, a high percentage of the acres examined annually do not contain volume of sufficient quantity or quality to make commercial harvest feasible. Although there are quite a few local low volume sawmills, their raw material needs are easily met by non state land ownerships. New market opportunities that have expanded tree utilization in the last decade include biomass utilization at the Fibro Minn. plant in Benson and furniture production in an expanding Amish community.

4.1 Acres of Timber Sold on DNR Lands in the Subsection

The annual harvest on DNR lands is allocated and tracked in acres. One reason for differences in the yearly harvest level is the variation in timber markets and the resulting amount sold each fiscal year (i.e. July 1–June 30).

Chart 4.1: Acres of Timber Sold, FY 2001-2010



Source: Timber Sales Historical Records database, Minnesota DNR, St. Paul.

An average of 191.4 acres per year was sold from DNR lands in the Hardwood Hills Subsection during 2001 – 2010.

Table 4.1: Acres of Timber Sold, FY 2001-2010

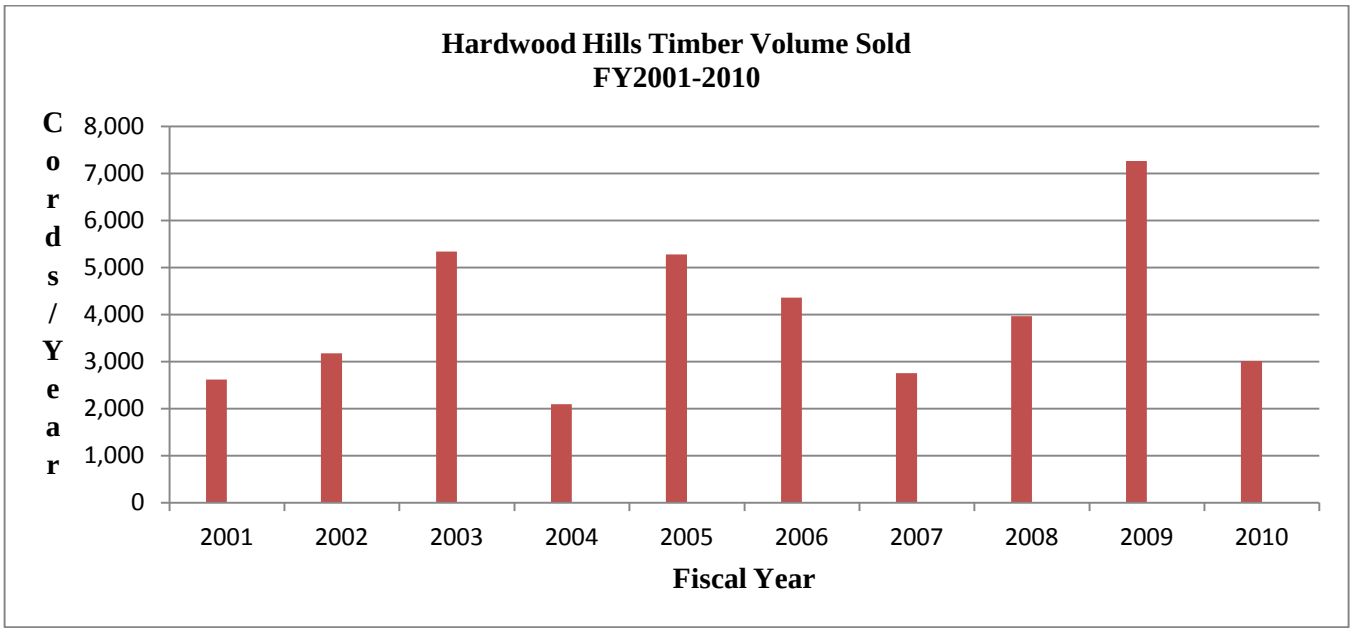
Hardwood Hills Acres of Timber Sold FY 2001-2010	
Year	**Acres**
2001	141
2002	185
2006	278
2004	100
2005	284
2006	256
2007	111
2008	195
2009	269
2010	95

Source: Timber Sales Historical Records database, Minnesota DNR, St. Paul.

4.2 Volume of Timber Sold From DNR Lands in the Subsection

The annual harvest on DNR lands is allocated and tracked in acres. The following chart shows the total ***volume*** sold per year in cords for the subsection.

Chart 4.2: Timber Volume Sold by Fiscal Year, 2001-2010



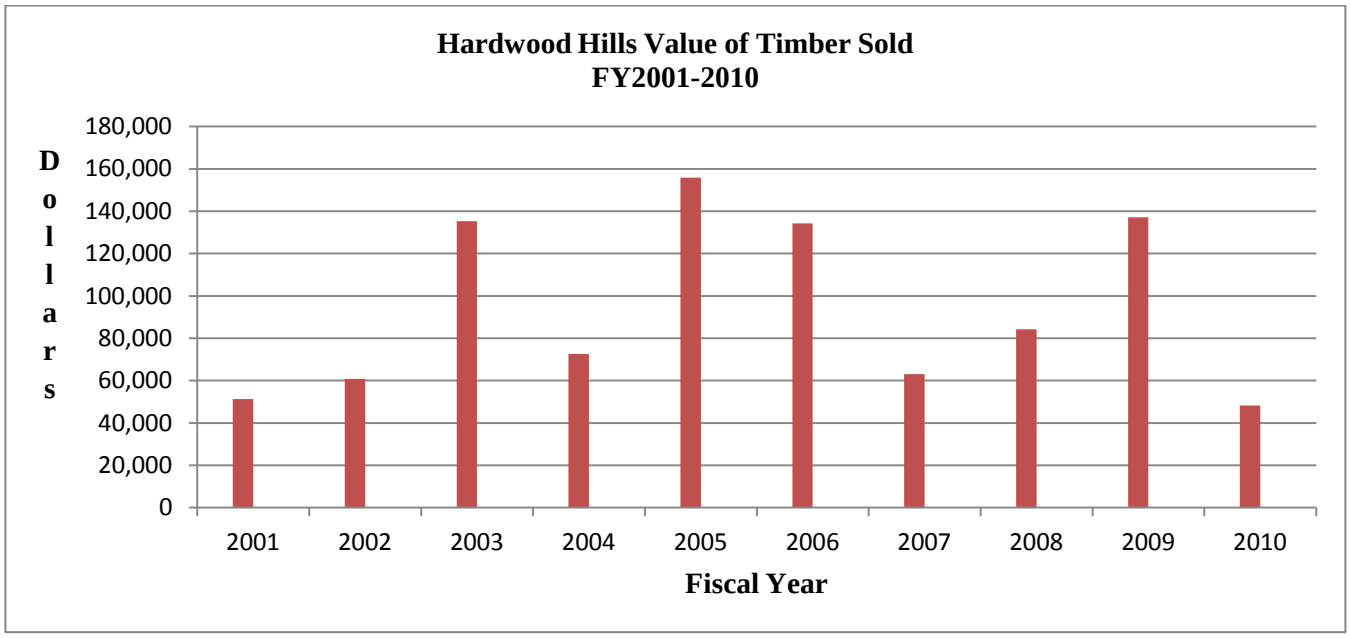
Source: Timber Sales Historical Records database, Minnesota DNR, St. Paul.

It must be noted that in FY 2005 & 2006, a total of 2,687 cords were forfeited by buyers and returned to the state. Forfeited volume numbers are included in the bar graph above.

4.3 Total Value of Timber Sold From DNR Lands Per Fiscal Year in the Subsection

The following chart shows the ***value*** of timber sold from DNR lands in the subsection during the past 10 fiscal years.

Chart 4.3: Value of Timber Sold by Fiscal year, 2001-2010

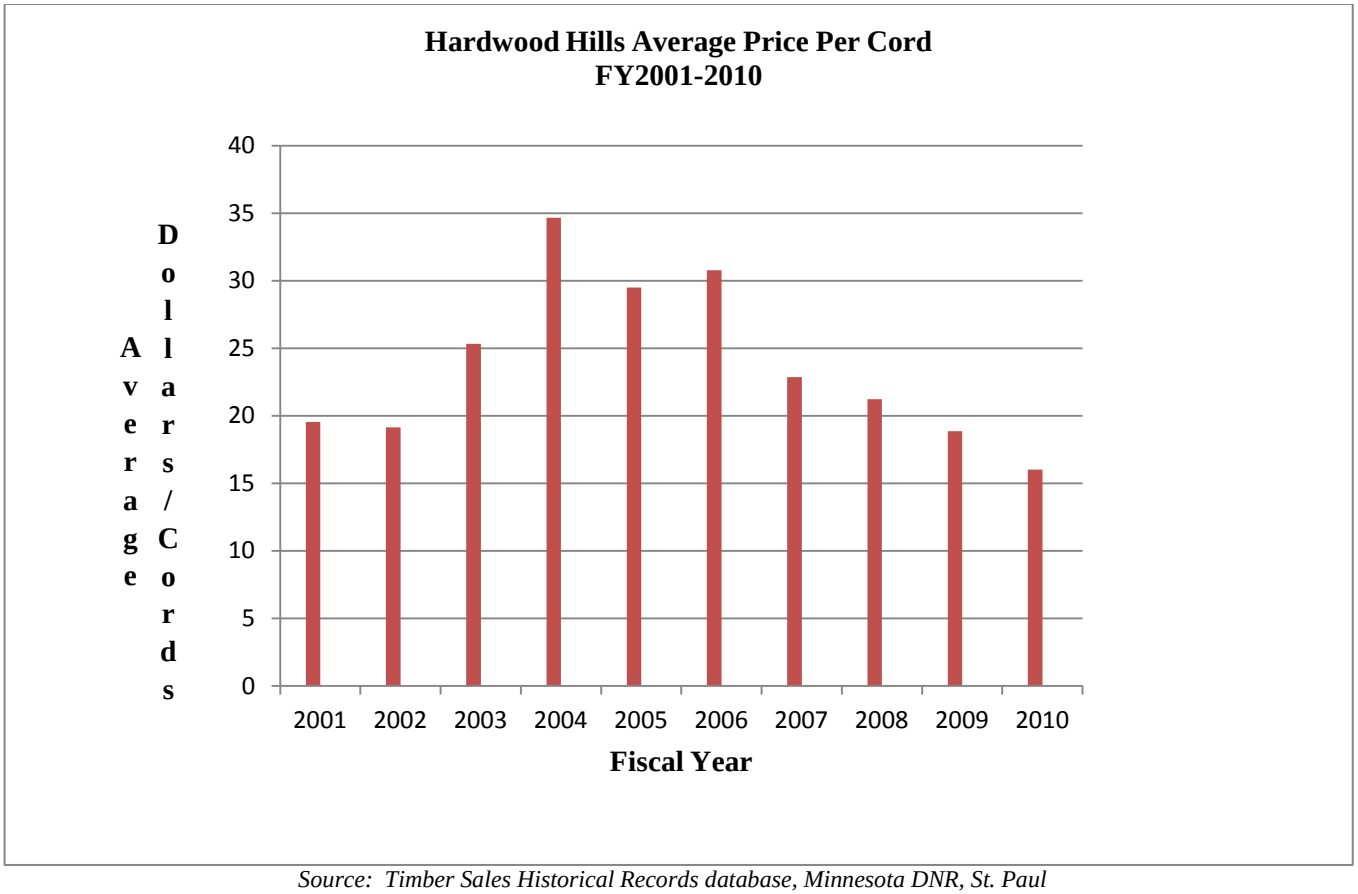


Source: Timber Sales Historical Records database, Minnesota DNR, St. Paul.

4.4 Average Stumpage Price Paid Per Cord for Timber From DNR Lands in the Subsection

The following chart shows how the **stumpage value** of timber sold from DNR lands in the subsection has changed from *2001-2010*.

Chart 4.4: Average Price Paid Per Cord for Timber Sold by Fiscal Year

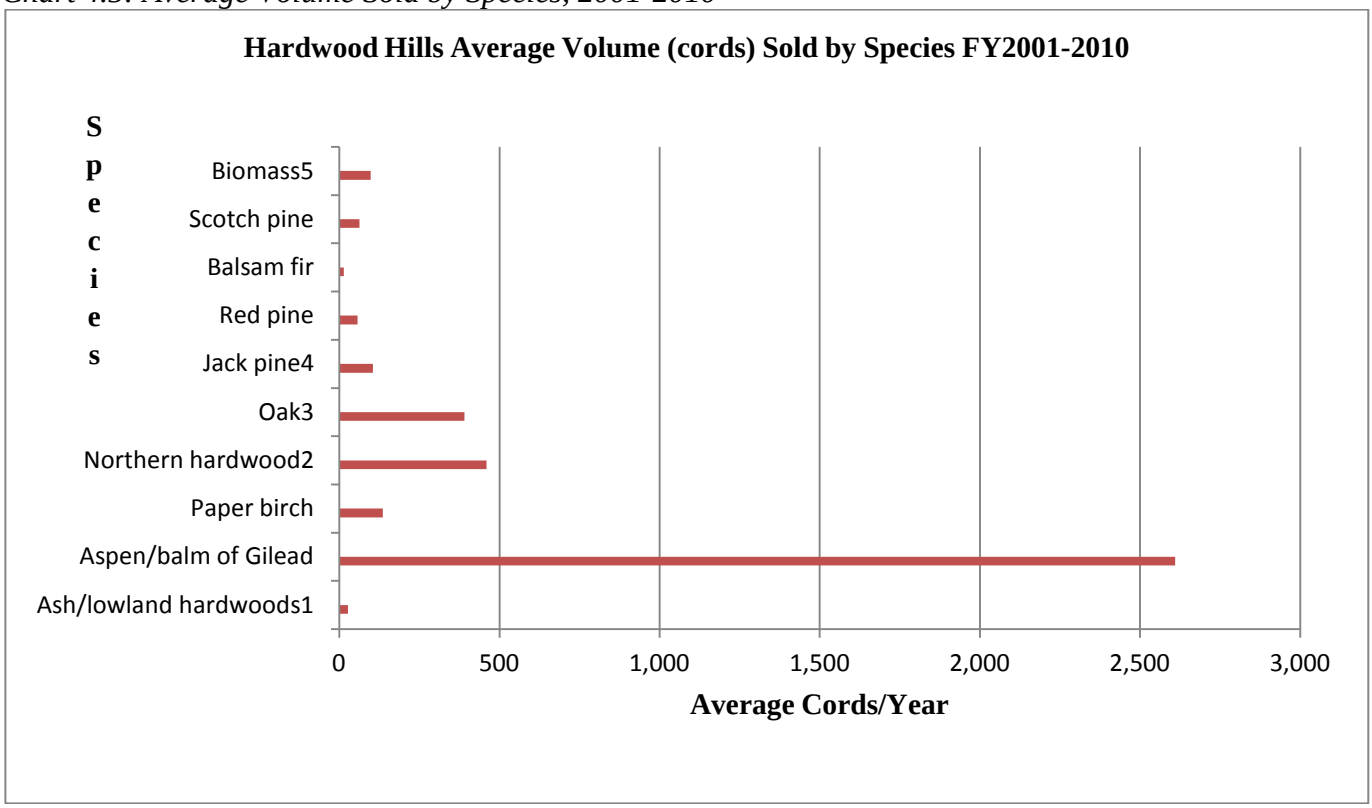


Source: Timber Sales Historical Records database, Minnesota DNR, St. Paul

4.5 Average Volume Sold Per Fiscal Year by Species From DNR Lands in the Subsection

Forest cover types normally consist of a variety of species, while the name of the cover type is based on the predominant species. The DNR bases harvest levels on cover type ***acres***, but timber is sold by tree ***species volume and value***. The following chart shows volumes sold by species

Chart 4.5: Average Volume Sold by Species, 2001-2010



Source: Timber Sales Historical Records database, Minnesota DNR, St. Paul
1 The ash/lowland hardwood cover type includes silver maple.
2 The northern hardwoods cover type includes sugar maple, basswood and mixed oak species.
3 The oak cover type contains red, bur and pin oak species.
4 The jack pine cover type includes 3 cords per year of mixed pine species.
5 Biomass is a combination of tops and other slash from mixed species.

During the period of 2001-2010, an average of 3,959 cords was sold per year from DNR timberlands in the subsection. The aspen volume includes volumes sold as aspen species, which includes both aspen species and balm of Gilead.

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CHAPTER 5

Ecological Information

Hardwood Hills Subsection

Notes relating to this chapter:

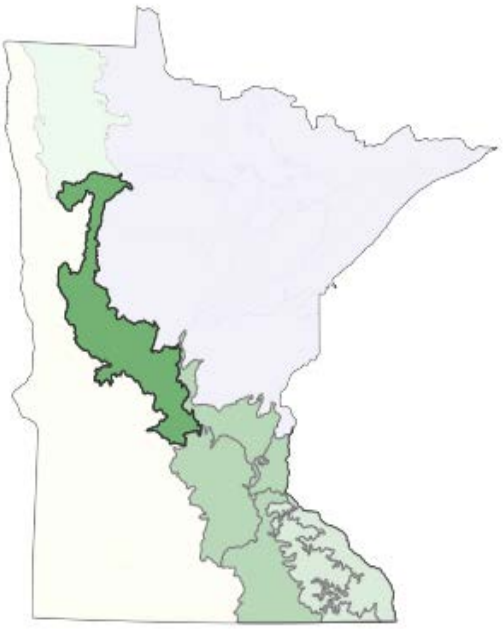
Color maps and graphs may be viewed as PDF files on the Hardwood Hills Subsection Forest Resource Management Plan (SFRMP) Web site at:
www.dnr.state.mn.us/forestry/subsection/hardwoodhills/index.html

Maps in this chapter depict information for an area within a "planning boundary." This boundary is designed to closely approximate the subsection while capturing data summary and planning efficiencies by using survey or jurisdiction lines in some cases.

Printed documents will be available for review at the Minnesota DNR Northwest Region Headquarters at 2115 Birchmont Beach Road N.E., Bemidji, Minnesota,56601 and on CD by request to Pat Matuseski at (218) 308-2381 or pat.matuseski@state.mn.us.

5.1 Summary Description of the Hardwood Hills Subsection

Map 5.1: Hardwood Hills Subsection



The Hardwood Hills Subsection, located in west central Minnesota, is a long band of deciduous forest, woodland, and prairie that stretches from Polk County in Northwestern Minnesota to Stearns County in Central Minnesota. The subsection is located at the northern end of a much larger province (Minnesota and Northeast Iowa Morainal Province) that stretches south into Iowa and serves as the transition zone between the prairie and forest areas. A majority of the subsection consists of rugged to hummocky moraines deposited along the eastern margin of the Des Moines ice lobe during the last glaciation.

The Alexandria Moraine Complex forms the western and southern boundary of this subsection. The eastern boundary was delineated based on general landform boundaries and the separation of lands dominated in the past by northern hardwoods from lands dominated by conifer or aspen-birch forest. Steep slopes, high hills and lakes formed in glacial end moraines and outwash plains characterize this subsection.

Landform

Ice stagnation moraines, end moraines, ground moraines, and outwash plains are major landforms present in this subsection. Kettle lakes are numerous, both on moraine and outwash deposits (Albert 1993). Parent material is primarily calcareous glacial till and outwash sediments. The glacial till is calcareous loamy sediment deposited by the last major glaciation (Wisconsin age).

Bedrock Geology

There are 100 to 500 feet of glacial drift covering most of the bedrock in this subsection. The thickest drift is in the northwestern half (Olsen and Mossler 1982). Middle Precambrian granitic bedrock is locally exposed in the southeast, along the Crow River (Morey 1976, 1981). Bedrock underlying the subsection is diverse. Cretaceous shale, sandstone, and clay and Lower Precambrian granite, meta-sedimentary and meta-igneous gneiss, schist, and migmatite underlie the southern half (Morey 1976). To the north are meta-sedimentary rocks, iron formation, enschist, and meta-volcanic rocks (Albert 1993).

Soils

Soil textures range from loamy sands and sandy loams on outwash plains to loams and clay loams on moraines. Loamy soils are prevalent. Most are classified as Borolls (cold well drained soils developed under grassland) and Aquolls (wet soils developed under grassland), with some Udolls (dry soils developed under grassland, with soil temperatures warmer than Borolls). There are some Alfisols (soils developed under forested or savanna conditions) (Cummins and Grigal 1981).

Climate

Total annual precipitation ranges from 24 inches in the west to 27 inches in the east. Growing season precipitation ranges from 10.5 to 11.5 inches. The growing season ranges from approximately 122 days in the north to 140 days in the south.

Hydrology

The Alexandria Moraine forms a high ridge that is the headwaters region of many rivers and streams flowing east and west. The drainage network is young and undeveloped throughout this subsection. Major rivers include the Chippewa, the Long Prairie, the Sauk, and the Crow Wing rivers. The Mississippi River forms a portion of the east boundary. The Continental Divide splits this subsection. North of the divide, water eventually flows into Hudson Bay. South of the divide, water flows into the Mississippi River system. The subsection has numerous lakes, with over 400 lakes greater than 160 acres in size. The majority of these are present on end moraines and pitted outwash plains.

Natural Disturbance

Fire was important in oak savanna development. Windthrow was common in the sugar maple-basswood forests. Tornados and other high wind events also created natural disturbances (Albert 1993).

Presettlement Vegetation

Irregular topography and presence of numerous lakes and wetlands provided a partial barrier to fire, resulting in woodland or forest rather than prairie vegetation. A mosaic of tallgrass prairie, aspen-oak land, and oak openings or savanna was present along the prairie boundary to the west (Marschner 1974). Mixed forests of oaks, sugar maple, basswood, and other hardwoods were present in fire protected sites farther east. Tallgrass prairie grew on more level terrain within the subsection.

Present Land Use and Vegetation

Agriculture is the major land use. Wetlands and lakes in poorly-drained potholes provide opportunities for recreation or wildlife habitat. Some upland forests remain, adjacent to lakes or on steep landscapes. Tourism is important, especially in areas around lakes.

5.2 Native Plant Communities of the Hardwood Hills Subsection

Minnesota's Native Plant Community Classification

The volume, *Field Guide to the Native Plant Communities of Minnesota: The Eastern Broadleaf Forest Province*, was published in 2005 and includes the Hardwood Hills Subsection addressed in this plan. The field keys to Minnesota's plant communities contained within this field guide are being used with other Ecological Classification System (ECS) and native plant community (NPC) information to assist in making land management decisions.

Classification of Plant Communities

The delineation of plant communities in this classification is based on statistical analyses of vegetation

plots collected from relatively undisturbed examples of native vegetation throughout the state. The relevé plot method was primarily used and more than 7,500 relevés were analyzed to develop this classification. The data from this sampling effort are housed in the MN DNR's Natural Heritage Information System Relevé Database. Attempts were made in the classification to recognize natural breaks or important thresholds along physical environmental gradients. Relevé data were supplemented by scientific literature, and field observations from plant ecologists and botanists, especially for those communities that were not well sampled with relevés, plus with the more generalized information from county soil surveys and geologic maps.

Analyses of the vegetation plot data were organized within the framework of ecologically defined land units (see Ecological Classification System map of Minnesota in Appendix A). The result is a classification of plant communities that relates more deliberately to variation in physical features of the landscape than previous classifications and has an ecologically based hierarchy. The hierarchy of Minnesota's plant community classification is:

Ecological System such as Fire-Dependent Forest/Woodland System
Floristic Region such as Southern Floristic Region
Native Plant Community Class such as Dry-Mesic Oak (Maple) Woodland
Native Plant Community Type such as Oak – (Red Maple) Woodland (sometimes with subtypes)

Native plant community classifications differ from forest cover types (such as those used in cooperative stand assessment forest inventory) in that they are based on all vascular plant species, not just the dominant canopy tree species.

Following is a list of the wooded native plant community systems, classes, types and subtypes known to occur in the Hardwood Hills (HH) Subsection (Table 5.1). Both the codes and their associated names are provided. Much more detailed information about each plant community in this subsection, including distribution maps, can be found in *Field Guide to the Native Plant Communities of Minnesota: Eastern Broadleaf Forest province.* The field guide is available through the Minnesota Bookstore at http://www.comm.media.state.mn.us/bookstore.

Table 5.1: Wooded Native Plant Community Systems, Classes, Types and Subtypes Documented in the Hardwood Hills Subsection with their Associated Rarity Rank.

Wooded Native Plant Communities found in the Hardwood Hills				
Native Plant Community System	**Floristic Region**	**Community Code**	**Community Name**	**State Rank**
Acid Peatland System	Northern	APn81	Northern Poor Conifer Swamp	NR
Acid Peatland System	Northern	APn81b	Poor Tamarack - Black Spruce Swamp	S4
Acid Peatland System	Northern	APn81b2	Poor Tamarack - Black Spruce Swamp: Tamarack Subtype	S4
Acid Peatland System	Northern	APn91	Northern Poor Fen	NR
Acid Peatland System	Northern	APn91a	Low Shrub Poor Fen	S5
Acid Peatland System	Northern	APn91b	Graminoid Poor Fen (Basin)	S3
Fire-Dependant Forest/Woodland System	Central	FDc23	Central Dry Pine Woodland	NR
Fire-Dependant Forest/Woodland System	Central	FDc23a2	Jack Pine - (Yarrow) Woodland: Bur Oak - Aspen Subtype	S1-S2
Fire-Dependant Forest/Woodland System	Central	FDc24	Central Rich Dry Pine Woodland	NR
Fire-Dependant Forest/Woodland System	Central	FDc34a	Red Pine - White Pine Forest	S2
Fire-Dependant Forest/Woodland System	Central	FDc34b	Oak - Aspen Forest	S3
Fire-Dependant Forest/Woodland System	Southern	FDs36a	Bur Oak - Aspen Forest	S3-S4
Fire-Dependant Forest/Woodland System	Southern	FDs37	Southern Dry-Mesic Oak (Maple) Woodland	NR
Fire-Dependant Forest/Woodland System	Southern	FDs37a	Oak - (Red Maple) Woodland	S4
Fire-Dependant Forest/Woodland System	Southern	FDs37b	Pin Oak - Bur Oak Woodland	S3
Fire-Dependant Forest/Woodland System	Western	FDw44	Northwestern Wet-Mesic Aspen Woodland	NR
Floodplain Forest System	Northern	FFn57a	Black Ash - Silver Maple Terrace Forest	S3
Floodplain Forest System	Southern	FFs59a	Silver Maple - Green Ash - Cottonwood Terrace Forest	S3
Floodplain Forest System	Southern	FFs59c	Elm - Ash - Basswood Terrace Forest	S2
Floodplain Forest System	Southern	FFs68a	Silver Maple - (Virginia Creeper) Floodplain Forest	S3
Forested Rich Peatland System	Northern	FPn73a	Alder - (Maple - Loosestrife) Swamp	S5
Forested Rich Peatland System	Northern	FPn82	Northern Rich Tamarack Swamp	NR

			(Western Basin)	
Forested Rich Peatland System	Northern	FPn82a	Rich Tamarack - (Alder) Swamp	S5
Forested Rich Peatland System	Northern	FPn82b	Extremely Rich Tamarack Swamp	S4
Forested Rich Peatland System	Southern	FPs63a	Tamarack Swamp (Southern)	S2-S3
Mesic Hardwood Forest System	Central	MHc26	Central Dry-Mesic Oak-Aspen Forest	NR
Mesic Hardwood Forest System	Central	MHc26a	Oak - Aspen - Red Maple Forest	S4
Mesic Hardwood Forest System	Central	MHc36	Central Mesic Hardwood Forest (Eastern)	NR
Mesic Hardwood Forest System	Central	MHc36a	Red Oak - Basswood Forest (Noncalcareous Till)	S4
Mesic Hardwood Forest System	Central	MHc36b	Red Oak - Basswood Forest (Calcareous Till)	S4
Mesic Hardwood Forest System	Central	MHc37	Central Mesic Hardwood Forest (Western)	NR
Mesic Hardwood Forest System	Central	MHc37a	Aspen - (Sugar Maple - Basswood) Forest	S4
Mesic Hardwood Forest System	Central	MHc37b	Sugar Maple - Basswood - (Aspen) Forest	S4
Mesic Hardwood Forest System	Central	MHc47a	Basswood - Black Ash Forest	S3
Mesic Hardwood Forest System	Northern	MHn35	Northern Mesic Hardwood Forest	NR
Mesic Hardwood Forest System	Northern	MHn35a	Aspen - Birch - Basswood Forest	S4
Mesic Hardwood Forest System	Northern	MHn35b	Red Oak - Sugar Maple - Basswood - (Bluebead Lily) Forest	S4
Mesic Hardwood Forest System	Northern	MHn44	Northern Wet-Mesic Boreal Hardwood-Conifer Forest	NR
Mesic Hardwood Forest System	Northern	MHn44d	Aspen - Birch - Fir Forest	S3
Mesic Hardwood Forest System	Northern	MHn46	Northern Wet-Mesic Hardwood Forest	NR
Mesic Hardwood Forest System	Northern	MHn46a	Aspen - Ash Forest	S4
Mesic Hardwood Forest System	Southern	MHs37b	Red Oak - White Oak - (Sugar Maple) Forest	S4
Mesic Hardwood Forest System	Southern	MHs38b	Basswood - Bur Oak - (Green Ash) Forest	S3
Mesic Hardwood Forest System	Southern	MHs38c	Red Oak - Sugar Maple - Basswood - (Bitternut Hickory) Forest	S3
Mesic Hardwood Forest System	Southern	MHs39	Southern Mesic Maple-Basswood Forest	NR
Mesic Hardwood Forest System	Southern	MHs39b	Sugar Maple - Basswood - Red Oak -	S3

			(Blue Beech) Forest	
Mesic Hardwood Forest System	Southern	MHs39c	Sugar Maple Forest (Big Woods)	S2
Mesic Hardwood Forest System	Southern	MHs49a	Elm - Basswood - Black Ash - (Hackberry) Forest	S3
Wet Forest System	Northern	WFn53b	Lowland White Cedar Forest (Northern)	S3
Wet Forest System	Northern	WFn55	Northern Wet Ash Swamp	NR
Wet Forest System	Northern	WFn55b	Black Ash - Yellow Birch - Red Maple - Basswood Swamp (Eastcentral)	S3
Wet Forest System	Northern	WFn64	Northern Very Wet Ash Swamp	NR
Wet Forest System	Northern	WFn64a	Black Ash - Conifer Swamp (Northeastern)	S4
Wet Forest System	Northern	WFn64c	Black Ash - Alder Swamp (Northern)	S4
Wet Forest System	Northern	WFn74	Northern Wet Alder Swamp	NR
Wet Forest System	Southern	WFs55a	Lowland Aspen Forest	S4
Wet Forest System	Southern	WFs57a	Black Ash - (Red Maple) Seepage Swamp	S1-S2

S-ranks, Native Plant Community Heritage Conservation Status Ranks for Minnesota:	
S1	Critically imperiled
S2	Imperiled
S3	Rare or uncommon
S4	Widespread, abundant, and apparently secure but with cause for long-term concern
S5	Demonstrably widespead, abundant, and secure
NR	Not Ranked

These plant communities are ranked per an assessment of their vulnerability. The ranks are based upon input from Mn DNR ecologists using eleven rank criteria: number of occurrences, number of occurrences with good viability or integrity, number of protected occurrences, range extent, area of occupancy, long-term trends, short-term trends, threats (severity, scope, and immediacy), number of protected and managed occurrences, intrinsic vulnerability, and environmental specificity. Thus the rank draws attention to the communities that are at greatest risk. By alerting resource managers and the public to communities in jeopardy, activities can be reviewed and prioritized to help preserve the diversity and abundance of Minnesota's natural heritage

5.3 Minnesota's List of Endangered, Threatened, and Special Concern Species

Rare Features Information

Assessment products have been prepared by staff of the Division of Ecological and Water Resources, Natural Heritage and Nongame Research Program (NHNRP), Minnesota Department of Natural Resources (DNR).

Additional information about rare features assessment products is available by contacting the Minnesota DNR.

Purpose, Scope, and Relationships to Federal Laws

Minnesota's Endangered Species Statute (Minnesota Statutes, Section 84.0895) requires the Minnesota DNR to adopt rules designating species meeting the statutory definitions of endangered, threatened, or species of special concern (ETS). The resulting List of Endangered, Threatened, and Special Concern Species (http://www.state.mn.us/rsg/index.html) is codified as Minnesota Rules, Chapter 6134. The Endangered Species Statute also authorizes the DNR to adopt rules that regulate treatment of species designated as endangered and threatened. These regulations are codified as Minnesota Rules, Parts 6212.1800 to 6212.2300.

Minnesota's Endangered Species Statute and the associated rules impose a variety of restrictions, a permit program, and several exemptions pertaining to species designated as endangered or threatened. A person may not take, import, transport, or sell any portion of an endangered or threatened species. However, these acts 1) may be allowed by a permit issued by the DNR, 2) exempt plants on certain agricultural lands and plants destroyed in consequence of certain agricultural practices, and 3) exempt the accidental, unknowing destruction of designated plants. Minnesota's Endangered Species Statute or the associated rules do not protect species of special concern. Persons are advised to read the full text ndardof the statute and rules in order to understand all regulations pertaining to species that are designated as endangered, threatened, or species of special concern.

Note that the federal Endangered Species Act of 1973, as amended (16 USC 1531 _ 1544; see http://www.fws.gov/endangered/policies/index.html) requires the U.S. Department of the Interior to identify species as endangered or threatened according to a separate set of definitions, and imposes a separate set of restrictions for those species. Only one species on the federal list of endangered or threatened species occurs in the Hardwood Hills subsection, Buelia nigra (a species of lichen). See: http://www.fws.gov/midwest/endangered/lists/minnesot-spp.html.

Minnesota Heritage Information System

Records of known locations of listed species are maintained in the Minnesota Heritage Information System. All DNR offices have this information available for review prior to forest management activities to determine if a known location of a rare species is in the vicinity of a stand. When reviewing forest stands for management activities during the planning process, this information will be available when assigning stand prescriptions. If an ETS species is known to exist or found on a site, management activities are modified to protect, promote, or enhance the ETS species on the site.

Survey Methods

Much of the information about rare features in the Minnesota Heritage Information System is the result of rare features survey work done since the 1970s. While survey processes and protocols for plants and animals are necessarily different in some ways, methods common to both include:

- Review of existing information;
- Selection of targeted species and survey sites;
- Field survey using techniques appropriate to the species; And,
- Information management.

A more detailed description of rare plant and animal survey procedures can be found in the MCBS page of the Minnesota DNR Web site at http://www.dnr.state.mn.us/eco/mcbs/index.html

Minnesota Listed Species

Copyright (2009), State of Minnesota, Department of Natural Resources. Rare features data included here were provided by the Natural Heritage and Nongame Research Program of the Division of Ecological and Water Resources, Minnesota Department of Natural Resources (DNR), and were current as of May 2011. These data are not based on an exhaustive inventory of the state. The lack of data for any geographic area shall not be construed to mean that no significant features are present. In addition, there may be inaccuracies in the data, of which the DNR is not aware and shall not be held responsible for. Permission to use these data does not imply endorsement or approval by the DNR of any interpretations or products derived from the data.

The rare feature products prepared for the Hardwood Hills subsection plan include information on species of plants and animals listed as endangered, threatened, and special concern (ETS). *Minnesota's List of Endangered, Threatened, and Special Concern Species* was created in 1984 and was last revised in 1996. The list, created under Minnesota's Endangered and Threatened Species Statute, draws attention to species that are at greatest risk of extinction within the state and applies special regulations to species listed as endangered or threatened. By alerting resource managers and the public to species in jeopardy, activities can be reviewed and prioritized to help preserve the diversity and abundance of Minnesota's flora and fauna. Because the list influences resource use and management activities in Minnesota, it is critical that it reflect the most current information regarding the distribution, abundance, and security of species within the state. Consequently, Minnesota law requires periodic revisions to the list. The DNR submitted a set of proposed revisions to *Minnesota's List of Endangered, Threatened, and Special Concern Species* to the 2006-07 Minnesota Legislature that await legislative action at the time of this report. The proposed revisions are not reflected in the following tables. To understand the tables it is useful to understand what the state ranking of endangered, threatened, and special concern mean.

END – Endangered. A species is considered **endangered** if the species is threatened with extinction throughout all or a significant portion of its range within Minnesota.
THR – Threatened. A species is considered **threatened** if the species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range within Minnesota.
SPC – Special Concern. A species is considered a species of **special concern** if, although the species is not endangered or threatened, it is extremely uncommon in Minnesota or has unique or highly specific habitat requirements and deserves careful monitoring of its status. Species on the periphery of their range not listed as threatened may be included in this category, along with those

species that were once threatened or endangered but now have increasing or protected, stable populations.

Table 5.2: Minnesota Listed Species – Animals

Listed Animals found in the Hardwood Hills						
Taxa	**Latin Name**	**Common Name**	**State Rank**	**Federal Rank**	**S_RANK**	**G_RANK**
Bird	Ammodramus henslowii	Henslow's Sparrow	END	NL	S1	G4
Bird	Calcarius ornatus	Chestnut-collared Longspur	END	NL	S1	G5
Insect	Cicindela limbata nympha	Sandy Tiger Beetle	END	NL	S1	G5
Insect	Hesperia leonardus pawnee	Pawnee Skipper	SPC	NL	S3	G4
Bird	Ammodramus nelsoni	Nelson's Sharp-tailed Sparrow	SPC	NL	S3	G5
Bird	Buteo lineatus	Red-shouldered Hawk	SPC	NL	S3	G5
Bird	Coturnicops noveboracensis	Yellow Rail	SPC	NL	S3	G4
Bird	Dendroica cerulea	Cerulean Warbler	SPC	NL	S3	G4
Bird	Haliaeetus leucocephalus	Bald Eagle	SPC	NL	S3	G5
Bird	Larus pipixcan	Franklin's Gull	SPC	NL	S3	G4-G5
Bird	Limosa fedoa	Marbled Godwit	SPC	NL	S3	G5
Bird	Sterna forsteri	Forster's Tern	SPC	NL	S3	G5
Bird	Tympanuchus cupido	Greater Prairie-chicken	SPC	NL	S3	G4
Bird	Wilsonia citrina	Hooded Warbler	SPC	NL	S3	G5
Fish	Acipenser fulvescens	Lake Sturgeon	SPC	NL	S3	G3-G4
Fish	Etheostoma microperca	Least Darter	SPC	NL	S3	G5
Fish	Notropis anogenus	Pugnose Shiner	SPC	NL	S3	G3
Insect	Cicindela patruela patruela	Northern Barrens Tiger Beetle	SPC	NL	S3	G3
Insect	Oxyethira ecornuta	A Caddisfly	SPC	NL	S3	G5
Insect	Oxyethira	A Caddisfly	SPC	NL	S3	G3

	itascae					
Insect	Speyeria idalia	Regal Fritillary	SPC	NL	S3	G3
Mammal	Microtus ochrogaster	Prairie Vole	SPC	NL	S3	G5
Mammal	Mustela nivalis	Least Weasel	SPC	NL	S3	G5
Mammal	Perognathus flavescens	Plains Pocket Mouse	SPC	NL	S3	G5
Mollusk	Lasmigona compressa	Creek Heelsplitter	SPC	NL	S3	G5
Mollusk	Lasmigona costata	Fluted-shell	SPC	NL	S3	G5
Mollusk	Ligumia recta	Black Sandshell	SPC	NL	S3	G5
Spider	Paradamoetas fontana	A Jumping Spider	SPC	NL	S3	GNR
Bird	Cygnus buccinator	Trumpeter Swan	THR	NL	S2	G4
Bird	Lanius ludovicianus	Loggerhead Shrike	THR	NL	S2	G4
Bird	Phalaropus tricolor	Wilson's Phalarope	THR	NL	S2	G5
Bird	Sterna hirundo	Common Tern	THR	NL	S2	G5
Insect	Cicindela lepida	Little White Tiger Beetle	THR	NL	S2	G3-G4
Mollusk	Actinonaias ligamentina	Mucket	THR	NL	S2	G5
Reptile	Emydoidea blandingii	Blanding's Turtle	THR	NL	S2	G4

Rank Key:	
CAND	Candidate
END	Endangered
SPC	Special Concern
THR	Threatened
NL	Not Listed
GNR	Globally Non-Ranked

Table 5.3: Minnesota Listed Species – Plants

Listed Plants in the Hardwood Hills						
Plant Type	**Latin Name**	**Common Name**	**State Rank**	**Federal Rank**	**S_RANK**	**G_RANK**
Vascular Plant	Botrychium pallidum	Pale Moonwort	END	NL	S1	G3
Vascular	Carex formosa	Handsome	END	NL	S1	G4

Plant		Sedge				
Vascular Plant	Oryzopsis hymenoides	Indian Ricegrass	END	NL	S1	G5
Vascular Plant	Platanthera flava var. herbiola	Tubercled Rein-orchid	END	NL	S1	G4
Vascular Plant	Senecio canus	Gray Ragwort	END	NL	S1	G5
Fungus	Buellia nigra	A Species of Lichen	END	NL	S1	G1-G2
Vascular Plant	Aristida purpurea var. longiseta	Red Three-awn	SPC	NL	S3	G5
Vascular Plant	Botrychium campestre	Prairie Moonwort	SPC	NL	S3	G3-G4
Vascular Plant	Botrychium mormo	Goblin Fern	SPC	NL	S3	G3
Vascular Plant	Botrychium simplex	Least Moonwort	SPC	NL	S3	G5
Vascular Plant	Carex obtusata	Blunt Sedge	SPC	NL	S3	G5
Vascular Plant	Carex woodii	Wood's Sedge	SPC	NL	S3	G4
Vascular Plant	Chamaesyce missurica	Missouri Spurge	SPC	NL	S3	G5
Vascular Plant	Cirsium hillii	Hill's Thistle	SPC	NL	S3	G3
Vascular Plant	Cladium mariscoides	Twig-rush	SPC	NL	S3	G5
Vascular Plant	Cypripedium candidum	Small White Lady's-slipper	SPC	NL	S3	G4
Vascular Plant	Drosera anglica	English Sundew	SPC	NL	S3	G5
Vascular Plant	Eleocharis quinqueflora	Few-flowered Spike-rush	SPC	NL	S3	G5
Vascular Plant	Gaillardia aristata	Blanket-flower	SPC	NL	S3	G5
Vascular Plant	Helictotrichon hookeri	Oat-grass	SPC	NL	S3	G5
Vascular Plant	Juniperus horizontalis	Creeping Juniper	SPC	NL	S3	G5
Vascular Plant	Malaxis monophyllos var. brachypoda	White Adder's-mouth	SPC	NL	S3	G5
Vascular Plant	Minuartia dawsonensis	Rock Sandwort	SPC	NL	S3	G5
Vascular	Najas marina	Sea Naiad	SPC	NL	S3	G5

Plant						
Vascular Plant	Orobanche fasciculata	Clustered Broomrape	SPC	NL	S3	G4
Vascular Plant	Panax quinquefolius	American Ginseng	SPC	NL	S3	G3-G4
Vascular Plant	Potamogeton vaginatus	Sheathed Pondweed	SPC	NL	S3	G5
Vascular Plant	Potamogeton vaseyi	Vasey's Pondweed	SPC	NL	S3	G4
Vascular Plant	Ruppia maritima	Widgeon-grass	SPC	NL	S3	G5
Vascular Plant	Sanicula trifoliata	Beaked Snakeroot	SPC	NL	S3	G4
Vascular Plant	Stellaria longipes	Long-stalked Chickweed	SPC	NL	S3	G5
Vascular Plant	Trillium nivale	Snow Trillium	SPC	NL	S3	G4
Vascular Plant	Botrychium rugulosum	St. Lawrence Grapefern	THR	NL	S2	G3
Vascular Plant	Carex sterilis	Sterile Sedge	THR	NL	S2	G4
Vascular Plant	Cypripedium arietinum	Ram's-head Lady's-slipper	THR	NL	S2	G3
Vascular Plant	Eleocharis rostellata	Beaked Spike-rush	THR	NL	S2	G5
Vascular Plant	Poa paludigena	Bog Bluegrass	THR	NL	S2	G3
Vascular Plant	Rhynchospora capillacea	Hair-like Beak-rush	THR	NL	S2	G4
Vascular Plant	Shinnersoseris rostrata	Annual Skeletonweed	THR	NL	S2	G5

Rank Key:	
CAND	Candidate
END	Endangered
SPC	Special Concern
THR	Threatened
NL	Not Listed
GNR	Globally Non-Ranked

Additional Species Data

In addition to information on listed species, the Hardwood Hills Subsection plan includes information on species labeled as “NONs and Species of Greatest Conservation Need (SGCNs).”

"NONs" are defined as a plant or animal species with no legal status, but for which data are being compiled in the Natural Heritage Information System because the species falls into one of the following categories:

- The species is being considered for addition to the state list.
- The species was removed from the state list but records for the species are still entered and maintained as a precautionary measure.
- The species has been recently discovered in the state.
- The species is presumed extirpated from the state.

Table 5.4: Minnesota "NONs" – Animals

State Non-listed Animals in the Hardwood Hills		
Taxa	**Latin Name**	**Common Name**
Amphibian	Rana catesbeiana	Bullfrog
Bird	Accipiter gentilis	Northern Goshawk
Bird	Bartramia longicauda	Upland Sandpiper
Bird	Botaurus lentiginosus	American Bittern
Bird	Grus canadensis	Sandhill Crane
Reptile	Heterodon platirhinos	Eastern Hognose Snake

Table 5.5: Minnesota "NONs" – Plants

State Non-listed Plants in the Hardwood Hills		
Plant Type	**Latin Name**	**Common Name**
Vascular Plant	Alisma gramineum	Narrow-leaved Water Plantain
Vascular Plant	Artemisia campestris	Canadian Wormwood
Vascular Plant	Astragalus lotiflorus	Low Milk-vetch
Vascular Plant	Astragalus neglectus	Cooper's Milk-vetch
Vascular Plant	Botrychium matricariifolium	Matricary Grapefern
Vascular Plant	Carex bromoides	A species of Sedge
Vascular Plant	Carex capillaris	Hair-like Sedge
Vascular Plant	Chamaerhodos nuttallii	Nutall's Ground-rose
Vascular Plant	Rubus semisetosus	Half Bristly Bramble
Vascular Plant	Torreyochloa pallida var. fernaldii	Pale Manna Grass
Vascular Plant	Triglochin palustris	Marsh Arrow-grass
Vascular Plant	Utricularia gibba	Humped Bladderwort

Species of Greatest Conservation Need (SGCNs)

Species of greatest conservation need are animal species whose populations are rare, declining, or vulnerable to decline and are below levels desirable to ensure their long-term health and stability. There are 292 species in Minnesota that meet this definition, 85 of which reside in the Hardwood Hills Subsection. These SGCN include 28 species that are federal or state endangered, threatened, or of special concern.

Table 5.6: Hardwood Hills Subsection: Minnesota Species of Greatest Conservation Needs-Animals

Species of Greatest Conservation Need found in the Hardwood Hills		
Taxa	**Latin Name**	**Common Name**
Amphibian	Rana catesbeiana	Bullfrog
Bird	Ammodramus leconteii	Le Conte's Sparrow
Bird	Ammodramus savannarum	Grasshopper Sparrow
Bird	Cistothorus platensis	Sedge Wren
Bird	Dolichonyx oryzivorus	Bobolink
Bird	Gavia immer	Common Loon
Bird	Melospiza georgiana	Swamp Sparrow
Bird	Buteo lineatus	Red-shouldered Hawk
Bird	Contopus virens	Eastern Wood-Pewee
Bird	Empidonax minimus	Least Flycatcher
Bird	Sphyrapicus varius	Yellow-bellied Sapsucker
Bird	Catharus fuscescens	Veery
Bird	Coccyzus erythropthalmus	Black-billed Cuckoo
Bird	Dendroica cerulea	Cerulean Warbler
Bird	Seiurus aurocapilla	Ovenbird
Bird	Hylocichla mustelina	Wood Thrush
Bird	Vermivora chrysoptera	Golden-winged Warbler
Bird	Haliaeetus leucocephalus	Bald Eagle
Bird	Sterna forsteri	Forster's Tern
Bird	Troglodytes troglodytes	Winter Wren
Bird	Zonotrichia albicollis	White-throated Sparrow
Bird	Chlidonias niger	Black Tern
Bird	Cistothorus palustris	Marsh Wren
Bird	Pelecanus erythrorhynchos	American White Pelican
Bird	Coturnicops noveboracensis	Yellow Rail
Bird	Podiceps grisegena	Red-necked Grebe
Bird	Gallinula chloropus	Common Moorhen
Bird	Spizella pusilla	Field Sparrow
Bird	Pheucticus ludovicianus	Rose-breasted Grosbeak
Bird	Sturnella magna	Eastern Meadowlark
Bird	Toxostoma rufum	Brown Thrasher
Bird	Circus cyaneus	Northern Harrier
Bird	Larus pipixcan	Franklin's Gull
Bird	Cygnus buccinator	Trumpeter Swan
Bird	Sterna hirundo	Common Tern
Bird	Chordeiles minor	Common Nighthawk
Bird	Empidonax traillii	Willow Flycatcher
Bird	Grus canadensis	Sandhill Crane

Bird	Botaurus lentiginosus	American Bittern
Bird	Stelgidopteryx serripennis	Northern Rough-winged Swallow
Bird	Nycticorax nycticorax	Black-crowned Night-Heron
Bird	Rallus limicola	Virginia Rail
Bird	Podiceps nigricollis	Eared Grebe
Bird	Scolopax minor	American Woodcock
Bird	Ammodramus nelsoni	Nelson's Sharp-tailed Sparrow
Bird	Melanerpes erythrocephalus	Red-headed Woodpecker
Bird	Phalaropus tricolor	Wilson's Phalarope
Bird	Caprimulgus vociferus	Whip-poor-will
Bird	Ixobrychus exilis	Least Bittern
Bird	Tympanuchus cupido	Greater Prairie-Chicken
Bird	Bartramia longicauda	Upland Sandpiper
Bird	Calcarius ornatus	Chestnut-collared Longspur
Bird	Spiza americana	Dickcissel
Bird	Limosa fedoa	Marbled Godwit
Bird	Ammodramus henslowii	Henslow's Sparrow
Bird	Wilsonia citrina	Hooded Warbler
Bird	Accipiter gentilis	Northern Goshawk
Bird	Lanius ludovicianus	Loggerhead Shrike
Fish	Couesius plumbeus	Lake Chub
Fish	Cyprinella lutrensis	Red Shiner
Fish	Lythrurus umbratilis	Redfin Shiner
Fish	Moxostoma valenciennesi	Greater Redhorse
Fish	Etheostoma microperca	Least Darter
Fish	Notropis anogenus	Pugnose Shiner
Fish	Acipenser fulvescens	Lake Sturgeon
Insect	Speyeria idalia	Regal Fritillary
Insect	Cicindela limbata nympha	A Tiger Beetle
Insect	Paradamoetas fontana	A Jumping Spider
Insect	Oxyethira ecornuta	A Caddisfly
Insect	Oxyethira itascae	A Caddisfly
Insect	Cicindela patruela patruela	A Tiger Beetle
Insect	Cicindela lepida	Little White Tiger Beetle
Mammal	Microtus ochrogaster	Prairie Vole
Mammal	Perognathus flavescens	Plains Pocket Mouse
Mammal	Mustela nivalis	Least Weasel
Mollusk	Lasmigona compressa	Creek Heelsplitter
Mollusk	Actinonaias ligamentina	Mucket
Mollusk	Ligumia recta	Black Sandshell
Mollusk	Lasmigona costata	Fluted-shell
Reptile	Chelydra serpentina	Snapping Turtle
Reptile	Heterodon platirhinos	Eastern Hognose Snake
Reptile	Emydoidea blandingii	Blanding's Turtle

Natural Heritage and Nongame Research Program Rare Species Fact Sheets

The Natural Heritage and Nongame Research Program has created fact sheets about each of Minnesota's rare species. The information on these species is web-based and available at http://www.dnr.state.mn.us/rsg/index.html. It uses an interactive database approach that allows users to search on selected fields and create customized reports. Users are also able to perform alphabetical searches and generate standard printouts of rare species accounts.

In total, the rare species fact sheets provide accounts on about 200 endangered and threatened species and about 240 species of special concern.

Information Resources

The Minnesota (DNR) Natural Heritage Information System (NHIS) rare features database is the primary source for species occurrences information presented in tables 5.1 – 5.4.

Sources for Additional Rare Species Information

1. The Nature Conservancy. *Element Occurrence Abstracts.*
2. NatureServe. A network connecting science with conservation that includes an online encyclopedia of rare plants and animals. http://www.natureserve.org/.
3. U.S. Department of Agriculture – Forest Service Region 9. Regional Forester *Sensitive Species Conservation Assessment Documents* (also on the Web at: http://www.fs.fed.us/r9/wildlife/tes/.
4. DNR Data Deli – Department of Natural Resources Data Deli (http://deli.dnr.state.mn.us/.

5.4 Minnesota County Biological Survey

Process for Conducting Minnesota County Biological Survey (MCBS) Landscape Assessments

The Minnesota County Biological Survey (MCBS) fieldwork has been completed in almost all counties in the subsection. However, some of these counties were among the first done by the survey in the 1980's and much has changed since then. The data from these counties is being updated and the SFRMP team is incorporating the updated data is it becomes available . The SFRMP team will include in its assessment package MCBS survey information available in the DNR rare features database, the DNR data deli, and from other sources. Where MCBS survey work is in progress, the SFRMP team will incorporate information into the planning process as it becomes available.

Status of MCBS in the Hardwood Hills Subsection

Table 5.7: Hardwood Hills Subsection: MCBS Status:

County	Field Data Collection Scheduled	Notes on Sites and NPCs
Polk	Completed	Draft sites are digital, some revisions are in process
Clearwater	In progress	Field Survey begun in 2009
Beltrami	In progress	Field survey begun in 2009
Norman	Completed	Draft sites are digital, some revisions are in process
Mahnomen	Completed	Draft sites are digital, some revisions are in process
Clay	Completed	Draft sites are digital, some revisions are in process
Becker	Completed	Sites are digital
Otter Tail	Completed	Sites are digital
Wadena	Completed	Sites are digital
Grant	Completed	Sites are digital
Douglas	Completed	Sites are digital
Todd	Completed	Sites are digital
Morrison	Completed	Sites are digital
Pope	Completed	Sites are digital
Stearns	Completed	Sites are digital
Kandiyohi	Completed	Sites are digital
Meeker	Completed	Sites are digital
Wright	Completed	Sites are digital

MCBS Site Delineation Process

MCBS ecologists analyze survey areas (a county or ECS subsection) using historic and current ecological information, including remotely sensed data, to identify and delineate areas that appear to have some level of biodiversity significance. These locations are considered MCBS sites. A site can be isolated from other sites or it can be part of a larger area and therefore contiguous with other sites. In either case, the site is the primary unit around which most MCBS data (such as field evaluations, native plant community records, and ecological evaluations) are organized.

MCBS Procedures – site and native plant community surveys

1. Review existing information

Within each county or ecological subsection, site and native plant community surveys begin with a review of existing records and information about areas of native vegetation.

Among the sources consulted are:

- Climate, geomorphology, soils data.
- Museum and herbarium records.

- Existing records in the Natural Heritage Information System and other historical records such as the public land surveys Bearing Tree Data Base conducted in Minnesota from 1847 to 1907.
- Other inventories, such as timber stand inventories and the National Wetlands Inventory.
- Knowledgeable individuals.

2. Site selection

Sites that appear to contain important areas of native vegetation are digitized in a Geographic Information System (GIS) or delineated on topographic maps using aerial photography, satellite imagery, and other related resource maps and data. These sources of information are used to determine boundaries and provide a preliminary determination of the types of native plant communities that are present within each site.

MCBS has developed guidelines for determining which sites to map within each county or ecological unit. These include guidance for site evaluation based on size, current condition (including type and extent of human disturbance), landscape context, spatial distribution of native plant communities, and availability of critical rare plant or rare animal habitat. A site most often contains several different kinds of native plant communities (for example, oak forests, sedge meadows, and tamarack swamps); the boundaries of each community type are usually delineated within the site.

3. Field surveys of selected sites

For sites that appear to be of good quality with little evidence of disturbance, the ecologist conducts a field survey, recording notes about the type and structure of vegetation present, the most common plants, and evidence of disturbance such as cut stumps, soil erosion, and abundant weedy or exotic plant species.

If there are good quality examples of native plant communities at the site, the ecologist will often do a vegetation plot sample, or relevé, within one or more of the communities.

4. Information management

After site and native plant community surveys are completed, the ecologist determines which sites and locations of native plant communities meet minimum MCBS standards for size and quality. Poor-quality sites are eliminated from further consideration. For good-quality sites the ecologist enters data into the Natural Heritage Information System (NHIS) that include:

- Descriptive summaries of the site (landforms, soils, hydrology, plant community types, kinds of disturbance, etc.)
- Descriptive records on good-quality plant community locations.
- Relevé samples.

5. Final Steps

1. Refine the boundaries of the sites and native plant communities on topographic maps or GIS files and the final boundaries and associated data reside in the NHIS.
2. Write ecological evaluations for selected high-quality sites. These are used to guide conservation activity, such as special vegetation management or acquisition as a park or natural area.

MCBS Procedures – Rare Species Surveys

MCBS field biologists also conduct surveys for rare plants and rare animals. Data gathered during these surveys inform decisions about the biodiversity importance of MCBS sites in the survey area. Detailed descriptions of methods can be found at the following MN DNR websites:

Plants: http://www.dnr.state.mn.us/eco/mcbs/procedures_plants.html

Animals: http://www.dnr.state.mn.us/eco/mcbs/procedures_animals.html

For further information on the MCBS, contact the Unit of Monitoring and Inventory at **(651) 259-5100**

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For more information on listed species and the MCBS contact: Minnesota Department of Natural Resources 500 Lafayette Rd, Box 25St. Paul, MN 55155; phone: 651-259-5100 or 1-888-646-6367 (toll free)

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CHAPTER 6

Stand Damage and Mortality

Hardwood Hills Subsection

Notes relating to this chapter:
Color maps and graphs may be viewed as PDF files on the Hardwood Hills Subsection Forest Resource Management Plan (SFRMP) Web site at:
www.dnr.state.mn.us/forestry/subsection/hardwoodhills/index.html.

Maps in this chapter depict information for an area within a "planning boundary." This boundary closely approximates the subsection(s) while capturing data summary and planning efficiencies by using survey or jurisdiction lines in some cases.

Printed documents will be available for review at the Minnesota DNR Northwest Region Headquarters at 2115 Birchmont Beach Road N.E., Bemidji, Minnesota, 56601 and on CD by request to Pat Matuseski at (218) 308-2381 or pat.matuseski@state.mn.us.

Introduction

This is an assessment of native forest insects and diseases known to cause tree mortality, growth loss, and quality reduction in forest stands in the Minnesota and Northern Iowa Morainal Section (MIM). The presence of forest insect and disease agents, as well as animal and abiotic agents, have been documented in reports by the Minnesota Department of Natural Resources (MN DNR), Forest Health Team; University of Minnesota; USDA Forest Service, State and Private Forestry; and North Central Forest Experiment Station. The potential impact of exotic pests and climate change are also discussed.

6.1 Role of Native Insects and Diseases Contrasted with Exotic Pests and Climate Change

Native forest insects and disease organisms influence forest ecosystem dynamics as pests and agents of stress, but also play a beneficial role in the natural processes. Many native insects and diseases are an essential natural component of healthy forests and may contribute to compositional, structural, and functional diversity. By selectively affecting tree growth and mortality rates, they alter forest composition, structure, and succession. They thin and prune host populations, reducing density and competition. They can slow or stall the process of succession, or they can accelerate it. Through decay and biomass decomposition, they contribute significantly to carbon cycling, nutrient cycling, and energy flow in forest ecosystems. Insect and disease organisms serve as food for many invertebrates and vertebrates. Of vertebrates, birds consume the most tree-feeding insects, but many mammals consume insects to some degree as well. Insects and diseases create structural habitat for shelter and nesting. Many species of woodpeckers are attracted to trees with decay where they excavate cavities for nesting. Many animals use dead wood to roost, nest, or forage.

Climate change expectations for Minnesota:
- Increased levels of carbon dioxide (CO2) and ozone (O3) in atmosphere;
- In winter, minimum temps will be warmer;
- Growing season will be longer;
- Drier weather during the growing season;
- Relative humidity peaks higher in summer;
- More and stronger wind storms;
- More thunderstorms;
- Less percolation of rain water into soil; and,
- More “blowdown events”.

These same native forest insect and diseases are perceived as problems or pests by some when occurring at a level or on a site where they interfere with human goals, plans, and desires for trees and forests. Native insects and diseases can reduce timber productivity, lumber grade, site aesthetics, wildlife habitat, and water quality, and can increase the hazard of falling trees and branches and the occurrence of fire hazards, etc. Data from the 1990 Forest Inventory and Analysis for Minnesota indicate that 37 percent of the wood volume produced by all tree species annually is lost due to mortality. Insects and disease organisms account for more than 53 percent of this loss or more than 143 million cubic feet of wood. (Miles, Chen, Leatherberry, 1995). Surveys conducted by the MN DNR- Division of Forestry of oak and birch mortality triggered by drought and attacks by boring insects and root rot organisms, found in excess of 300,000 oaks and 200 million birch dying during the late 1980s and early 1990s (Albers, 1998). More than 40 percent of the birch type in Minnesota was affected.

In the last decade, scientists have noted that climate change is affecting the environment in the temperate forests of North America. Based on Frelich and Reich’s predictions, “the climate change expectations for Minnesota” are listed in the box.

As tree becomes stressed by drought and higher temperatures, changes in tree chemistry can occur. Certain pests, called "opportunistic pests," can key in on these stress-related chemicals and successfully attack the stressed tree. In the short-term, weather and climate changes will allow opportunistic insects and pathogens and abiotic declines to accelerate the demise of tree species no longer suited to their current sites. Other tree species will move into MN or become more prevalent as their range expands. Eventually, the forest prairie ecotone will likely move north-eastward as a culmination of the all the disturbances (Frelich and Reich). The harsher (drier) habitat, large herbivore populations and local insects and diseases will make it difficult to re-establish tree seedlings. Additionally, the occurrence of exotic forest pests would accelerate all the negative consequences of climate change on affected native forest tree species and communities.

The USFS has developed a series of maps showing where climate change is likely to have effects for the 130+ tree species in the NE USA. Forest layer is based on FIA plots. (Iverson, Prasad, et al Northern Research Station, 2007) In MN, 12 of 22 forest species will have hotspot(s) of change where that tree species will be under stress and the population is likely to diminish. In the MIM, only bur oak is expected to have an increase in its suitable habitat. Quaking aspen, balm of Gilead, black spruce, tamarack, jack pine and red pine are expected to have a 10% decrease in the area of suitable habitat in the next 50 years.

While native insect and disease organisms have co-evolved with native trees and forests, exotic insects and disease organisms have not. Exotics do not have a "natural role" in our native ecosystems and have and will continue to alter forest ecosystem diversity, function, and productivity. Successful exotic organisms have historically caused intensive and severe disturbances over large areas. In extreme cases they have virtually eliminated their host species. The elm resource has been devastated by introduction of the Dutch elm disease fungus and its bark beetle vector. The white pine blister rust fungus, accidentally introduced near the start of the 20th century, has played an important role in reducing the amount of white pine in Minnesota. Emerald ash borer was found first in St. Paul in 2009 and is expected to decimate the ash species in Minnesota. Gypsy moth, while not yet established in Minnesota, is established in Wisconsin and Michigan and is expected to be found along the North Shore or in southeastern Minnesota in the next few years. While future impacts of these insects in Minnesota are difficult to predict, they have the potential to cause widespread mortality oak and ash and will alter the composition and structure of many forest communities.

An ecosystem perspective requires that strategies to maintain the health of individual stands consider the beneficial, as well as the detrimental effects of insects and disease organisms. Forests must be considered as an ecosystem and manipulation to one part of that ecosystem affects the other parts. Pests have long influenced forest management, but forest management also affects pest populations. Vigorous trees tend to suffer less damage from these agents. Forest management aims to promote stand vigor and productivity by matching tree species to the planting site; manipulating rotation age, stand density, and species composition; avoiding wounding and root damage during thinning and harvesting; removing diseased and infested trees during harvesting operations, etc. Forest management does not attempt to eliminate native insect and diseases or their processes, but rather to control their activity and impact to a level that allows goals for timber production, water quality, aesthetics, recreation, wildlife, etc. to be realized.

In contrast, a much more aggressive approach is needed with exotic/ invasive organisms. It is important to avoid the introduction of exotics and attempt to contain and eradicate them when first found. Often it is not possible to eradicate or contain exotics once they are established. Attempts to slow their spread and management techniques to minimize their damage are then needed. Dutch elm disease and white pine blister rust are exotics that have become "naturalized" and are now considered permanent components of

forested ecosystems. This will also happen with gypsy moth and emerald ash borer after they become established and spread in Minnesota.

6.2 Damage and Mortality Tables

The damage and mortality table summarizes acres affected and acres of mortality from the Cooperative Stand Assessment (CSA) inventory on state lands in this subsection.

Table 6.1: Acres of cover type present, percent of acres affected by damaging agents and percent of acres with tree mortality on them caused by damaging agents.

Acres of cover type, percent of acres with damage and percent of acres with mortality			
Cover Type	***Acres***	***Percent Affected***[1]	***Percent Mortality***[2]
Northern hardwoods	5587	18	17
Aspen	5267	36	31
Oak	5117	40	33
Ash	358	27	22
Lowland hardwoods	139	39	43
Tamarack	742	26	39
Red pine	153	9	0
White spruce	128	1	0

1 *Each stand is assessed for the presence or absence of damage. These numbers reflect the sums of all acres in a cover type that are damaged or have died. In reality, the number of damaged and dead trees per acre is usually very low.*

2 *Percent affected and percent mortality is not additive.*

Table 6.2 Native and Exotic Insects and Disease in the Hardwood Hills Subsection

The table below summarizes the insect and disease agents that are known to cause mortality or volume losses in this subsection.

Table 6.2 Native and exotic insects and diseases that cause tree mortality or volume loss by tree species			
Tree species	***Agents known to cause tree mortality***	***Agents known to cause volume or quality reductions***	***Exotic agents** known to cause tree mortality***
All cover types	*Armillaria* root rot	Stem and root decay fungi	
Aspen	*Hypoxylon* canker	White trunk rot	Gypsy moth
		Forest tent caterpillar	
		Poplar borer	
Oak	Forest tent caterpillar		Gypsy moth

	Two-lined chestnut borer		
Birch	Birch decline		Gypsy moth
Ash	Ash decline		Emerald ash borer
Tamarack	Larch beetle		*Sirex* woodwasp
Jack pine	Jack pine budworm	Red rot	*Heterobasidion* root disease
			Sirex woodwasp
Red pine	Bark beetles	*Diplodia* blight	*Heterobasidion* root disease
			Sirex woodwasp
Balsam fir	Spruce budworm		*Heterobasidion* root disease
White spruce	Spruce budworm		*Heterobasidion* root disease
			Sirex woodwasp
Black spruce	Eastern dwarf mistletoe		*Heterobasidion* root disease
			Sirex woodwasp

6.3 Insects and Diseases Common to Each Tree Species

The following assessment is organized by tree species. Each species includes a description of the Damage Agent(s) followed by a discussion of Management Implications that can both increase and decrease outbreaks of damage agents as well as their impacts. Decisions on which pests and information to include in this assessment are based on literature, surveys, and reports of state and federal agencies and university forest pathologists and entomologists, and on personal experience.

ALL SPECIES

Damage Agents

- **Stem decay and root rot —** Many species of decay-causing fungi.

  All tree species are subject to stem decay or root rot by an array of fungi. The prevalence of stem decay in all species increases as tree age increases. Wounds such as dead branch stubs, fire scars, and logging injuries serve as sites where decay fungi can enter the trees. Many tree species have the ability to confine decay to the wood present at the time of wounding, but with multiple wounds, decay columns tend to coalesce and the total amount of decay in the stem increases significantly. As the stand ages, the proportion of trees in the stand with decay will increase and the volume of decay in each tree will increase. Stem decay does not kill trees outright, but it does lead to more stem breakage from wind and can greatly reduce merchantable volume.

  Wounds that occur to residual trees during a partial harvest or other management activities can be critically important. Minimizing wounding during logging, maintaining a level of stocking to promote natural branch shedding, and, rotation age management can be keys to controlling the amount of stem decay.

- **Root disease—***Armillaria* spp. and others
  All tree species are susceptible to root disease caused by *Armillaria spp.* Damage and death from root diseases are likely very common, but impact is not well documented since the damage is hidden below ground. Root diseases reduce the growth of trees and, if severe, can result in death or wind throw. *Armillaria* spp. is present on all forested sites. Hardwood and softwood trees weakened by drought, defoliation, wounding, soil compaction, or old age are predisposed to Armillaria root disease. This is especially a concern when hardwood sites are converted to softwoods. The fungus is able to use stumps as a food base in order to grow through the soil and infect live roots of the planted softwoods. Partial cutting has also been shown to increase Armillaria root disease.

Management Implications for all species

As a general rule, as stands of trees are allowed to age, the incidence and impact of stem decay and root rot increase. The presence of stem decay and root rot decreases stand productivity. Stem decay is the primary defect of most species, and as such, has been dealt with in this plan by managing the rotation age of each tree species. Root rot is a concern when hardwood sites are converted to softwoods. Partial cutting has also been shown to increase Armillaria root rot. Trees weakened by drought, defoliation, wounding, soil compaction, and old age can be predisposed to Armillaria root disease and tree mortality.

ASPEN

Damage Agents

- **Hypoxylon canker—***Entoleuca mammata (=Hypoxylon mammatum)*
  A common disease of aspen, Hypoxylon canker causes mortality and is the most destructive pathogen of young aspen in the Lake States. It is estimated that Hypoxylon canker infects 12 percent and kills 1 percent to 2 percent of the aspen in the Lake States each year (Schipper and Anderson, 1976). Hypoxylon canker is primarily a disease of quaking aspen, but bigtooth aspen is also occasionally infected. Aspen of all age classes is susceptible; however, mortality is usually greatest in young trees. The fungus kills the trees by girdling the stem, which leads to stem breakage. Some clones appear to be much more susceptible to Hypoxylon canker than others, and mortality in susceptible clones may approach 100 percent. Infection levels are not strongly correlated to site characteristics, but do appear to be related to stand density. Insect wounds made by cicadas, poplar-gall saperdas, and tree hoppers serve as infection courts for the fungus causing Hypoxylon canker. These insects prefer open-grown stands and stand edges. Because of this preference, there tends to be a greater amount of insect wounding and Hypoxylon canker incidence in the more open-grown stands and along stand edges (Ostry, et al., 1989).

- **Stem Decay (White trunk rot)—***Phellinus tremulae*
  White trunk rot is the major cause of decay in aspen. Decay becomes apparent in stands at 20 years of age and increases as the stands age. There does not seem to be a strong correlation between amount of decay and site factors. The genetic susceptibility to decay of individual clones seems to override any observable correlations between decay and site factors. The best external indicator of decay is the presence of conks (Jones and Ostry, 1998). However, only about 50 percent of the trees with decay have visible conks, and lack of conks generally leads to an underestimation of decay. Wounds serve as infection sites. Stands with a larger incidence of wounds from such things as equipment scrapes, fire, hail, and storm breakage may have higher levels of decay. Studies have indicated that the pathological rotation age (the age at which the loss of wood volume from decay begins to exceed the annual increment of sound wood) is from 40 to 50 years of age (Schmitz and Jackson, 1927). Others

indicate that in many parts of the Lake States, aspen stands begin to deteriorate rapidly when they reach 50 to 60 years of age (Ostry and Walters, 1984). Some stands (or clones) may have relatively little decay even when they exceed 50 years of age, while others may suffer high losses before 50 years. (Christensen et. al., 1951)

- **Forest tent caterpillar—***Malacosoma disstria*
  Forest tent caterpillar (FTC) is a native defoliator that has likely caused outbreaks for hundreds or thousands of years. These outbreaks often occur about once a decade and usually last about three to four years, although some have lasted for five to eight years. Outbreaks result in defoliation of most hardwood tree species especially aspen, birch, basswood, and oaks within the outbreak area.

Outbreaks can begin suddenly or develop slowly over a period of years. Outbreaks normally collapse quickly due to natural causes with defoliation reduced by as much as 80% in a single year. Defoliation starts in late May in central Minnesota and early June in northern areas. Defoliation will normally be obvious by mid-June and finished by late June.

North-wide outbreaks of FTC occur at intervals of five to ten years and are five to eight years in duration. In west central counties, FTC populations may synchronize with northern outbreaks or they may have small, localized outbreaks that pop-up and collapse quickly. These outbreaks occur in oaks, basswoods and aspens on lakeshores and have relatively low acreages.

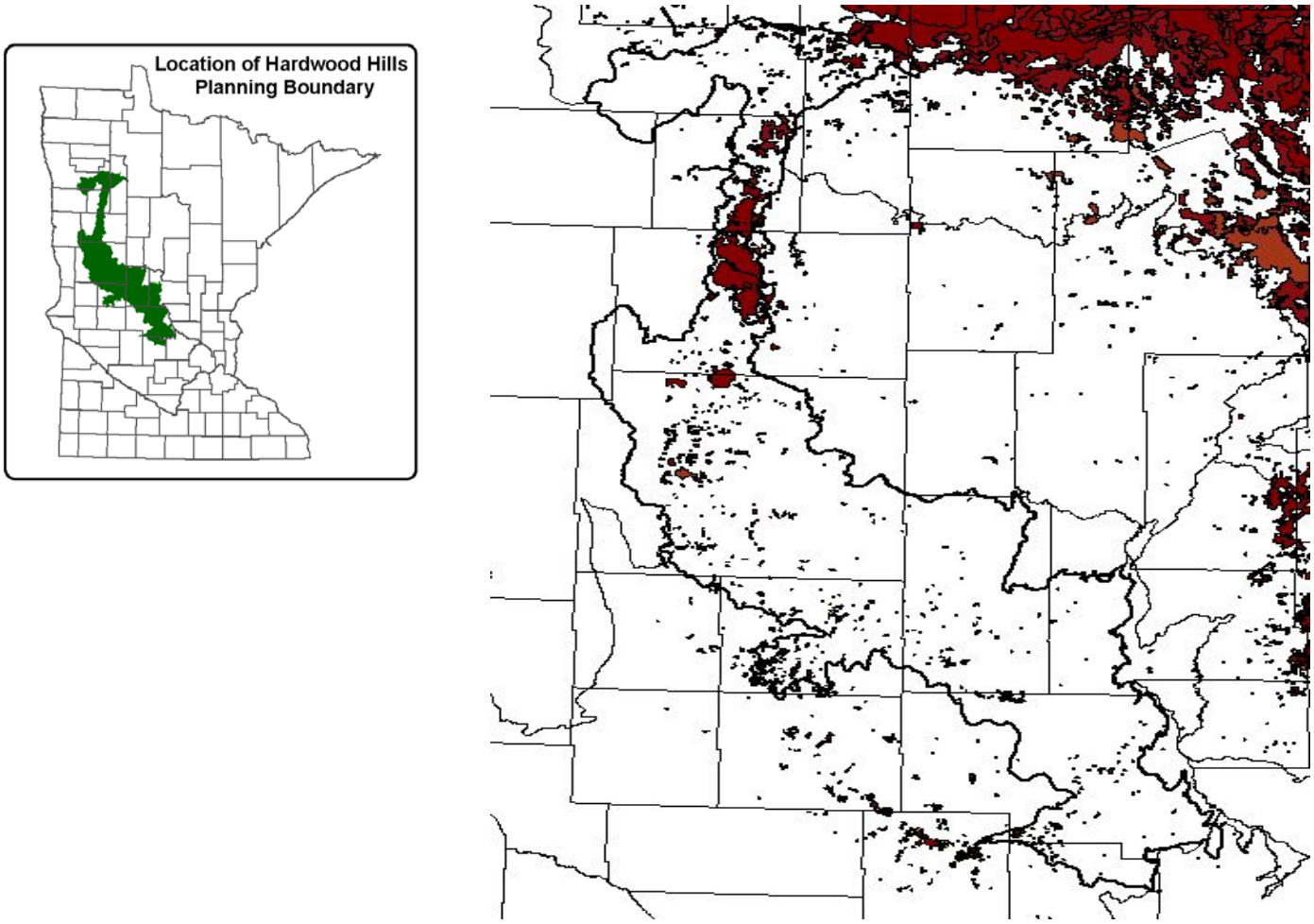
In the forest, defoliation from FTC usually causes little damage to aspen tree health. Most trees develop a second set of leaves after attack, but these leaves are noticeably smaller and tend to cluster near the branch tips. The second year after the collapse of an outbreak, 80% of the trees have normal sized leaves. FTC defoliation reduces tree vigor, but vigor recovers within a few years of the population collapse.

FTC defoliation reduces aspen stem growth. As defoliation intensity and duration increase, stem growth decreases. For example, a single light defoliation does not reduce growth. However, a single heavy defoliation may reduce stem growth by 50 percent to 60 percent. Two years of heavy defoliation reduces growth 90 percent. Growth rate recovers quickly, returning to 80 percent of normal during the first year after the end of the outbreak.

Aspen trees usually do not die from FTC defoliation alone. A Minnesota study of the 1948 to 1956 outbreak documented the death of 396 aspen trees out of 4877 aspens. Identifiable problems other than FTC accounted for the death of all but four trees. So, in this instance, about one percent of the aspens died due to FTC defoliation alone.

FTC defoliation does weaken trees and makes them more susceptible to attack from a variety of other pests. These pests, called secondary pests, do more damage than the FTC and may kill the infested tree. Trees defoliated by FTC and suffering stress from other factors such as prolonged drought or defoliation due to late spring frosts, growing on poor sites or old age, they are much more vulnerable to attack by secondary pests. Weakened aspen may die from subsequent attack by Saperda borer, Hypoxylon canker, or Armillaria root rot. Similarly, other hardwoods can be weakened by FTC defoliation. Commonly, oaks weakened by FTC defoliation and drought or root system damage suffer branch dieback or whole-tree mortality from two-lined chestnut borer attack or Armillaria root disease. Climate change is expected to accelerate aspen losses due to combined effects of drought and defoliation.

Map 6.1: Forest Tent Caterpillar Defoliation of Oak, Basswood and Aspen from 2005 to 2010 in the Hardwood Hills Subsection.



- **Poplar borer—***Saperda calcarata*
  Poplar borer occurs wherever aspen grow. Larvae bore into sapwood and heartwood, and trees that have been attacked have swollen scars and holes in the trunk and larger branches. Moisture bleeds out of the holes, producing varnished-looking streaks running down the trunk. Extensive tunneling can girdle small trees and makes large trees susceptible to wind breakage. Attack is often concentrated in brood trees that are usually the larger and faster-growing trees in stands. Infestations tend to increase with a decrease in stand density. The best management practice is to maintain well-stocked stands that are clear-cut at maturity.

- **Gypsy Moth** – *Lymantria dispar*

See Oak section below. FTC outbreaks usually average two to three years of defoliation in each 10 to 12 year period. The beginnings of FTC outbreaks usually coincide with droughty weather. When GM outbreaks coincide or are closely timed to FTC outbreaks, there is a high risk of oak, aspen and birch mortality due to combined defoliation.

Aspen Management Implications

As aspen stands are set aside to meet extended-rotation and old-growth targets, or aspen clumps are left behind to meet leave-tree guidelines, white trunk rot is expected to increase as the ages of these aspen stands increase. Harvesting strategies that reduce the number of acres of older aspen will decrease the amount of decay. Sequential or partial harvesting of aspen stands will wound the residual stems and root systems. An increase in wounding will increase decay incidence and volume of decay. If wounding is done early in the life of the stand, time will become an enemy in producing sound wood volume. The longer the decay is present in aspen, the less sound volume there will be since white trunk rot has the ability to breach the defenses of the trees and continue to grow at will throughout the infected trees.

Management practices, such as creating irregular stand shapes, using intermediate cuts to capture mortality, partially harvesting stands at the end of the rotation, or leaving scattered patches of standing live aspen in the stand at the end of the rotation, increase the incidence and severity of poplar borer and Hypoxylon canker. To reduce poplar borer and Hypoxylon canker occurrence and impact, larger clear-cuts, which produce fully stocked stands and minimal edge, are preferred. If clones have greater than 25 percent of the basal area infected with Hypoxylon canker, it is recommended to convert those clones to other species or other clones more resistant to Hypoxylon canker (Schipper and Anderson, 1976). Both bigtooth aspen and balm of Gilead are more resistant to Hypoxylon canker. If these species exist in proximity to aspen clones with a high infection rate from Hypoxylon, consider favoring these species when regenerating the stands.

Defoliator occurrence and impacts are difficult to predict and to influence by management practices. If forest tent caterpillar continues to cause widespread defoliation every 10 or 12 years, delay the harvest in intensively managed aspen stands on good sites to accommodate reductions in growth rate every decade during the rotation. If forest tent caterpillar defoliation and drought are simultaneous, expect decline and mortality in aspen, birch, and oaks that occur on light soils and higher elevations where defoliation was prolonged.

OAK

Damage Agents

- **Forest tent caterpillar—***Malacosoma disstria*
  See aspen section above.

- **Two-lined chestnut borer—***Agrilus bilineatus*
  This insect is an opportunistic insect that attacks weakened oak trees. It is a native beetle known to attack all oak species found in Minnesota, red oak being its preferred host. When trees and stands are healthy, two-lined chestnut borer (TLCB) confines its attack to low-vigor trees, broken branches or windthrown trees. When drought stress and/or forest tent caterpillar defoliation have reduced tree and stand vigor, oaks are predisposed to TLCB attack. Under severe stress and/or defoliation conditions, widespread outbreaks of TLCB can occur. Climate change will likely accelerate TLCB-caused oak mortality on the more mesic sites and on the extremely dry sites in the Hardwood Hills.

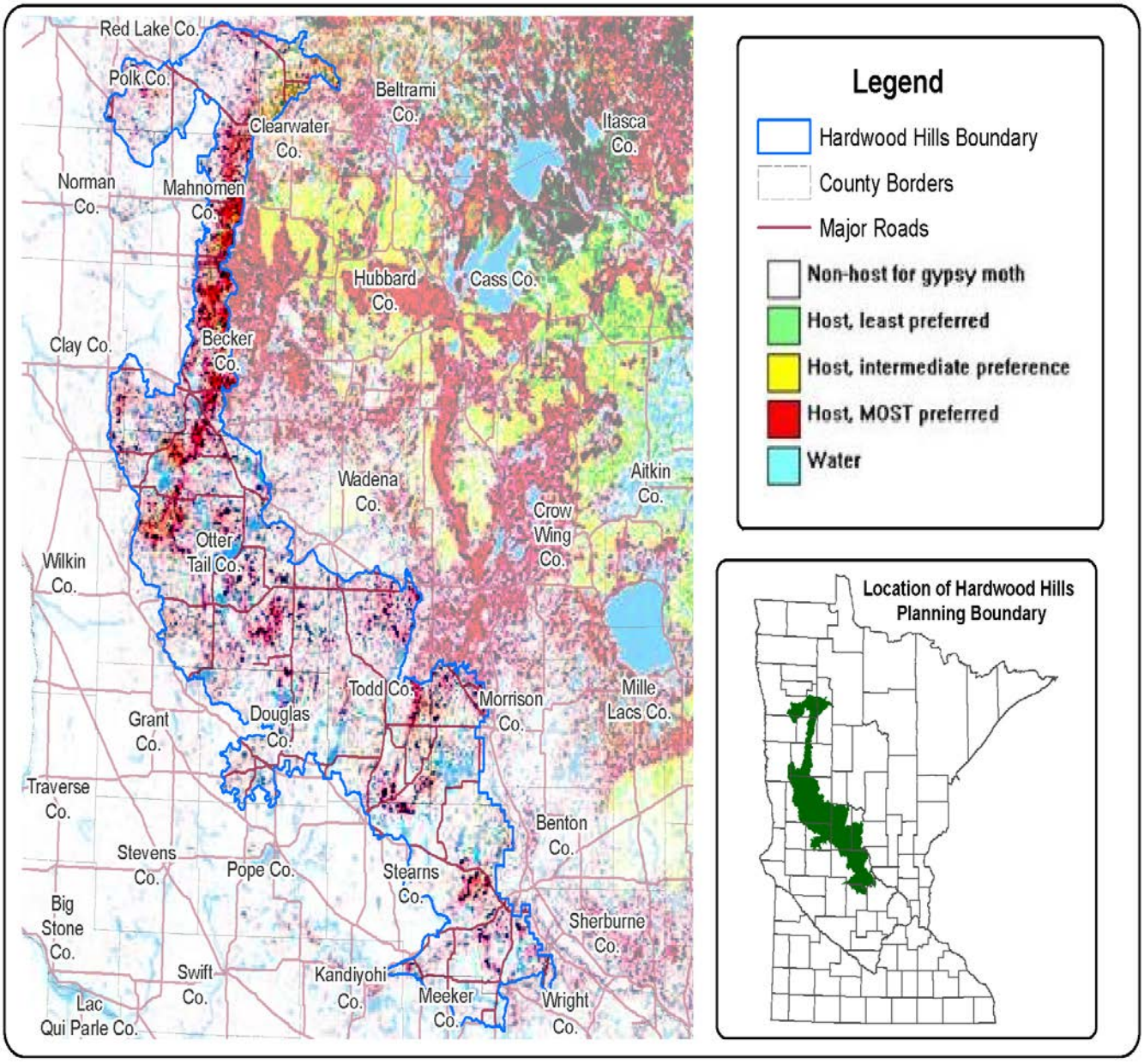
- **Gypsy moth—***Lymantria dispar*

  Gypsy moth (GM) is an exotic insect pest spreading across the United States and Canada. While GM will soon be "established in the state", it is included in this assessment because it will spread into and become established here during this planning period. GM is invading Minnesota from the east. Natural spread of GM is slow, but the unintentional spread by humans can be very rapid. Egg masses are transported on cars, recreational vehicles, logs, firewood, nursery stock, etc. Gypsy moth caterpillars feed on most hardwood trees and shrubs and in heavy infestations will also feed on conifers. Repeated defoliations lead to tree decline and death. Trees under stress suffer higher levels of mortality. Oaks, aspen, birch, basswood, tamarack, willows, hazelnut, and ironwood- are among the gypsy moth's preferred trees.

  Pheromone traps are the primary method used to detect and monitor GM populations. The DNR is a member of the Gypsy Moth Program Advisory Council and cooperates with the Minnesota Department of Agriculture in its pheromone-trapping program and the federal Slow-the-Spread program.

  The extent and severity of impact in this area is unknown at this time; however, GM will likely cause changes in the forest composition once it is established. According to the latest analysis of GAP data, when GM arrives, hardwood stands will have different vulnerabilities to the effects of multi-year defoliation. A risk potential map was developed in 2003. (See map 6.2)

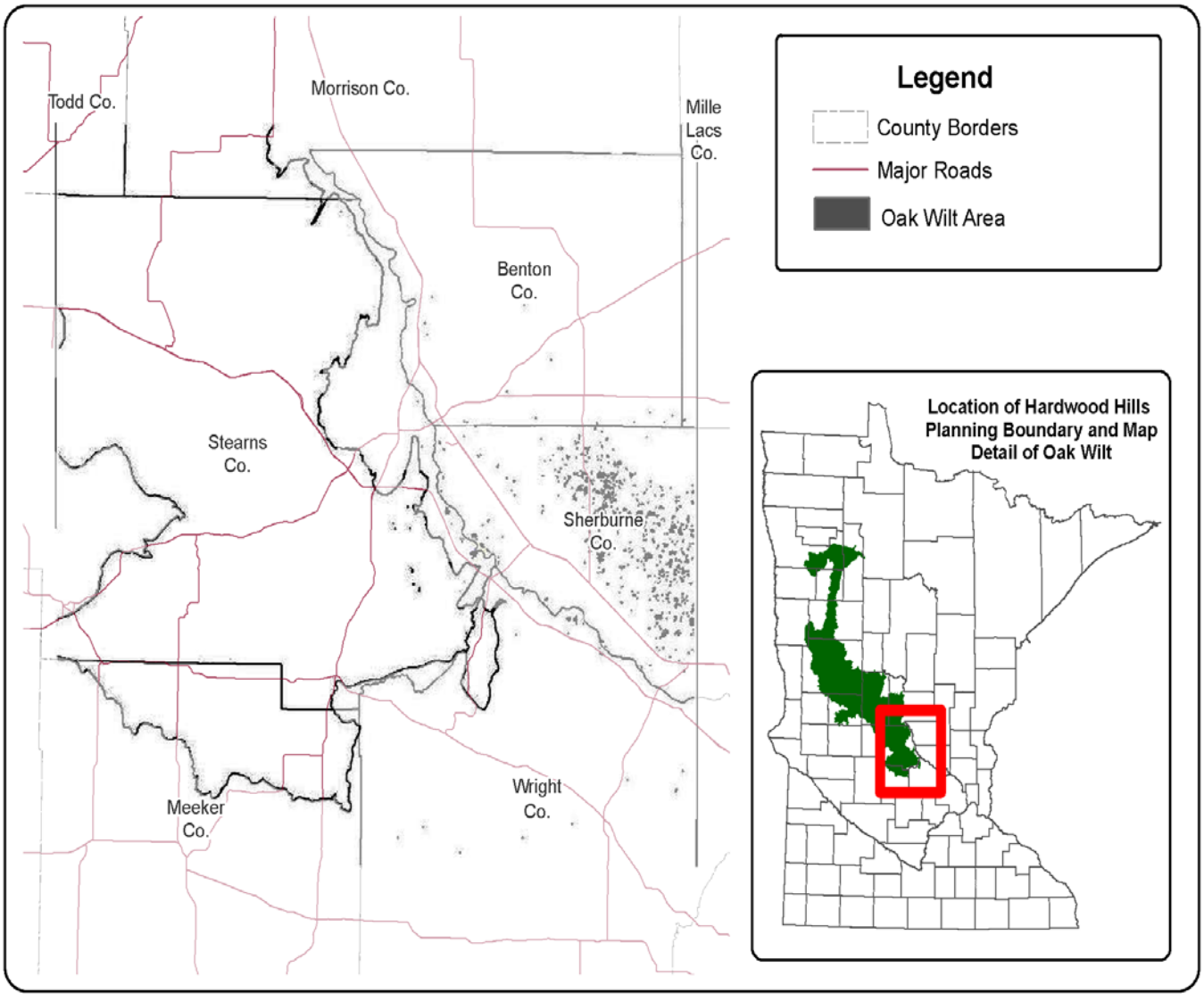
Map 6.2: Mortality Risk Analysis for Gypsy Moths: Gypsy Moth Preferred Species Analysis (2003).



☐ **Oak wilt** *Certocystis fagacearum*

Thousands of oaks in woodland and urban settings die from oak wilt every year. Widespread in Minnesota and Wisconsin, the disease is caused by a fungus that invades the tree's water conducting system, resulting in wilting and tree death. The Anoka Sandplain Subsection has, by far, the most oak wilt in the state and it abuts the southeastern border of the Hardwood Hills Subsection. As of 2010, oak wilt has become established on 32 acres and has caused mappable mortality of oaks on 16 sites.

Map 6.3: Oak mortality caused by Oak Wilt in the extreme southeastern portion of Hardwood Hills Subsection (Stearns County). 2006 to 2010.



Oaks vary in their susceptibility to the disease; red oaks are very susceptible and white oaks are moderately resistant. Oak trees become infected by (1) beetles carrying the oak wilt fungus to fresh wounds, or (2) the spread of spores in grafted roots of a diseased tree. In the first case, a beetle carrying

spores to a fresh wound only travels 1500 feet from the infected tree or wood pile. In the second case, tree root systems must be grafted together, usually less than 75 feet between the healthy and infected tree. Two precautions can decrease the chance of oak wilt from invading a woodlot or a wooded home site. Do not harvest, prune or otherwise wound oak trees from budbreak to 3 weeks past full leaf development (generally from April 1 to July 15). Secondly, do not move infected trees with the bark still attached (logs or firewood) into the woodlot or home site.

Root graft spread of oak wilt can be controlled by using a vibratory plow or trenching machine to sever roots around the perimeter of an oak wilt infection center down to a depth of five feet. Overland spread can be controlled by cutting and removing all the wilting and recently dead red oaks inside the plowline perimeter so spores are not produced to spread the disease further.

Oak Management Implications

A goal in oak management should be to promote stand vigor by manipulating stocking in order to prevent and minimize TLCB-caused oak mortality. Once the damage from a population of TLCBs becomes evident, management options are postponement of any activity in the stand for at least one growing season then salvage and sanitation. Thinning during an outbreak should be strictly avoided because thinning activities wound trees and create droughty conditions for the remaining crop trees.

FTC outbreaks usually average two to three years of defoliation in each 10 to 12 year period. The beginnings of FTC outbreaks usually coincide with droughty weather. When GM outbreaks coincide or are closely timed to FTC outbreaks, there is a high risk of oak, aspen and birch mortality due to combined defoliation.

When it arrives, GM defoliation and mortality will make forest management and planning more difficult. See Map 6.2 where red shows high risk of mortality due to GM defoliation. The predominance of aspen and oak makes the likelihood of forest tent caterpillar defoliation impact even greater when gypsy moth and FTC outbreaks are concurrent or separated by only a year or two. There is a high risk of mortality due to the duration and severity of defoliation when both defoliators are present.

Silvicultural considerations for gypsy moths are:

- Encourage species diversification that will slowly make the stands less vulnerable to both GM and FTC.
- Once infested, there will be a slow spread rate between stands because stands are so widely separated. Spraying a bio-rational insecticide (Btk) to control defoliation and impact would be most effective in these isolated stands.
- Treating either or both FTC and GM caterpillars with bio-pesticides would prevent mortality after two years of consecutive defoliation or after a single year of defoliation concurrent with droughty weather.

Silvicultural considerations for oak wilt are:

- Two precautions can decrease the chance of oak wilt from invading a woodlot or a wooded home site. Do not harvest, prune or otherwise wound oak trees from budbreak to 3 weeks past full leaf development (generally from April 1 to July 15). Secondly, do not move infected trees with the bark still attached (logs or firewood) into the woodlot or home site.

- Root graft spread of oak wilt can be controlled by using a vibratory plow or trenching machine to sever roots around the perimeter of an oak wilt infection center down to a depth of five feet. Overland spread can be controlled by cutting and removing all the wilting and recently dead red oaks inside the plowline perimeter so spores are not produced to spread the disease further.

NORTHERN HARDWOODS

Damage Agents

The greatest volume losses in northern hardwood species are the result of disease organisms which discolor, decay, or deform standing timber. The management recommendations for reducing decay losses are discussed above. Mortality in the northern hardwood type is not common. Growth losses and periodic declines can occur following insect defoliation or adverse climatic conditions. Occasional tree mortality can be caused by shoestring root rot, *Armillaria spp*. usually after a prolonged drought and/or defoliation event.

Maple decline is identified by branch dieback, stunted foliage and epicormic branching. It can be reduced by maintaining a well-stocked stand with a diversity of species. Canker diseases caused by *Nectria galligena* and *Eutypella parasitica* can reduce yields, cause minor mortality in young trees, particularly maples, and serve as openings for decay organisms. Sapstreak disease, caused by *Ceratocystis coerulescens*, is rarely found in wounded or stressed maple trees.

Early spring defoliation by Basswood thrips, *Seriocothrips tilae* (Hood) occur in occasional outbreaks lasting for several years causing growth loss and some mortality on stressed and understory trees. The heaviest defoliation occurs at higher elevations and on north slopes with abundant basswood stocking.

Late summer defoliators including the variable oakleaf caterpillar, saddled prominent, orangehumped mapleworm, greenstriped mapleworm, and walking sticks can cause infrequent outbreaks that seldom last longer than 1 or 2 years and cause only minor growth loss. We recommend that these pests are NOT treated by insecticides. They are rare insects and as such should be protected to maintain biodiversity.

Management recommendations:
Prevent volume losses by avoiding wounding during all management activities including prescribed burns and wildfires. Always avoid high-grading in hardwood stands with the exception of black ash stands in the face of emerald ash borer mortality. Do not use insecticides against insects of the fall defoliator complex as they are rare insects and should be protected to maintain biodiversity.

BIRCH

Damage Agents

- **Forest tent caterpillar—***Malacosoma disstria*
  See Aspen section above.

- **Birch decline—**unknown etiology and causal agents, such as bronze birch borer, *Agrilus anxius.* Birch decline is a complex disease caused by a combination of factors including stress from drought, high temperatures, insect defoliation that culminates in branch or death by the bronze birch borer. Birch decline starts as a thinning of the crown with dieback of branches. As the stress continues, the bronze birch borer begins to make successful attacks on the birch and mortality often results. The amount of mortality due to birch decline can increase dramatically as a result of severe and lengthy drought. A study of the effects of the drought in the early 1990s estimated that 40 percent of the birch on FIA plots died in Minnesota from 1988 to 1992 as a result of birch decline. Based on the findings on the FIA plots, it was estimated that 228 million birch trees died during this period (Anonymous, 1992).

- **Gypsy Moth** – *Lymantria dispar*
  See Oak section. FTC outbreaks usually average two to three years of defoliation in each 10 to 12 year period. The beginnings of FTC outbreaks usually coincide with droughty weather. When GM outbreaks coincide or are closely timed to FTC outbreaks, there is a high risk of oak, aspen and birch mortality due to combined defoliation.

Birch Management Implications

Birch decline depends on stress such as drought, defoliation and disturbance. This makes it difficult to predict a trend in birch decline over the life of the subsection plan. Older, decadent birch stands will reflect stress conditions and resultant dieback and decline before younger, thriftier stands. If stands of birch are set aside in legacy patches or rotations are extended, the vulnerability of these stands to birch decline will increase. Partial harvesting birch stands can create stress to the residual trees from an increase in soil temperatures as the stands are opened up. Partially harvesting birch and using birch to provide leave-tree clumps will likely lead to significant mortality in these stands and residual birches.

ASH

Damage Agents

- **Emerald ash borer** – *Agrilus planipennis*
  Emerald ash borer (EAB) is an exotic insect first found in Michigan in 2002. EAB attacks and kills all species of *Fraxinus,* which includes white, black and green ash. The borer attacks healthy as well as stressed trees and trees of all sizes. Since it is an exotic, it has no native parasites or predators in North America. In 2009, EAB was found in St. Paul and along the Mississippi River in Victory, WI. APHIS and MDA have established quarantines in Ramsey, Hennepin and Houston Counties for ash trees, ash wood products, ash firewood and living specimens of EAB.

  Shade trees can be protected by injecting them with insecticides. Forest stands containing green and black ash can be managed to reduce the size and number of ash trees in advance of EAB infestation. Once a county is infested with EAB, marketing of ash will be more difficult. Interstate quarantines have been enacted to control the possible movement of EAB from infested states to un-infested states. However, it is easily moved unintentionally on firewood. The MDA and DNR are encouraging the public to use locally grown firewood at all recreational sites and the DNR has specific requirements for all DNR-administered lands.

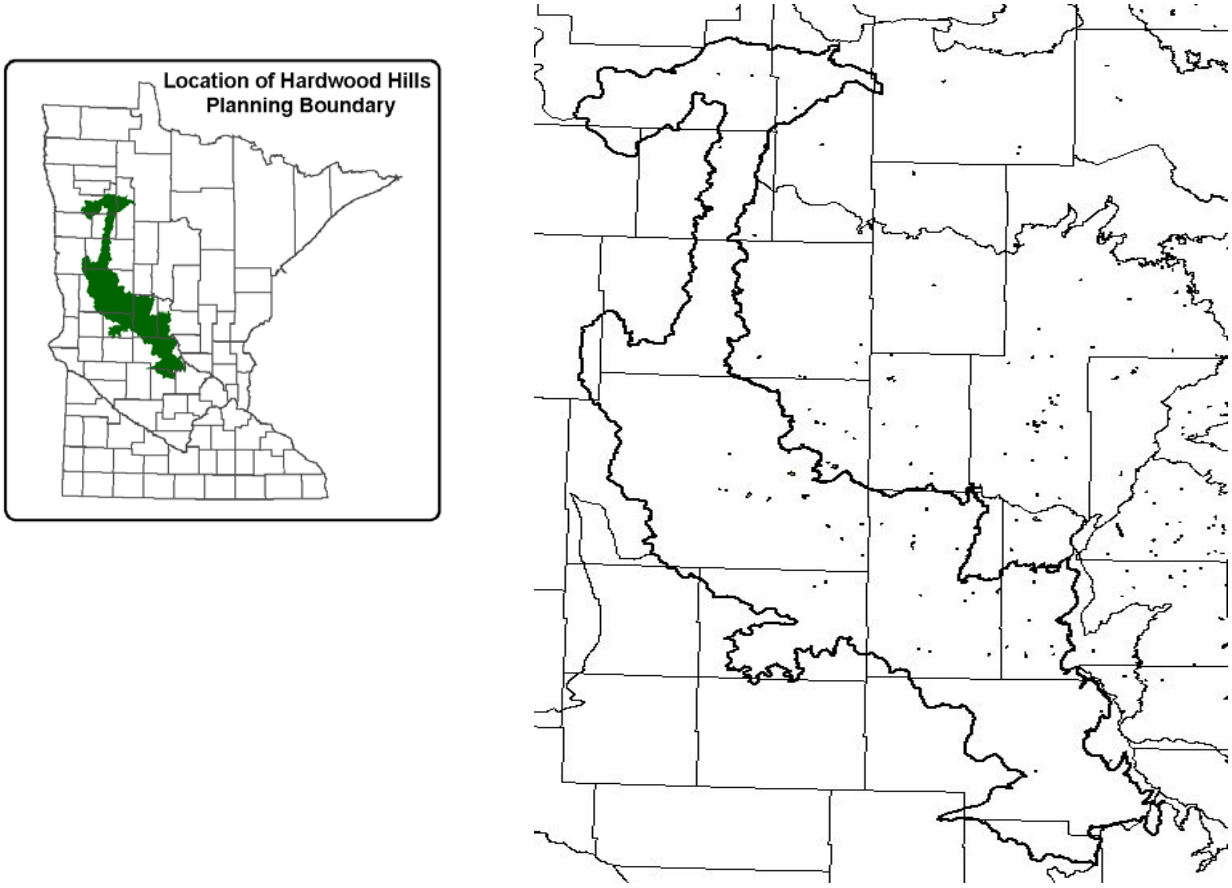
If EAB is found or suspected, please contact MDA (Hot-line is 1-888-545-6684) and your Regional Forest Health Specialist.

- **Black Ash decline** – Interacting biotic and abiotic factors

  Black ash stands showing signs of branch dieback, declining crowns, epicormic shoots and tree death is a common sight along roads. Periodically the amount of ash showing signs of decline increases. This was apparent in the early 1990's and again in the mid-2000's. An analysis of Forest Inventory and Analysis (FIA) and Forest Health Monitoring (FHM) data by the United States Forest Service - Northern Research Station (USFS-NRS) in St Paul was recently conducted. Findings included:
  -Trees growing on wetter sites had greater decline symptoms than trees growing on drier sites.
  -Severity of decline was greater in older trees than in younger trees.
  -Black ash regeneration was greater on better-drained plots.
  -Trees growing closer to roads had more decline symptoms than those farther from roads.

  In field studies conducted by the USFS-NRS and the MN DNR Forest Health Unit, no biotic agent was found to be responsible for the decline. Further study is needed and will continue. It appears the decline is caused by a number of interacting factors. Different combinations may be involved on different sites. Some of the factors likely involved include tree age, proximity to roads likely involving changes in hydrology, closed drainages, droughts and above normal precipitation causing fluctuations in water tables, open winters possibly injuring roots, defoliation, soil type, etc.

Map 6.4: Ash Decline and Mortality in Hardwood Hills from 2003 to 2010.



Ash Management Implications

It is assumed EAB populations will begin spreading from the initially infested sites into the rest of the state. When it does arrive in this subsection, it is expected that most or all of the ash trees will eventually be killed. At the present time there are no management options to control EAB in forests. Forest stands containing green and black ash can be managed to reduce the size and number of ash trees in advance of EAB infestation. Once a county is infested with EAB, marketing of ash will be more difficult. If there are opportunities to encourage other tree species in order to increase diversity on sites dominated by black ash, they should be pursued. On the wettest sites, do not enter the stands for fear of altering the stand's hydrology, but do consider selective harvest around the edges of wet stands and in riparian areas where the ash is growing on drier sites.
Black ash decline is a periodic recurring problem especially on the wetter sites in closed drainages. Management on these sites is difficult and it is very easy to degrade the site. Black ash management is more likely to be possible where it is growing onto drier sites and may need some help such as thinning to help it compete with other species growing on the sites. Keeping EAB in mind, any management efforts should try for increased species diversity.

BUTTERNUT

Damage agents/ Moratorium of harvest of living butternuts

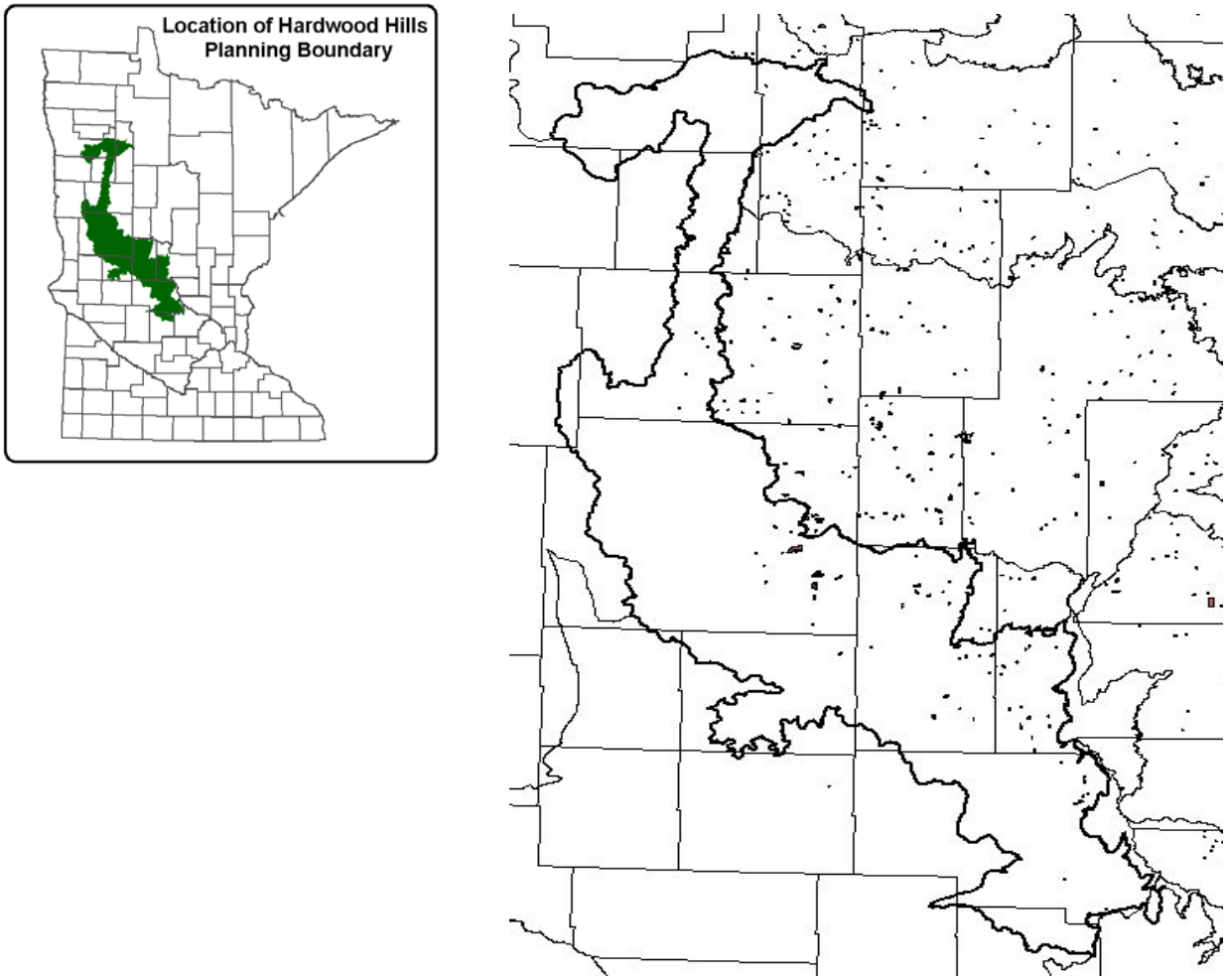
- ***Butternut canker*** *Ophiognomonia clavigignenti-juglandacearum*
  This fungus causes cankers to form on stems and branches, causing crown decline symptoms and ultimately tree death. Unfortunately, this disease has nearly wiped out the butternut species in North America. As a result, Minnesota DNR issued a moratorium on the harvest of living butternuts in 1992 and the USFS-NRS is collecting scion material from surviving trees.

TAMARACK

Damage Agents

- **Larch beetle—***Dendroctonus simplex*
  This is a native bark beetle that attacks tamarack and exotic larches. Mapped since 2003, larch beetle mortality has been detected on a total of 1140 acres, and of that 751 acres were mapped in 2008. See map 6.3. Presently, populations and attacks are on the increase, and in some stands 30 percent to 90 percent tree mortality has been observed. Flooding, droughts, defoliation by larch casebearers, and old age have been associated with larch beetle attacks. Larch beetle also appears to be able to kill healthy trees as well. Populations can build up in tamarack blowdowns or logging slash and then attack and kill live trees left for seed production as well as live trees in surrounding stands. Beetles over-winter in attacked trees, so wood peckers can find these insects year-round.

Map 6.5: Larch Beetle Mortality in Hardwood Hills from 2001 to 2010.



☐ **Sirex woodwasp** – *Sirex noctilio* .
This invasive exotic insect is not known to be in Minnesota in 2010, but it can be spread very rapidly in fresh logs and firewood. This insect will kill all pines, all spruces, balsam fir and tamarack. *Sirex* is an exotic that could be a very serious mortality agent in natural stands and plantations. Sirex wood wasps thrive in decadent and dying pines and spruces where they build up population numbers and are able to mass attack healthy trees and kill them. If *Sirex* is suspected, please contact MDA (Hot-line is 1-888-545-6684) and your Regional Forest Health Specialist.

Tamarack Management Implications

Apparent healthy trees can be successfully attacked when there are high populations of larch beetles. Harvesting can also create stress conditions on residual trees left for seed production or biodiversity objectives by affecting water table levels and by increasing temperatures. Most harvesting plans are salvage operations due to larch beetle mortality.

JACK PINE

Damage Agents

- **Jack pine budworm—***Choristoneura pinus pinus*
  Jack pine budworm (JPBW) larvae eat the needles of jack pine causing defoliation, which leads to top kill and mortality.

- **Stem decay (red rot) -** *Phellinus pini*
  This organism is the most destructive decay organism in the United States. It attacks most softwoods and causes significant decay. It is a "canker rot" organism. This type of decay organism cannot be walled off and confined to the portion of the stem present at the time infection takes place. This organism will grow and cause decay throughout the stem as the stem increases in size. Often red rot is not discovered until harvesting takes place. For more details see both discussions of stem decay for the aspen and tamarack cover types.

- **Heterobasidion root disease** – *Heterobasidium* spp.
  Not known to be in Minnesota in 2010, this exotic fungal disease affects wounded pines and spruces causing tree mortality. Once carried into a plantation, in debris, fruiting bodies, diseased roots or wood, this fungus infects cut stumps and root systems. Infected trees die and the fungus spreads through root systems to adjacent healthy trees, creating an ever-expanding disease pocket. Neither pines nor spruces can grow in the infection centers for many decades.

- **Sirex woodwasp** – *Sirex noctilio* .
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Jack Pine Management Implications

Management strategies that call for holding jack pine beyond 50 years of age will lead to conditions where stands begin to break up because of the incidence of red rot caused by *Phellinus pini*.

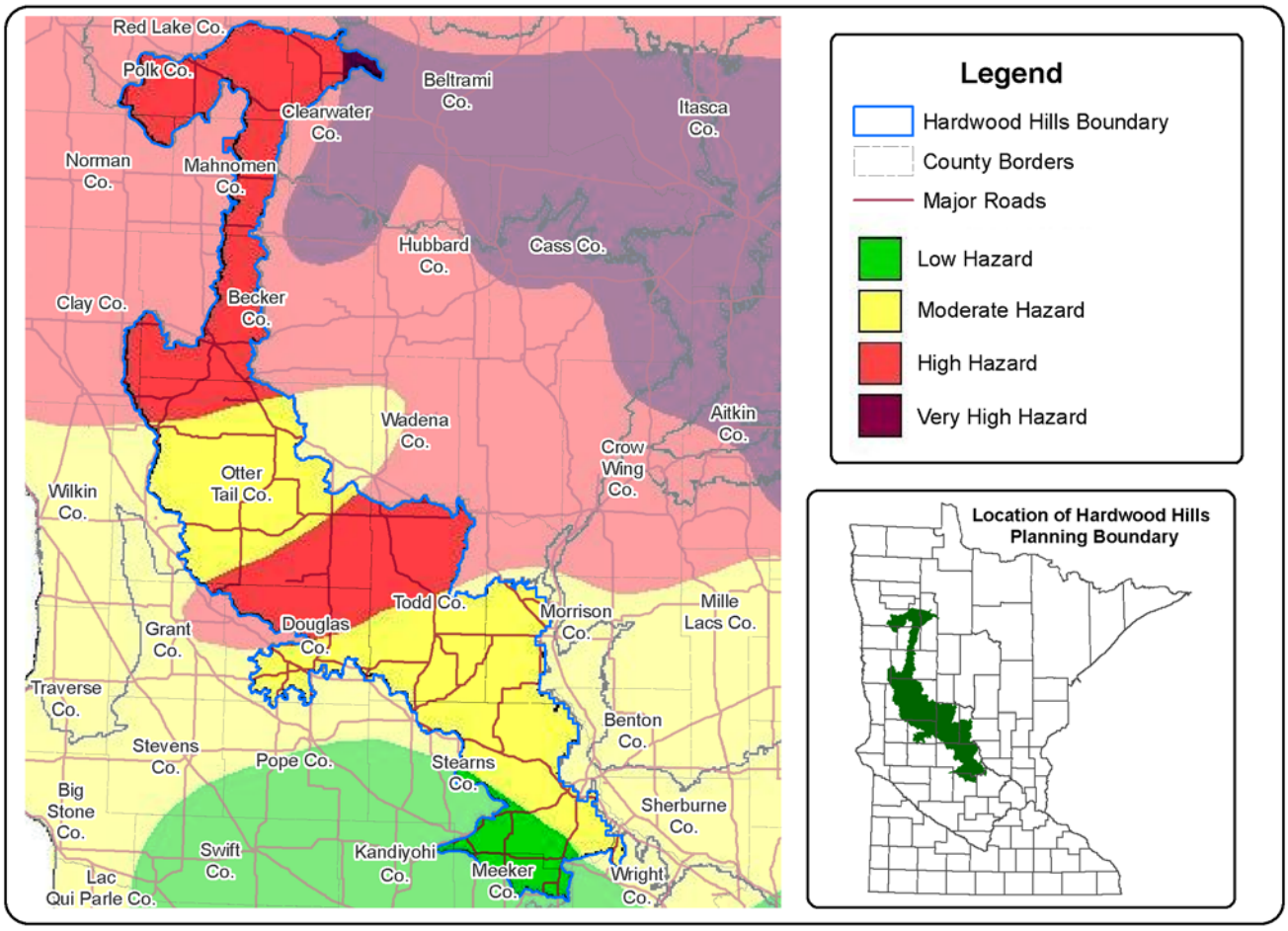
WHITE PINE

Damage Agents

- **White pine blister rust** - *Cronartium ribicola*
  White pine blister rust is an exotic fungus, first found in Minnesota in 1916. Blister rust is found throughout Minnesota wherever white pine is grown. This disease has changed where and how white pine is grown in northern Minnesota. The fungus requires both white pine and the alternate host, species of *Ribes,* to complete its life cycle. Injury to infected trees include dead branches, stem cankers, and mortality. Levels of infection of 80 percent or more of the trees in a stand or plantation have been reported in northern Minnesota. Levels of infection can vary greatly from site to site due to micro-site climate differences, age of trees, presence and abundance of *Ribes*, topography, and forest

stand structure. No major gene for resistance has been found in eastern white pine, but breeding efforts continue to try to produce a more resistant tree. Injury to *Ribes* species is not significant.

Map 6.6: White Pine Blister Rust Hazard Zones, 1972-Van Arsdel.



White Pine Management Implications

As more white pine is planted, the incidence of white pine blister rust will increase. Van Arsdel developed a hazard zone map for Minnesota (see map) based on the likelihood of infection (Anderson, 1973). All hazard zones occur in the Hardwood Hills Subsection. In the high risk zones, damage will usually occur to more than 50% of the established white pines and it will be very difficult to establish new plantings and natural regeneration. The “probability of a stand experiencing high levels of blister rust mortality is great in this zone. Choosing planting sites based on microclimatic factors is critical” (Jones, 1989). Establishing white pine as an understory tree will help mitigate the impacts from blister rust. For more information, please see the references.

RED PINE

Damage Agents

- **Diplodia tip blight and canker –** *Diplodia pinea*
  Diplodia damage can be locally high on sites where large infected red pine and jack pine are left on or next to sites being regenerated to red pine or jack pine. It causes a tip blight as well as a canker that can girdle branches and stems and kill trees. It spreads most during wet weather where it can infect through wounds, but this fungus does not require a wound for infection. A strain of this fungus can cause latent infections, which become activated when the host trees become stressed from such things as drought, overcrowding, or "j" rooting.

- **Bark beetles** (pine engraver beetle) - *Ips pini*
  Many species of conifer bark beetles exist in Minnesota. The pine engraver beetle is very common and sometimes very abundant in pine plantations. Stress from drought, overcrowding, equipment and fire scarring, and weather events such as hail, snow, and ice breakage can reduce tree vigor and predispose the trees to bark beetle attack. Stressed trees cannot defend themselves against bark beetle attacks and it becomes easy for the beetles to kill the trees.

- **Heterobasidion root disease** – *Heterobasidium* spp.
  Not known to be in Minnesota in 2010, this exotic fungal disease affects wounded pines and spruces causing tree mortality. Once carried into a plantation, in debris, fruiting bodies, diseased roots or wood, this fungus infects cut stumps and root systems. Infected trees die and the fungus spreads through root systems to adjacent healthy trees, creating an ever-expanding disease pocket. Neither pines nor spruces can grow in the infection centers for many decades.

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Red Pine Management Implications

This is a long-lived tree species that is relatively free of potential catastrophic pests problems. Concerns are more directed at young stands regenerating under existing stands of pine. As management strategies lead to more partial harvesting and development of all-aged stands, understory pines will be susceptible to both shoot blights. Bark beetle problems will arise in plantations when they're under drought stress and/or slash-creating activities have occurred in the spring or summer. Efforts should be taken to prevent the movement of *Heterobasdion* into pine plantations. See the DOF – Invasives Species OP Order for more information.

BALSAM FIR

Damage Agents

- **Spruce budworm -** *Choristoneura fumiferana*
  Spruce budworm (SBW), a native insect defoliator of balsam fir and spruce, causes topkill and mortality.

  Spruce budworm-caused damage tends to be higher in older-age fir. Stands with multiple ages of fir often experience greater levels of damage to the young fir trees than would normally occur in single-age stands. Balsam fir is the preferred host, but since 1990 budworm has been causing defoliation, top kill, and mortality in plantations of white spruce that are 25 years and older.

- **Sirex woodwasp** – *Sirex noctilio*
  This invasive exotic insect is not known to be in Minnesota in 2010, but it can be spread very rapidly in fresh logs and firewood. This insect will kill all pines, all spruces, balsam fir and tamarack. *Sirex* is an exotic that could be a very serious mortality agent in natural stands and plantations. Sirex wood wasps thrive in decadent and dying pines and spruces where they build up population numbers and are able to mass attack healthy trees and kill them. If *Sirex* is suspected, please contact MDA (Hot-line is 1-888-545-6684) and your Regional Forest Health Specialist.

Balsam Fir Management Implications

Spruce budworm is a sporadic invader of this subsection; however, management strategies that increase the component of balsam fir will only lead to more frequent and more severe SBW outbreaks. Since the older stands tend to serve as the niches in which the budworm builds up, strategies to develop extended rotation balsam fir will only add to the potential for stand-destroying budworm populations to develop.

WHITE SPRUCE

Damage Agents

- **Spruce budworm -** *Choristoneura fumiferana*
  See spruce budworm discussion under the balsam fir cover type.

- **Heterobasidion root disease** – *Heterobasidium* spp.
  Not known to be in Minnesota in 2010, this exotic fungal disease affects wounded pines and spruces causing tree mortality. Once carried into a plantation, in debris, fruiting bodies, diseased roots or wood, this fungus infects cut stumps and root systems. Infected trees die and the fungus spreads through root systems to adjacent healthy trees, creating an ever-expanding disease pocket. Neither pines nor spruces can grow in the infection centers for many decades.

- **Sirex woodwasp** – *Sirex noctilio*
  This invasive exotic insect is not known to be in Minnesota in 2010, but it can be spread very rapidly in fresh logs and firewood. This insect will kill all pines, all spruces, balsam fir and tamarack. *Sirex* is an exotic that could be a very serious mortality agent in natural stands and plantations. Sirex wood wasps thrive in decadent and dying pines and spruces where they build up population numbers and are

able to mass attack healthy trees and kill them. If *Sirex* is suspected, please contact MDA (Hot-line is 1-888-545-6684) and your Regional Forest Health Specialist.

White Spruce Management Implications

The occurrence of spruce budworm in white spruce plantations may be related to the plantations being overcrowded and not managed. Commitments must be made to do early and periodic thinning in the white spruce plantations.

BLACK SPRUCE

Damage Agents

- **Eastern dwarf mistletoe -** *Arceuthobium pusillum*
  Dwarf mistletoe is a disease caused by a parasitic seed plant and is the major mortality agent of black spruce. It primarily affects black spruce, but occasionally is found on white spruce and tamarack. It causes witches brooms on infected trees, and trees of all sizes become infected and killed. Catastrophic fires were the major factor in keeping this disease in check in the past. Once a stand is infected, it remains infected until all the mistletoe-infected trees are killed by fire, harvesting, or shearing. Residual infected trees left behind after harvesting introduce the disease to the regenerating stand. Mistletoe spreads locally by seeds that are explosively discharged and can travel up to 60 feet. Long-distance spread is by birds carrying the sticky seeds on their feet and feathers. When an even-aged stand becomes infected, the large trees are killed, creating openings in the stand. Young trees seed into these openings and become infected. The stand then gradually changes to an all-aged stand with heavy infections of all ages and very little to no merchantable volume.

- **Heterobasidion root disease** – *Heterobasidium* spp.
  Not known to be in Minnesota in 2010, this exotic fungal disease affects wounded pines and spruces causing tree mortality. Once carried into a plantation, in debris, fruiting bodies, diseased roots or wood, this fungus infects cut stumps and root systems. Infected trees die and the fungus spreads through root systems to adjacent healthy trees, creating an ever-expanding disease pocket. Neither pines nor spruces can grow in the infection centers for many decades.

- **Sirex woodwasp** – *Sirex noctilio* .
  This invasive exotic insect is not known to be in Minnesota in 2010, but it can be spread very rapidly in fresh logs and firewood. This insect will kill all pines, all spruces, balsam fir and tamarack. *Sirex* is an exotic that could be a very serious mortality agent in natural stands and plantations. Sirex wood wasps thrive in decadent and dying pines and spruces where they build up population numbers and are able to mass attack healthy trees and kill them. If *Sirex* is suspected, please contact MDA (Hot-line is 1-888-545-6684) and your Regional Forest Health Specialist.

Black Spruce Management Implications

Incidence of this disease is increasing due to the absence of fire and because there is no practical means of killing all infected trees at the time of harvest. Shearing after the harvest has also met with a variety of successes and rarely eradicates mistletoe from the stand. Even young trees that are infected will live long enough to continue the cycle of dwarf mistletoe in the regenerating stand. These young, infected trees are nearly impossible to kill in the absence of fire. If dwarf mistletoe is not aggressively eradicated from

black spruce stands when harvesting and regenerating the stands, the total acreage of this cover type will decline.

6.4 Additional Information Sources

Additional information on these and other insects and diseases of forest trees in Minnesota can be obtained by referring to the Minnesota Forest Health Reports prepared by the MN DNR, Division of Forestry, Forest Health Unit. They can be found in the DNR Library in St. Paul and in various other libraries in the state. They have been printed on an annual basis since at least 1974. The title has varied over the years from the Forest Pest Report, to the Forest Insect and Disease Report, to the current title of Minnesota Forest Health Annual Report. They contain data on the insect and diseases included in this assessment as well as others. Observations and annual survey results are included. Current information can be found in the Minnesota DNR Forest Insect and Disease Newsletter, which is published four or five times during the growing season and can be accessed online through the DNR Web site at http://www.dnr.state.mn.us/fid/index.html.

Other sources of information include reports from the USDA Forest Service, University of Minnesota, and Minnesota Department of Agriculture.

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CHAPTER 7

Wildlife Species Status & Trends

Hardwood Hills Subsection

Notes relating to this chapter:
Color maps may be viewed as PDF files on the Hardwood Hills Subsection Forest Resource Management Plan (SFRMP) Web site at:
www.dnr.state.mn.us/forestry/subsection/hardwoodhills/index.html

Maps in this chapter depict information for an area within a "planning boundary." This boundary is designed to closely approximate the subsection while capturing data summary and planning efficiencies by using survey or jurisdiction lines in some cases.

Printed documents will be available for review at the Minnesota DNR Northwest Region Headquarters at 2115 Birchmont Beach Road N.E., Bemidji, Minnesota,56601 and on compact disk by request to Pat Matuseski at (218) 308-2381 or pat.matuseski@state.mn.us.

Chapter 7 provides information on the occurrence, legal status and the population trends of wildlife species in this subsection. Species presence information is summarized from data collected by the Minnesota Gap Analysis Project (MN-GAP), a project organized to provide a state assessment on the conservation status of native vertebrate species and natural land cover types.

A recent initiative, *Minnesota's Comprehensive Wildlife Conservation Strategy*, is a strategic plan to better manage populations of "species in greatest conservation need (SGCN)". Species of greatest conservation need (SGCN) are defined as "animals whose populations are rare, declining, or vulnerable to decline and are below levels desirable to ensure their long-term health and stability". Please see chapter 5 of this assessment document for additional information on SCGNs species in the Hardwood Hills Subsection.

MN DNR was a partner in development of this plan, and is committed to working towards its implementation, both internally and with external partners. The plan includes goals and targets for stabilizing and increasing populations of species in greatest conservation need, improving knowledge about these species, and enhancing people's appreciation and enjoyment of them.

In this assessment, select information is presented on SGCN species presence in the Hardwood Hills subsection covered by this forest resource management plan. A copy of the full plan may be viewed on the MN DNR public website at this location: http://www.dnr.state.mn.us/cwcs/strategy.html

Terrestrial, Vertebrate Species List
Hardwood Hills ECS Subsection

Information Source: The following information has been summarized from ongoing efforts of the Minnesota Gap Analysis Project (MN-GAP), a project to provide a statewide assessment on the conservation status of native vertebrate species and natural land cover types.
Species Criteria: Species criteria for MN-GAP includes the following: 1) Be known to breed in Minnesota (evidence of breeding 5 of the past 10 years) and be a regularly occurring non-accidental, 2) Be listed as state endangered, threatened, or special concern or as federally endangered or threatened, 3) Be listed as a furbearer, big game, small game, or migratory bird in Minnesota, and, 4) Be an exotic species in Minnesota that impacts native species or is of management interest.

Species Group: Notes one of four major species groups - Amphibians, Reptiles, Birds, and Mammals.

Species Common and Scientific Names: Notes standard MN-GAP protocol based on NatureServe and it's related searchable plant, animal and ecological database called NatureServe Explorer located at www.natureserveexplorer.org.

Resident Status: R=Regular occurring resident as Breeding, Nesting, or Migratory (acceptable records exists in at least eight of the past ten years); PR=Permanent Resident (exists year-round).

Minnesota Legal Status: E = State Endangered; T = State Threatened; SC = State Species of Special Concern; BG = Big Game; SG = Small Game; F = Furbearer; MW = Migratory Waterfowl; UB = Unprotected Bird; PB = Protected Bird; PWA = Protected Wild Animal; UWA = Unprotected Wild Animal. Note: A species may have more than one Minnesota Legal Status notation.

Federal Legal Status: T = Federal Threatened; E = Federal Endangered; P = Federal Protection by the Migratory Bird Treaty Act or Bald Eagle Protection Act or CITES.

DISCLAIMER: Information and data listed in these tables has been produced by ongoing wildlife species assessment efforts conducted under the MNDNR Division of Fish and Wildlife's Minnesota Gap Analysis Project (MN-GAP). This effort and related tables noted here are unpublished products that are currently in various stages of literature and expert review.

Table 7.1: Terrestrial Vertebrate Species List

Species Common Name	*Scientific Name*	Resdient Status	MN legal status	Federal legal status
AMPHIBIANS				
Blue-spotted Salamander	*Ambystoma laterale*	PR		
Tiger Salamander	*Ambystoma tigrinum*	PR		
Eastern Newt	*Notophthalmus viridescens*	PR		
American Toad	*Bufo americanus*	PR	PWA	
Canadian Toad	*Bufo hemiophrys*	PR	PWA	
Cope's Gray Treefrog	*Hyla chrysoscelis*	PR	PWA	
Gray Treefrog	*Hyla versicolor*	PR	PWA	
Western Chorus Frog	*Pseudacris triseriata*	PR	PWA	
Northern Leopard Frog	*Rana pipiens*	PR	PWA	
Mink Frog	*Rana septentrionalis*	PR	PWA	
Wood Frog	*Rana sylvatica*	PR	PWA	
REPTILES				
Snapping Turtle	*Chelydra serpentina*	PR	PWA, SC	
Painted Turtle	*Chrysemys picta*	PR	PWA	

Blanding's Turtle	*Emydoidea blandingii*	PR	PWA, T	
Prairie Skink	*Eumeces septentrionalis*	PR		
Redbelly Snake	*Storeria occipitomaculata*	PR		
Plains Garter Snake	*Thamnophis radix*	PR		
Common Garter Snake	*Thamnophis sirtalis*	PR		
Smooth Green Snake	*Liochlorophis vernalis*	PR		

BIRDS

Common Loon	*Gavia immer*	R	PB	P
Pied-billed Grebe	*Podilymbus podiceps*	R	PB	P
Red-necked Grebe	*Podiceps grisegena*	R	PB	P
Eared Grebe	*Podiceps nigricollis*	R	PB	P
Western Grebe	*Aechmophorus occidentalis*	R	PB	P
Clark's Grebe	*Aechmophorus clarkii*	R	PB	P
Double-crested Cormorant	*Phalacrocorax auritus*	R	UB	P
American Bittern	*Botaurus lentiginosus*	R	PB	P
Least Bittern	*Ixobrychus exilis*	R	PB	P
Great Blue Heron	*Ardea herodias*	R	PB	P
Great Egret	*Ardea albus*	R	PB	P
Green Heron	*Butorides virescens*	R	PB	P
Black-crowned Night-heron	*Nycticorax nycticorax*	R	PB	P
Trumpeter Swan	*Cygnus buccinator*	R	PB, MW, T	P
Canada Goose	*Branta canadensis*	R	PB, MW	P
Wood Duck	*Aix sponsa*	R	PB, MW	P
Mallard	*Anas platyrhynchos*	R	PB, MW	P
Northern Pintail	*Anas acuta*	R	PB, MW	P
Blue-winged Teal	*Anas discors*	R	PB, MW	P
Northern Shoveler	*Anas clypeata*	R	PB, MW	P
Gadwall	*Anas strepera*	R	PB, MW	P
Canvasback	*Aythya valisineria*	R	PB, MW	P
Redhead	*Aythya americana*	R	PB, MW	P
Ring-necked Duck	*Aythya collaris*	R	PB, MW	P
Hooded Merganser	*Lophodytes cucullatus*	R	PB, MW	P
Ruddy Duck	*Oxyura jamaicensis*	R	PB, MW	P
Turkey Vulture	*Cathartes aura*	R	PB	P
Osprey	*Pandion haliaetus*	R	PB	P
Bald Eagle	*Haliaeetus leucocephalus*	R	PB, SC	P/T
Northern Harrier	*Circus cyaneus*	R	PB	
Cooper's Hawk	*Accipiter cooperii*	R	PB	
Red-shouldered Hawk	*Buteo lineatus*	R	PB, SC	
Broad-winged Hawk	*Buteo platypterus*	R	PB	
Red-tailed Hawk	*Buteo jamaicensis*	R	PB	
American Kestrel	*Falco sparverius*	R	PB	
Gray Partridge	*Perdix perdix*	PR	PB, SG	
Ring-necked Pheasant	*Phasianus colchicus*	PR	PB, SG	
Ruffed Grouse	*Bonasa umbellus*	PR	PB, SG	
Wild Turkey	*Meleagris gallopavo*	PR	PB, SG	
Virginia Rail	*Rallus limicola*	R	PB, SG	
Sora	*Porzana carolina*	R	PB, SG	

American Coot	*Fulica americana*	R	PB, SG	
Sandhill Crane	*Grus canadensis*	R	PB	
Killdeer	*Charadrius vociferus*	R	PB	
Spotted Sandpiper	*Actitis macularia*	R	PB	
Upland Sandpiper	*Bartramia longicauda*	R	PB	
American Woodcock	*Scolopax minor*	R	PB, SG	
Wilson's Phalarope	*Phalaropus tricolor*	R	PB, T	
Forster's Tern	*Sterna forsteri*	R	PB, SC	
Black Tern	*Chlidonias niger*	R	PB	
Rock Dove	*Columba livia*	R	PB	
Mourning Dove	*Zenaida macroura*	R	PB	
Black-billed Cuckoo	*Coccyzus erythropthalmus*	R	PB	
Yellow-billed Cuckoo	*Coccyzus americanus*	R	PB	
Eastern Screech-Owl	*Otus asio*	PR	PB	
Great Horned Owl	*Bubo virginianus*	PR	UB	
Barred Owl	*Strix varia*	PR	PB	
Long-eared Owl	*Asio otus*	PR	PB	
Short-eared Owl	*Asio flammeus*	R	PB, SC	
Northern Saw-whet Owl	*Aegolius acadicus*	R	PB	
Common Nighthawk	*Chordeiles minor*	R	PB	
Whip-poor-will	*Caprimulgus vociferus*	R	PB	
Chimney Swift	*Chaetura pelagica*	R	PB	
Ruby-throated Hummingbird	*Archilochus colubris*	R	PB	
Belted Kingfisher	*Ceryle alcyon*	R	PB	
Red-headed Woodpecker	*Melanerpes erythrocephalus*	R	PB	
Red-bellied Woodpecker	*Melanerpes carolinus*	PR	PB	
Yellow-bellied Sapsucker	*Sphyrapicus varius*	R	PB	
Downy Woodpecker	*Picoides pubescens*	PR	PB	
Hairy Woodpecker	*Picoides villosus*	PR	PB	
Northern Flicker	*Colaptes auratus*	R	PB	
Pileated Woodpecker	*Dryocopus pileatus*	PR	PB	
Eastern Wood-Pewee	*Contopus virens*	R	PB	
Alder Flycatcher	*Empidonax alnorum*	R	PB	
Willow Flycatcher	*Empidonax traillii*	R	PB	
Least Flycatcher	*Empidonax minimus*	R	PB	
Eastern Phoebe	*Sayornis phoebe*	R	PB	
Great Crested Flycatcher	*Myiarchus crinitus*	R	PB	
Western Kingbird	*Tyrannus verticalis*	R	PB	
Eastern Kingbird	*Tyrannus tyrannus*	R	PB	
Horned Lark	*Eremophila alpestris*	R	PB	
Purple Martin	*Progne subis*	R	PB	
Tree Swallow	*Tachycineta bicolor*	R	PB	
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	R	PB	
Bank Swallow	*Riparia riparia*	R	PB	
Cliff Swallow	*Petrochelidon pyrrhonota*	R	PB	
Barn Swallow	*Hirundo rustica*	R	PB	
Blue Jay	*Cyanocitta cristata*	PR	PB	
American Crow	*Corvus brachyrhynchos*	PR	PB	
Black-capped Chickadee	*Poecile atricapillus*	PR	PB	

Red-breasted Nuthatch	*Sitta canadensis*	PR	PB	
White-breasted Nuthatch	*Sitta carolinensis*	PR	PB	
House Wren	*Troglodytes aedon*	R	PB	
Winter Wren	*Troglodytes troglodytes*	R	PB	
Sedge Wren	*Cistothorus platensis*	R	PB	
Marsh Wren	*Cistothorus palustris*	R	PB	
Blue-gray Gnatcatcher	*Polioptila caerulea*	R	PB	
Eastern Bluebird	*Sialia sialis*	R	PB	
Veery	*Catharus fuscescens*	R	PB	
Hermit Thrush	*Catharus guttatus*	R	PB	
Wood Thrush	*Hylocichla mustelina*	R	PB	
American Robin	*Turdus migratorius*	R	PB	
Gray Catbird	*Dumetella carolinensis*	R	PB	
Brown Thrasher	*Toxostoma rufum*	R	PB	
European Starling	*Sturnus vulgaris*	PR	UB	
Cedar Waxwing	*Bombycilla cedrorum*	R	PB	
Yellow-throated Vireo	*Vireo flavifrons*	R	PB	
Warbling Vireo	*Vireo gilvus*	R	PB	
Red-eyed Vireo	*Vireo olivaceus*	R	PB	
Golden-winged Warbler	*Vermivora chrysoptera*	R	PB	
Nashville Warbler	*Vermivora ruficapilla*	R	PB	
Yellow Warbler	*Dendroica petechia*	R	PB	
Chestnut-sided Warbler	*Dendroica pensylvanica*	R	PB	
Cerulean Warbler	*Dendroica cerulea*	R	PB, SC	
Black-and-white Warbler	*Mniotilta varia*	R	PB	
American Redstart	*Setophaga ruticilla*	R	PB	
Ovenbird	*Seiurus aurocapillus*	R	PB	
Northern Waterthrush	*Seiurus noveboracensis*	R	PB	
Common Yellowthroat	*Geothlypis trichas*	R	PB	
Scarlet Tanager	*Piranga olivacea*	R	PB	
Northern Cardinal	*Cardinalis cardinalis*	PR	PB	
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	R	PB	
Indigo Bunting	*Passerina cyanea*	R	PB	
Dickcissel	*Spiza americana*	R	PB	
Eastern Towhee	*Pipilo erythrophthalmus*	R	PB	
Chipping Sparrow	*Spizella passerina*	R	PB	
Clay-colored Sparrow	*Spizella pallida*	R	PB	
Field Sparrow	*Spizella pusilla*	R	PB	
Vesper Sparrow	*Pooecetes gramineus*	R	PB	
Lark Sparrow	*Chondestes grammacus*	R	PB	
Savannah Sparrow	*Passerculus sandwichensis*	R	PB	
Grasshopper Sparrow	*Ammodramus savannarum*	R	PB	
Le Conte's Sparrow	*Ammodramus leconteii*	R	PB	
Nelson's Sharp-tailed sparrow	*Ammodramus nelsoni*	R	PB, SC	
Song Sparrow	*Melospiza melodia*	R	PB	
Swamp Sparrow	*Melospiza georgiana*	R	PB	
White-throated Sparrow	*Zonotrichia albicollis*	R	PB	
Bobolink	*Dolichonyx oryzivorus*	R	PB	
Red-winged Blackbird	*Agelaius phoeniceus*	R	UB	

Eastern Meadowlark	*Sturnella magna*	R	PB	
Western Meadowlark	*Sturnella neglecta*	R	PB	
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	R	UB	
Brewer's Blackbird	*Euphagus cyanocephalus*	R	UB	
Common Grackle	*Quiscalus quiscula*	R	UB	
Brown-headed Cowbird	*Molothrus ater*	R	PB	
Baltimore Oriole	*Icterus galbula*	R	PB	
Purple Finch	*Carpodacus purpureus*	R	PB	
House Finch	*Carpodacus mexicanus*	PR	PB	
Pine Siskin	*Carduelis pinus*	R	PB	
American Goldfinch	*Carduelis tristis*	R	PB	

MAMMALS

Cinereus Shrew	*Sorex cinereus*	PR		
Water Shrew	*Sorex palustris*	PR		
Arctic Shrew	*Sorex arcticus*	PR		
Pygmy Shrew	*Sorex hoyi*	PR		
Northern Short-tailed Shrew	*Blarina brevicauda*	PR		
Star-nosed Mole	*Condylura cristata*	PR		
Little Brown Bat	*Myotis lucifugus*	PR		
Northern Myotis	*Myotis septentrionalis*	PR	SC	
Silver-haired Bat	*Lasionycteris noctivagans*	R		
Big Brown Bat	*Eptesicus fuscus*	PR		
Eastern Red Bat	*Lasiurus borealis*	R		
Hoary Bat	*Lasiurus cinereus*	R		
Eastern Cottontail	*Sylvilagus floridanus*	PR	PWA, SG	
Snowshoe Hare	*Lepus americanus*	PR	PWA, SG	
White-tailed Jackrabbit	*Lepus townsendii*	PR	PWA, SG	
Eastern Chipmunk	*Tamias striatus*	PR		
Woodchuck	*Marmota monax*	PR		
Thirteen-lined Ground Squirrel	*Spermophilus tridecemlineatus*	PR		
Franklin's Ground Squirrel	*Spermophilus franklinii*	PR		
Eastern Gray Squirrel	*Sciurus carolinensis*	PR	PWA, SG	
Eastern Fox Squirrel	*Sciurus niger*	PR	PWA, SG	
Red Squirrel	*Tamiasciurus hudsonicus*	PR		
Southern Flying Squirrel	*Glaucomys volans*	PR		
Northern Flying Squirrel	*Glaucomys sabrinus*			
Plains Pocket Gopher	*Geomys bursarius*	PR	UWA	
American Beaver	*Castor canadensis*	PR	PWA, SG, F	
Prairie Deer Mouse	*Peromyscus maniculatus bairdii*	PR		
White-footed Mouse	*Peromyscus leucopus*	PR		
Southern Red-backed Vole	*Clethrionomys gapperi*	PR		
Meadow Vole	*Microtus pennsylvanicus*	PR		
Prairie Vole	*Microtus ochrogaster*	PR	SC	
Muskrat	*Ondatra zibethicus*	PR	PWA, SG, F	
Meadow Jumping Mouse	*Zapus hudsonius*	PR		
North American Porcupine	*Erethizon dorsatum*	PR	UWA	
Coyote	*Canis latrans*	PR	UWA	

Gray Wolf	*Canis lupus*	PR	SC	T
Red Fox	*Vulpes vulpes*	PR	PWA, SG, F	
Gray Fox	*Urocyon cinereoargenteus*	PR	PWA, SG, F	
American Black Bear	*Ursus americanus*	PR	PWA, BG	
Northern Raccoon	*Procyon lotor*	PR	PWA, SG, F	
Ermine	*Mustela erminea*	PR	UWA	
American Mink	*Mustela vison*	PR	PWA, SG, F	
American Badger	*Taxidea taxus*	PR	PWA, SG, F	
Striped Skunk	*Mephitis mephitis*	PR	UWA	
Northern River Otter	*Lontra canadensis*	PR	PWA, SG, F	
Bobcat	*Lynx rufus*	PR	PWA, SG, F	
White-tailed Deer	*Odocoileus virginianus*	PR	PWA, BG	

This page contains a standard table header format, column/row format, content description and selected species examples for the following tables: Mammals; Birds; and, Amphibians and Reptiles.

Wildlife Habitat Relationships - Hardwood Hills ECS Subsection

habitat relationships by Minnesota Gap Analysis Project (MN-GAP) land cover type>>

Non-Forested types>>> | Forest land cover types>>>

SPECIES GROUP / Species Common Name	Habitat feature	Barren	Urban/ Dev.			Ag./Grass			Shrub			Aquatic				Upland Coniferous Forest								Up. coniferous/deciduous mix	Lowland Coniferous Forest								Upland Deciduous Forest					Lowland Deciduous Forest				Low. deciduous/coniferous mix	Forest size class				
			High intensity urban	Low intensity urban	Transportation	Cropland	Grassland	Prairie	Upland shrub	Lowland deciduous shrub	Lowland evergreen shrub	Water	Floating aquatic	Sedge Meadow	Broadleaf sedge/Cattail	Jack Pine	Red Pine	White Pine mix	Balsam Fir mix	White Spruce	Upland Black Spruce	Up. N. White Cedar	Upland Conifer		Lowland Black Spruce	Stagnant black spruce	Tamarack	Stagnant tamarack	Low. N. White Cedar	Stagnant N. White Cedar	Stagnant conifer	Aspen/White Birch	Bur/White Oak	Red Oak	Maple/Basswood	Upland deciduous mix	Black Ash	Silver Maple	Cottonwood	Lowland deciduous mix		Seedling	Sapling	Pole timber	Saw timber	Uneven
NUTHATCHES																																												
Red-breasted Nuthatch	CS															Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y									Y			Y	Y	Y
White-breasted Nuthatch	CS																														Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y

The above table and its content serve to note habitat relationships (i.e. land cover types, habitat features and forest size class) of wildlife known or predicted to occur in the Hardwood Hills ECS Subsection. Details to this information is as follows:

SPECIES GROUP:	Notes a common species group to search by.
Species common name:	Species common name as standardized through NatureServe located at <www.natureserveexplorer.org>.
Habitat feature:	C = Cavity, D = Dead/down material, M = Mast, R = Riparian, S = Snag, V = Vernal pool
Habitat relationships:	Y = species utilizes noted land cover type for at least part of its habitat needs.
Forest age class/successional stage:	Y = species utilizes noted age class/successional stage for at least part of its habitat needs.

Table 7.2: Mammal Habitat Relationships by Minnesota Gap Analysis Project (MN-GAP) land cover type

WILDLIFE HABITAT RELATIONSHIPS - HARDWOOD HILLS ECS SUBSECTION

Habitat relationships by Minnesota Gap Analysis Project (MN-GAP) land cover type

Non-Forest land cover types>>> Forest land cover types>>>

			Urban/ Dev.			Ag./Grass			Shrub			Aquatic				Upland Coniferous Forest									Lowland Coniferous Forest							Upland Deciduous Forest					Lowland Deciduous Forest					Forest size class				
SPECIES GROUP Species common name	habitat Feature	Barren	High intensity urban	Low intensity urban	Transportation	Cropland	Grassland	Prairie	Upland shrub	Lowland deciduous shrub	Lowland evergreen shrub	Water	Floating aquatic	Sedge Meadow	Broadleaf sedge/Cattail	Jack Pine	Red Pine	White Pine mix	Balsam Fir mix	White Spruce	Upland Black Spruce	Up. N. White Cedar	Upland Conifer	Up. coniferous/deciduous mix	Lowland Black Spruce	Stagnant black spruce	Tamarack	Stagnant tamarack	Low. N. White Cedar	Stagnant N. White Cedar	Stagnant conifer	Aspen/White Birch	Bur/White Oak	Red Oak	Maple/Basswood	Upland deciduous mix	Black Ash	Silver Maple	Cottonwood	Lowland deciduous mix	Low. deciduous/coniferous mix	Seedling	Sapling	Pole timber	Saw timber	Uneven
INSECTIVORES																																														
Cinereus Shrew	D						Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Water Shrew	DR									Y	Y	Y		Y	Y										Y	Y	Y	Y	Y	Y	Y													Y	Y	Y
Arctic Shrew	R						Y	Y		Y	Y			Y	Y				Y		Y			Y	Y	Y	Y	Y	Y	Y	Y						Y			Y	Y	Y	Y	Y	Y	Y
Pygmy Shrew	D						Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				Y					Y	Y	Y	Y	Y	Y
Northern Short-tailed Shrew	D	Y		Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Star-nosed Mole	DR									Y	Y			Y	Y										Y	Y	Y	Y	Y	Y	Y						Y	Y		Y	Y			Y	Y	Y
BATS																																														
Big Brown Bat	CRS			Y			Y	Y				Y				Y	Y	Y		Y	Y			Y								Y	Y	Y		Y			Y	Y	Y			Y	Y	
Silver-haired Bat	CRS											Y					Y	Y		Y			Y	Y	Y		Y		Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				Y	Y
Eastern Red Bat	CR		Y	Y			Y		Y	Y		Y			Y					Y	Y											Y	Y	Y	Y	Y	Y	Y	Y	Y					Y	Y
Hoary Bat	R			Y			Y		Y			Y				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y		Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y
Little Brown Bat	CRS						Y	Y	Y	Y		Y		Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y		Y		Y			Y	Y	Y	Y	Y	Y	Y		Y	Y	Y				
Northern Myotis	CRS		Y	Y												Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y		Y			Y	Y	Y	Y	Y	Y	Y		Y	Y				Y	Y
CARNIVORES																																														
Coyote	M	Y		Y		Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Gray Wolf	M					Y	Y		Y	Y	Y					Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Gray Fox	CDM					Y	Y	Y	Y	Y																							Y	Y	Y	Y	Y	Y	Y	Y					Y	Y
Red Fox		Y		Y		Y	Y	Y	Y	Y				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y								Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bobcat	CD								Y	Y						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				Y	Y	Y	Y	Y	Y	Y
Northern River Otter												Y	Y	Y	Y																															
Ermine	DR								Y	Y						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
American Mink	DR									Y		Y	Y	Y	Y																															
American Badger						Y	Y	Y	Y																								Y													
Striped Skunk	DM			Y		Y	Y	Y	Y							Y	Y	Y	Y	Y	Y	Y	Y	Y								Y	Y	Y	Y	Y						Y	Y	Y	Y	Y
Northern Raccoon	CMRS	Y		Y		Y	Y		Y	Y		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y								Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				Y	Y
American Black Bear	CDMR								Y								Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Habitat relationships by Minnesota Gap Analysis Project (MN-GAP) land cover type

Non-Forest land cover types>>> Forest land cover types>>>

SPECIES GROUP Species common name	habitat Feature		Barren	High intensity urban	Low intensity urban	Transportation	Cropland	Grassland	Prairie	Upland shrub	Lowland deciduous shrub	Lowland evergreen shrub	Water	Floating aquatic	Sedge Meadow	Broadleaf sedge/Cattail	Jack Pine	Red Pine	White Pine mix	Balsam Fir mix	White Spruce	Upland Black Spruce	Up. N. White Cedar	Upland Conifer	Up. coniferous/deciduous mix	Lowland Black Spruce	Stagnant black spruce	Tamarack	Stagnant tamarack	Low. N. White Cedar	Stagnant N. White Cedar	Stagnant conifer	Aspen/White Birch	Bur/White Oak	Red Oak	Maple/Basswood	Upland deciduous mix	Black Ash	Silver Maple	Cottonwood	Lowland deciduous mix	Low. deciduous/coniferous mix		Seedling	Sapling	Pole timber	Saw timber	Uneven
				Urban/ Dev.			Ag./Grass			Shrub			Aquatic				Upland Coniferous Forest									Lowland Coniferous Forest							Upland Deciduous Forest					Lowland Deciduous Forest						Forest size class				
EVEN-TOED UNGULATES																																																
White-tailed Deer							Y	Y	Y	Y							Y	Y	Y	Y	Y	Y	Y	Y	Y								Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y
RODENTS																																																
Northern Flying Squirrel	CDMS																Y	Y	Y	Y	Y	Y	Y	Y	Y											Y						Y					Y	Y
Southern Flying Squirrel	CDMS																																	Y	Y	Y	Y	Y	Y							Y	Y	Y
Woodchuck					Y		Y	Y		Y	Y																							Y	Y									Y				
Eastern Gray Squirrel	CDM				Y		Y																		Y									Y	Y	Y	Y	Y									Y	
Eastern Fox Squirrel	CDM				Y			Y																										Y	Y	Y	Y		Y								Y	Y
Franklin's Ground Squirrel					Y			Y	Y	Y																																				Y	Y	
Thirteen-lined Ground Squirrel					Y		Y	Y	Y	Y																																						
Eastern Chipmunk	DM				Y			Y		Y	Y							Y	Y		Y	Y	Y	Y	Y								Y	Y	Y	Y	Y			Y				Y	Y	Y	Y	Y
Red Squirrel	CDMS																Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y										Y				Y	Y	Y
American Beaver	R									Y	Y		Y																				Y				Y							Y	Y	Y	Y	Y
Plains Pocket Gopher							Y	Y	Y	Y																							Y	Y	Y	Y	Y							Y	Y			
Meadow Jumping Mouse								Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y		Y																				Y				
Prairie Deer Mouse																																																
White-footed Mouse	CDMS									Y							Y	Y	Y	Y	Y	Y		Y	Y								Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y
Southern Red-backed Vole	DM									Y	Y	Y					Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y
Meadow Vole								Y		Y					Y	Y	Y	Y	Y														Y	Y	Y	Y	Y											
Prairie Vole								Y	Y	Y	Y				Y			Y	Y						Y									Y	Y	Y	Y											
Muskrat	R										Y		Y	Y		Y																																
North American Porcupine	CDS																Y	Y	Y	Y	Y	Y		Y	Y											Y	Y					Y				Y	Y	Y
RABBITS AND HARES																																																
Eastern Cottontail	E				Y		Y	Y	Y	Y	Y														Y								Y	Y	Y	Y	Y			Y	Y	Y		Y				
Snowshoe Hare										Y	Y	Y					Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y
White-tailed Jackrabbit								Y	Y	Y	Y																																					

Table 7.3: Bird Habitat Relationships by Minnesota Gap Analysis Project (MN-GAP) land cover type

WILDLIFE HABITAT RELATIONSHIPS - BIRDS

Habitat relationships by Minnesota Gap Analysis Project (MN-GAP) land cover type>>

Non-Forested types>>> Forest land cover types>>>

			Urban/ Dev.			Ag./Grass			Shrub			Aquatic				Upland Coniferous Forest									Lowland Coniferous Forest							Upland Deciduous Forest					Lowland Deciduous Forest						Forest size class				
SPECIES GROUP Species Common Name	Habitat feature	Barren	High intensity urban	Low intensity urban	Transportation	Cropland	Grassland	Prairie	Upland shrub	Lowland deciduous shrub	Lowland evergreen shrub	Water	Floating aquatic	Sedge Meadow	Broadleaf sedge/Cattail	Jack Pine	Red Pine	White Pine mix	Balsam Fir mix	White Spruce	Upland Black Spruce	Up. N. White Cedar	Upland Conifer	Up. coniferous/deciduous mix	Lowland Black Spruce	Stagnant black spruce	Tamarack	Stagnant tamarack	Low. N. White Cedar	Stagnant N. White Cedar	Stagnant conifer	Aspen/White Birch	Bur/White Oak	Red Oak	Maple/Basswood	Upland deciduous mix	Black Ash	Silver Maple	Cottonwood	Lowland deciduous mix	Low. deciduous/coniferous mix		Seedling	Sapling	Pole timber	Saw timber	Uneven
LOONS AND GREBES																																															
Common Loon												Y	Y																																		
Pied-billed Grebe												Y	Y	Y	Y																																
Red-necked Grebe												Y	Y		Y																																
Eared Grebe												Y	Y		Y																																
Western Grebe												Y	Y		Y																																
Clark's Grebe												Y	Y		Y																																
PELICANS AND CORMORANTS																																															
Double-crested Cormorant	RS											Y	Y	Y	Y																	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y					Y	Y
HERONS AND BITTERNS																																															
American Bittern	R						Y	Y		Y		Y	Y	Y	Y																																
Least Bittern	R									Y		Y	Y	Y	Y																																
Great Egret	R						Y	Y				Y	Y	Y	Y																		Y	Y	Y	Y	Y	Y	Y	Y	Y					Y	Y
Great Blue Heron	RS											Y	Y	Y	Y																	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y					Y	Y
Green Heron	R								Y	Y		Y	Y	Y	Y												Y	Y									Y	Y	Y	Y	Y					Y	Y
Black-crowned Hight-heron	R									Y		Y	Y	Y	Y																						Y	Y	Y	Y	Y		Y	Y	Y		
VULTURES																																															
Turkey Vulture	S						Y	Y	Y							Y	Y	Y	Y	Y	Y	Y	Y									Y	Y	Y	Y	Y									Y	Y	
SWANS AND GEESE																																															
Canada Goose	R			Y		Y	Y	Y	Y	Y		Y	Y	Y	Y																																
Trumpeter Swan										Y		Y	Y	Y	Y																																

Habitat relationships by Minnesota Gap Analysis Project (MN-GAP) land cover type>>

Non-Forested types>>> / Forest land cover types>>>

SPECIES GROUP Species Common Name	Habitat feature		Urban/ Dev.			Ag./Grass			Shrub			Aquatic				Upland Coniferous Forest									Lowland Coniferous Forest							Upland Deciduous Forest					Lowland Deciduous Forest					Forest size class				
		Barren	High intensity urban	Low intensity urban	Transportation	Cropland	Grassland	Prairie	Upland shrub	Lowland deciduous shrub	Lowland evergreen shrub	Water	Floating aquatic	Sedge Meadow	Broadleaf sedge/Cattail	Jack Pine	Red Pine	White Pine mix	Balsam Fir mix	White Spruce	Upland Black Spruce	Up. N. White Cedar	Upland Conifer	Up. coniferous/deciduous mix	Lowland Black Spruce	Stagnant black spruce	Tamarack	Stagnant tamarack	Low. N. White Cedar	Stagnant N. White Cedar	Stagnant conifer	Aspen/White Birch	Bur/White Oak	Red Oak	Maple/Basswood	Upland deciduous mix	Black Ash	Silver Maple	Cottonwood	Lowland deciduous mix	Low. deciduous/coniferous mix	Seedling	Sapling	Pole timber	Saw timber	Uneven
DUCKS AND MERGANSERS																																														
Wood Duck	CMRS									Y		Y	Y		Y																	Y	Y	Y	Y	Y	Y	Y	Y	Y				Y	Y	Y
Mallard	RM			Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y																						Y	Y	Y	Y	Y				Y	Y
Blue-winged Teal	R					Y	Y	Y	Y	Y		Y	Y	Y	Y																															
Norther Shoveler	R						Y	Y	Y	Y		Y	Y	Y	Y																															
Gadwall	R					Y	Y	Y				Y	Y	Y	Y																															
Canvasback												Y	Y		Y																															
Redhead												Y	Y	Y	Y																															
Ring-necked Duck										Y		Y	Y	Y	Y																															
Hooded Merganser	CRS									Y		Y	Y	Y	Y																	Y	Y	Y	Y		Y	Y	Y	Y					Y	Y
Ruddy Duck												Y	Y	Y	Y																															
OSPREYS																																														
Osprey	RS											Y																																Y	Y	
HAWKS AND EAGLES																																														
Bald Eagle	R											Y					Y	Y					Y	Y								Y	Y	Y	Y	Y	Y			Y	Y				Y	Y
Northern Harrier						Y	Y	Y	Y		Y															Y		Y									Y	Y	Y	Y	Y					
Cooper's Hawk							Y		Y							Y	Y	Y														Y	Y	Y	Y	Y	Y	Y	Y	Y					Y	Y
Red-shouldered Hawk	R																															Y	Y	Y	Y	Y	Y	Y	Y	Y					Y	Y
Broad-winged Hawk							Y		Y							Y	Y	Y	Y	Y			Y	Y								Y	Y	Y	Y	Y									Y	Y
Red-tailed Hawk							Y	Y						Y		Y	Y	Y						Y								Y	Y	Y	Y	Y						Y	Y	Y	Y	
FALCONS																																														
American Kestrel	CS					Y	Y	Y																																						
GROUSE AND TURKEYS																																														
Gray Partridge						Y	Y	Y	Y											Y																										
Ring-necked Pheasant	M					Y	Y	Y	Y	Y				Y	Y					Y				Y								Y	Y	Y	Y	Y	Y	Y	Y	Y	Y					
Ruffed Grouse									Y	Y														Y								Y	Y	Y	Y	Y						Y	Y	Y	Y	
Wild Turkey	M					Y	Y																										Y	Y		Y									Y	

Habitat relationships by Minnesota Gap Analysis Project (MN-GAP) land cover type>>

Non-Forested types>>> Forest land cover types>>>

			Urban/ Dev.			Ag./Grass			Shrub			Aquatic				Upland Coniferous Forest									Lowland Coniferous Forest							Upland Deciduous Forest					Lowland Deciduous Forest					Forest size class				
SPECIES GROUP Species Common Name	Habitat feature	Barren	High intensity urban	Low intensity urban	Transportation	Cropland	Grassland	Prairie	Upland shrub	Lowland deciduous shrub	Lowland evergreen shrub	Water	Floating aquatic	Sedge Meadow	Broadleaf sedge/Cattail	Jack Pine	Red Pine	White Pine mix	Balsam Fir mix	White Spruce	Upland Black Spruce	Up. N. White Cedar	Upland Conifer	Up. coniferous/deciduous mix	Lowland Black Spruce	Stagnant black spruce	Tamarack	Stagnant tamarack	Low. N. White Cedar	Stagnant N. White Cedar	Stagnant conifer	Aspen/White Birch	Bur/White Oak	Red Oak	Maple/Basswood	Upland deciduous mix	Black Ash	Silver Maple	Cottonwood	Lowland deciduous mix	Low. deciduous/coniferous mix	Seedling	Sapling	Pole timber	Saw timber	Uneven
RAILS AND COOTS																																														
Virginia Rail	R									Y		Y	Y	Y	Y																															
Sora	R									Y		Y	Y	Y	Y																															
American Coot	R											Y	Y	Y	Y																															
CRANES																																														
Sandhill Crane						Y	Y	Y		Y	Y		Y	Y	Y																															
PLOVERS																																														
Killdeer	R	Y		Y		Y	Y	Y	Y																																					
SANDPIPERS																																														
Spotted Sandpiper	R	Y		Y			Y	Y	Y		Y	Y		Y	Y																															
Upland Sandpiper						Y	Y	Y	Y	Y				Y	Y																															
American Woodcock							Y		Y	Y																						Y	Y	Y	Y	Y						Y				
Wilson's Phalarope							Y	Y				Y	Y	Y	Y																															
JAEGERS, GULLS AND TERNS																																														
Forster's Tern												Y	Y	Y	Y																															
Black Tern												Y	Y	Y	Y																															
PIGEONS AND DOVES																																														
Rock Dove							Y																																							
Mourning Dove				Y		Y	Y									Y	Y	Y	Y	Y	Y		Y																			Y		Y	Y	Y
CUCKOOS																																														
Black-billed Cuckoo									Y	Y																																				
Yellow-billed Cuckoo									Y	Y																						Y	Y	Y	Y	Y		Y				Y				Y

Habitat relationships by Minnesota Gap Analysis Project (MN-GAP) land cover type>>

Non-Forested types>>> Forest land cover types>>>

SPECIES GROUP / Species Common Name	Habitat feature	Barren	Urban/Dev.			Ag./Grass			Shrub			Aquatic				Upland Coniferous Forest								Up. coniferous/deciduous mix	Lowland Coniferous Forest							Upland Deciduous Forest					Lowland Deciduous Forest				Low. deciduous/coniferous mix	Forest size class				
			High intensity urban	Low intensity urban	Transportation	Cropland	Grassland	Prairie	Upland shrub	Lowland deciduous shrub	Lowland evergreen shrub	Water	Floating aquatic	Sedge Meadow	Broadleaf sedge/Cattail	Jack Pine	Red Pine	White Pine mix	Balsam Fir mix	White Spruce	Upland Black Spruce	Up. N. White Cedar	Upland Conifer		Lowland Black Spruce	Stagnant black spruce	Tamarack	Stagnant tamarack	Low. N. White Cedar	Stagnant N. White Cedar	Stagnant conifer	Aspen/White Birch	Bur/White Oak	Red Oak	Maple/Basswood	Upland deciduous mix	Black Ash	Silver Maple	Cottonwood	Lowland deciduous mix		Seedling	Sapling	Pole timber	Saw timber	Uneven
OWLS																																														
Eastern Screech-Owl	CMS			Y																													Y	Y		Y		Y	Y	Y					Y	Y
Great Horned Owl	CS			Y			Y		Y							Y	Y	Y	Y	Y	Y		Y	Y								Y	Y	Y	Y	Y	Y	Y	Y	Y					Y	Y
Barred Owl	C															Y	Y	Y	Y	Y	Y	Y	Y									Y	Y	Y	Y	Y	Y	Y	Y	Y					Y	Y
Long-eared Owl							Y							Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y		Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				Y	Y
Short-eared Owl						Y	Y	Y		Y	Y			Y	Y																															
Northern Saw-whet Owl	C								Y							Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y										Y				Y	
NIGHTJARS																																														
Common Nighthawk		Y	Y	Y		Y	Y	Y																																						
Whip-poor-will	FD						Y		Y							Y								Y								Y	Y	Y	Y	Y						Y	Y	Y	Y	
SWIFTS																																														
Chimney Swift	CS	Y	Y	Y																												Y	Y	Y	Y	Y						Y	Y	Y	Y	
HIMMINGBIRDS																																														
Ruby-throated Hummingbird	R			Y			Y		Y																							Y			Y		Y	Y	Y		Y				Y	Y
KINGFISHERS																																														
Belted Kingfisher	B	Y										Y	Y		Y																															
WOODPECKERS																																														
Red-headed Woodpecker	CMS																																Y	Y	Y	Y								Y	Y	
Red-bellied Woodpecker	CMS																																		Y		Y	Y		Y					Y	Y
Yellow-bellied Sapsucker	CMS																							Y								Y	Y	Y	Y	Y									Y	
Downy Woodpecker	CDS																							Y								Y	Y	Y	Y	Y	Y	Y	Y	Y				Y	Y	Y
Hairy Woodpecker	CDS															Y	Y	Y						Y	Y		Y		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y				Y	Y
Northern Flicker	CS								Y	Y						Y	Y	Y	Y	Y	Y		Y	Y								Y	Y	Y	Y	Y						Y			Y	Y
Pileated Woodpecker	CDMS																							Y								Y	Y	Y	Y	Y	Y	Y		Y				Y	Y	Y

Habitat relationships by Minnesota Gap Analysis Project (MN-GAP) land cover type>>

		Non-Forested types>>>														Forest land cover types>>>																														
			Urban/ Dev.			Ag./Grass			Shrub			Aquatic				Upland Coniferous Forest									Lowland Coniferous Forest							Upland Deciduous Forest					Lowland Deciduous Forest					Forest size class				
SPECIES GROUP Species Common Name	Habitat feature	Barren	High intensity urban	Low intensity urban	Transportation	Cropland	Grassland	Prairie	Upland shrub	Lowland deciduous shrub	Lowland evergreen shrub	Water	Floating aquatic	Sedge Meadow	Broadleaf sedge/Cattail	Jack Pine	Red Pine	White Pine mix	Balsam Fir mix	White Spruce	Upland Black Spruce	Up. N. White Cedar	Upland Conifer	Up. coniferous/deciduous mix	Lowland Black Spruce	Stagnant black spruce	Tamarack	Stagnant tamarack	Low. N. White Cedar	Stagnant N. White Cedar	Stagnant conifer	Aspen/White Birch	Bur/White Oak	Red Oak	Maple/Basswood	Upland deciduous mix	Black Ash	Silver Maple	Cottonwood	Lowland deciduous mix	Low. deciduous/coniferous mix	Seedling	Sapling	Pole timber	Saw timber	Uneven
FLYCATCHERS																																														
Western Kingbird				Y		Y	Y	Y	Y	Y						Y	Y	Y						Y								Y	Y	Y	Y	Y	Y	Y	Y	Y	Y					
Eastern Kingbird	MRS			Y			Y	Y	Y	Y				Y	Y	Y	Y	Y						Y								Y	Y	Y	Y	Y	Y	Y	Y	Y	Y					
Eastern Wood-Pewee				Y													Y	Y						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y								Y	
Alder Flycatcher	R									Y																																				
Willow Flycatcher	E								Y	Y				Y																																
Least Flycatcher									Y	Y														Y								Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y
Eastern Phoebe	R			Y	Y				Y	Y		Y																				Y	Y	Y	Y	Y	Y	Y	Y	Y				Y	Y	
Great Crested Flycatcher	CS																															Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y
SHRIKES																																														
Northern Shrike							Y		Y																							Y	Y	Y	Y	Y						Y	Y			
Loggerhead Shrike						Y	Y	Y	Y																							Y	Y	Y	Y	Y										
VIREOS																																														
Yellow-throated Vireo	R			Y					Y	Y														Y								Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y
Warbling Vireo	R			Y					Y																							Y	Y	Y	Y	Y	Y	Y	Y	Y				Y	Y	Y
Red-eyed Vireo																	Y	Y		Y	Y		Y									Y	Y	Y	Y	Y								Y	Y	
JAYS, CROWS AND RAVENS																																														
Blue Jay	M															Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
American Crow	M			Y		Y	Y	Y	Y	Y	Y					Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
LARKS																																														
Horned Lark		Y		Y		Y	Y	Y	Y	Y																																				
SWALLOWS																																														
Purple Martin	RS		Y	Y			Y					Y			Y																															
Tree Swallow	CS						Y	Y		Y	Y	Y	Y	Y	Y																	Y	Y	Y	Y	Y	Y	Y	Y	Y						
Northern Rough-winged	BR	Y		Y								Y																																		
Bank Swallow	BR	Y		Y			Y	Y				Y	Y																																	
Cliff Swallow	R			Y	Y	Y	Y					Y																																		
Barn Swallow				Y	Y	Y	Y					Y	Y	Y	Y																															

		Habitat relationships by Minnesota Gap Analysis Project (MN-GAP) land cover type>>																																												
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			Urban/ Dev.			Ag./Grass			Shrub			Aquatic				Upland Coniferous Forest									Lowland Coniferous Forest							Upland Deciduous Forest					Lowland Deciduous Forest					Forest size class				
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CHICKADEES																																														
Black-capped Chickadee	CS			Y					Y	Y	Y					Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
NUTHATCHES																																														
Red-breasted Nuthatch	CS															Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y										Y			Y	Y	Y
White-breasted Nuthatch	CS																															Y	Y	Y	Y	Y	Y	Y	Y	Y				Y	Y	Y
CREEPERS																																														
Brown Creeper	CS																																				Y	Y		Y	Y			Y	Y	Y
WRENS																																														
House Wren	CS			Y					Y	Y																						Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y			
Winter Wren	DS															Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y		Y			Y		Y	Y	Y	Y	Y		Y	Y				Y	Y
Sedge Wren							Y	Y		Y				Y	Y											Y		Y		Y	Y															
Marsh Wren	R									Y		Y		Y	Y																															
KINGLETS																																														
Blue-gray Gnatcatcher																																Y	Y	Y	Y	Y	Y	Y	Y	Y				Y	Y	Y
THRUSHES																																														
Eastern Bluebird	CS			Y			Y	Y	Y	Y																						Y	Y	Y	Y	Y						Y				
Veery	M															Y								Y								Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Hermit Thrush	M															Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y													Y	Y	Y
Wood Thrush	M			Y																				Y								Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y
American Robin	M			Y			Y		Y							Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
MIMICS AND THRASHERS																																														
Gray Catbird	MR			Y					Y	Y	Y															Y		Y		Y	Y	Y	Y	Y	Y	Y						Y	Y			
Brown Thrasher	M			Y					Y																							Y	Y	Y	Y	Y						Y	Y			
WAXWINGS																																														
Cedar Waxwing	MR			Y					Y							Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y										Y	Y	Y	Y	Y	Y

		Habitat relationships by Minnesota Gap Analysis Project (MN-GAP) land cover type>>																																											
		Non-Forested types>>>														Forest land cover types>>>																															
			Urban/ Dev.			Ag./Grass			Shrub			Aquatic				Upland Coniferous Forest									Lowland Coniferous Forest							Upland Deciduous Forest					Lowland Deciduous Forest						Forest size class				
SPECIES GROUP Species Common Name	Habitat feature	Barren	High intensity urban	Low intensity urban	Transportation	Cropland	Grassland	Prairie	Upland shrub	Lowland deciduous shrub	Lowland evergreen shrub	Water	Floating aquatic	Sedge Meadow	Broadleaf sedge/Cattail	Jack Pine	Red Pine	White Pine mix	Balsam Fir mix	White Spruce	Upland Black Spruce	Up. N. White Cedar	Upland Conifer	Up. coniferous/deciduous mix	Lowland Black Spruce	Stagnant black spruce	Tamarack	Stagnant tamarack	Low. N. White Cedar	Stagnant N. White Cedar	Stagnant conifer	Aspen/White Birch	Bur/White Oak	Red Oak	Maple/Basswood	Upland deciduous mix	Black Ash	Silver Maple	Cottonwood	Lowland deciduous mix	Low. deciduous/coniferous mix		Seedling	Sapling	Pole timber	Saw timber	Uneven
WARBLERS																																															
Golden-winged Warbler	R								Y	Y						Y	Y	Y	Y					Y								Y	Y	Y			Y	Y		Y			Y	Y	Y	Y	
Nashville Warbler									Y	Y						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	
Yellow Warbler	R			Y					Y	Y																											Y	Y		Y			Y	Y			
Chestnut-sided Warbler				Y					Y																							Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y			
Cerulean Warbler																																			Y			Y							Y	Y	Y
Black-and-white Warbler	D								Y	Y						Y	Y	Y					Y	Y		Y						Y	Y	Y	Y	Y	Y	Y		Y	Y		Y	Y	Y		
American Redstart									Y	Y						Y																Y	Y	Y	Y	Y	Y	Y	Y	Y				Y	Y	Y	
Ovenbird																Y	Y	Y	Y	Y			Y	Y								Y	Y	Y	Y	Y									Y	Y	
Northern Waterthrush	DR									Y															Y	Y	Y	Y	Y	Y	Y						Y	Y		Y	Y				Y	Y	Y
Common Yellowthroat	R								Y	Y				Y	Y	Y	Y								Y	Y	Y	Y	Y	Y	Y												Y	Y			
TANAGERS																																															
Scarlet Tanager																Y								Y								Y	Y	Y	Y	Y	Y	Y	Y	Y					Y	Y	
TOWHEES AND SPARROWS																																															
Dickcissel						Y	Y	Y	Y																																						
Eastern Towhee	M								Y	Y						Y							Y										Y	Y		Y							Y	Y	Y	Y	
Chipping Sparrow				Y					Y							Y	Y	Y	Y	Y	Y	Y	Y	Y																	Y				Y	Y	
Clay-colored Sparrow							Y	Y	Y	Y	Y					Y	Y	Y	Y	Y	Y	Y	Y		Y		Y		Y			Y	Y			Y	Y	Y	Y	Y	Y		Y	Y			
Field Sparrow							Y	Y	Y							Y	Y	Y						Y								Y	Y	Y	Y	Y				Y			Y				
Vesper Sparrow						Y	Y	Y	Y					Y																		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						
Lark Sparrow				Y		Y	Y	Y	Y					Y																		Y	Y	Y	Y	Y	Y										
Savannah Sparrow						Y	Y	Y	Y	Y	Y			Y	Y													Y		Y	Y		Y														
Grasshopper Sparrow				Y		Y	Y	Y	Y					Y																																	
Le Conte's Sparrow						Y	Y	Y		Y	Y			Y	Y																																
Nelson's Sharp-tailed sparrow							Y	Y		Y				Y	Y													Y		Y	Y																
Song Sparrow									Y	Y				Y		Y																Y					Y	Y	Y	Y			Y	Y	Y		
Swamp Sparrow							Y			Y	Y			Y	Y																																
White-throated Sparrow									Y	Y						Y			Y	Y	Y		Y	Y	Y		Y		Y												Y		Y	Y	Y		

Habitat relationships by Minnesota Gap Analysis Project (MN-GAP) land cover type>>

		Non-Forested types>>>														Forest land cover types>>>																														
			Urban/ Dev.			Ag./Grass			Shrub			Aquatic				Upland Coniferous Forest									Lowland Coniferous Forest							Upland Deciduous Forest					Lowland Deciduous Forest					Forest size class				
SPECIES GROUP Species Common Name	Habitat feature	Barren	High intensity urban	Low intensity urban	Transportation	Cropland	Grassland	Prairie	Upland shrub	Lowland deciduous shrub	Lowland evergreen shrub	Water	Floating aquatic	Sedge Meadow	Broadleaf sedge/Cattail	Jack Pine	Red Pine	White Pine mix	Balsam Fir mix	White Spruce	Upland Black Spruce	Up. N. White Cedar	Upland Conifer	Up. coniferous/deciduous mix	Lowland Black Spruce	Stagnant black spruce	Tamarack	Stagnant tamarack	Low. N. White Cedar	Stagnant N. White Cedar	Stagnant conifer	Aspen/White Birch	Bur/White Oak	Red Oak	Maple/Basswood	Upland deciduous mix	Black Ash	Silver Maple	Cottonwood	Lowland deciduous mix	Low. deciduous/coniferous mix	Seedling	Sapling	Pole timber	Saw timber	Uneven
GROSBEAKS																																														
Northern Cardinal	M			Y					Y	Y													Y									Y	Y	Y	Y	Y	Y	Y		Y		Y	Y			
Rose-breasted Grosbeak	M			Y																												Y	Y	Y	Y	Y								Y	Y	
Indigo Bunting									Y	Y																						Y	Y	Y	Y	Y	Y	Y		Y		Y	Y			
BLACKBIRDS AND ORIOLES																																														
Bobolink						Y	Y	Y	Y	Y	Y			Y																																
Red-winged Blackbird	R					Y	Y		Y	Y		Y	Y	Y	Y																															
Eastern Meadowlark						Y	Y	Y		Y				Y	Y																		Y													
Western Meadowlark						Y	Y	Y	Y	Y				Y	Y																															
Yellow-headed Blackbird	R											Y		Y	Y																															
Brewer's Blackbird	R			Y		Y	Y	Y	Y	Y	Y			Y	Y											Y		Y		Y	Y	Y	Y						Y							
Common Grackle				Y		Y	Y	Y		Y	Y			Y	Y																															
Brown-headed Cowbird						Y	Y	Y	Y							Y	Y	Y	Y	Y	Y	Y	Y	Y								Y	Y	Y	Y	Y						Y				
Baltimore Oriole	MR			Y																				Y								Y	Y	Y	Y	Y	Y	Y	Y	Y				Y	Y	Y
FINCHES																																														
Purple Finch	M			Y														Y	Y	Y	Y		Y			Y		Y	Y	Y	Y										Y			Y	Y	Y
House Finch	M		Y	Y																																										
Pine Siskin	M			Y												Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y		Y		Y										Y			Y	Y	Y
American Goldfinch				Y			Y		Y	Y																						Y	Y	Y	Y	Y						Y				

Table 7.4: Amphibian and Reptile Habitat Relationships by Minnesota Gap Analysis Project (MN-GAP) land cover type

WILDLIFE HABITAT RELATIONSHIPS - AMPHIBIANS AND REPTILES

AMPHIBIANS																																																
TOADS AND FROGS																																																
American Toad	RV			Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y
Canadian Toad								Y	Y				Y		Y																																	
Cope's Gray Treefrog								Y	Y		Y		Y	Y	Y	Y																		Y														
Gray Treefrog	DRV										Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y								Y	Y	Y	Y	Y	Y	Y	Y	Y	Y					Y	Y
Western Chorus Frog	RV			Y	Y			Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y								Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y
Northern Leopard Frog	R								Y	Y	Y		Y	Y	Y	Y											Y		Y		Y	Y						Y	Y	Y	Y	Y						
Mink Frog	R											Y	Y	Y		Y										Y	Y	Y	Y	Y	Y	Y										Y						
Wood Frog	DV										Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y					Y	Y
SALAMANDERS																																																
Blue-spotted Salamander	DV										Y		Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y									Y	Y	Y	Y	Y	Y	Y	Y	Y	Y					Y	Y
Tiger Salamander	V			Y	Y		Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y								Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y
Eastern Newt	DR												Y				Y	Y	Y					Y	Y								Y	Y	Y	Y	Y	Y	Y	Y	Y	Y					Y	Y
REPTILES																																																
LIZARDS																																																
Prairie Skink								Y	Y																									Y														
SNAKES																																																
Smooth Green Snake					Y			Y	Y	Y	Y	Y			Y	Y	Y	Y	Y							Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y											
Redbelly Snake	D							Y							Y		Y	Y	Y						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						
Plains Garter Snake					Y			Y	Y						Y	Y																																
Common Garter Snake	D			Y	Y			Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						
TURTLES																																																
Snapping Turtle	R												Y	Y		Y																																
Painted Turtle	DR											Y	Y	Y		Y																																
Blanding's Turtle								Y	Y				Y	Y	Y	Y																																

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APPENDICES

A. Background on DNR Forest Inventory and Data Currency
   Table A1.1: Elapsed time since most recent stand inventory

B. Ecological Classification System
   Figure A: Ecological Provinces, Sections, and Subsections of Minnesota, 1999

C. Glossary

D. Acronyms

APPENDIX A

Background on DNR Forest Inventory and Data Currency

The Minnesota Department of Natural Resources (DNR) uses a forest stand mapping and information system to classify the approximately 5 million acres (7,800 sq. mi.) owned and administered by the state. The system is designed to be a course classification of forest stands adequate to guide management decisions. It is commonly referred to as the "forest inventory."

The forest inventory system maps the boundaries and tabulates the contents of all forest stands five acres and larger on state-owned land. A forest stand is a group of trees uniform enough in composition to be managed as a unit. Boundaries are drawn by interpretation of aerial photographs. All other stand data are collected in the field on plots within each stand and boundaries may be adjusted at the time of the field visit.

The general descriptive term for the content of a stand is "cover type." Although cover types commonly bear the name of the primary tree species, they are usually an association of multiple tree species along with shrubbery and herbaceous plants.

When it originated in 1952, the forest inventory was called the Cooperative Stand Assessment (CSA) and was based on pencil-drawn maps with a computer punch-card database. Over the years, the system matured into a geographic information system (GIS) database accessible to DNR forest managers online. Forest inventory is now managed using a computer program called the Forest Inventory Module (FIM). Consequently, the inventory is now referred to as "FIM" rather than "CSA."

FIM data are not compatible with the previous CSA layers. FIM data follows an internal DNR Division of Forestry classification and attribute-coding scheme not used by CSA. Also, comparisons between past inventory data (CSA) and current conditions (FIM) encounter some difficulty due to CSA stands being limited by section lines. This limitation does not exist with FIM data and stand boundaries can extend all the way to a township line if the stand characteristics warrant it.

The accuracy of forest inventory is limited by the method used to establish stand boundaries. Features are digitized on screen over standard electronic topographical maps [24k Digital Raster Graphic (DRG) images] and electronic aerial photography [USGS Digital Orthophoto Quads (DOQs)] and inherit the horizontal positional accuracy of these products.

FIM allows foresters to update data as changes to stands occur due to the passage of time, natural events, or management activities. However, many stands do not receive field visits or re-measurement for 20 years or more if they are established but not approaching maturity. These stands have their age brought up-to-date by computer calculation, but other attributes such as volume, disease, and understory composition are not updated until a field visit. Attempts to model these attributes forward have met with some success, but they have not become standard practice.

A synopsis of the currency of field inventory is shown in table A1.1, below. It is important to keep in mind that only selected stands are scheduled for a visit depending on a number of factors. These include the years since inventory, known natural factors that may have impacted the stand, potential merchantability, potential for treatment, etc. These factors must be taken into consideration when looking at inventory data, using it in analysis, and making management decisions.

Table A1.1 Elapsed time since most recent stand inventory

Years Since Inventory	Number of Stands	Total Acres
0	61	915
1	82	1,117
2	65	1,224
3	126	1,882
4	43	1,164
5	63	837
6	138	2,597
7	34	946
8	24	465
9	31	506
10	48	806
11	29	758
12	97	1,576
13	19	385
14	4	231
15	17	197
16	30	478
17	6	99
18	151	2,847
19	60	632
20	9	81
21	1	10
22	1	9
23	3	107
24	18	252
25	1	6
26	179	3,199
27	34	794
28	108	2,489
29	316	11,143
30	406	8,310
33	2	40
Totals	2,206	46,100

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APPENDIX B

Ecological Classification System (ECS)

Contents

I. Definition

The ECS is part of a nationwide mapping initiative developed to improve our ability to manage all natural resources on a sustainable basis.

Ecological Classification System is 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, and topographic, soil, and vegetation data.

In Minnesota, the classification and mapping is divided into six levels of detail. These levels are:

Province: Largest units representing the major climate zones in North America, each covering several states. Minnesota has three provinces: eastern broadleaf forest, northern boreal forest and prairie.

Section: Divisions within provinces that often cross state lines. Sections are defined by the origin of glacial deposits, regional elevation, distribution of plants, and regional climate. Minnesota has 10 sections (e.g., Red River Valley).

Subsection: County-sized areas or larger within sections that are defined by glacial land-forming processes and residuals, bedrock formations, local climate, topographic relief, and the distribution of plants. Minnesota has 26 subsections (e.g., Mille Lacs Uplands).

Land-type association: Landscapes within subsections, characterized by glacial formations, bedrock types, topographic roughness, lake and stream patterns, depth to ground water table, and soil material (e.g., Alexandria Moraine).

Land type: The individual elements of land type associations, defined by recurring patterns of uplands and wetlands, soil types, plant communities, and fire history(e.g., fire-dependent xeric pine-hardwood association).

Community: Unique combinations of plants and soils within land types, defined by characteristic trees, shrubs and forbs, elevation, and soil moisture (e.g., sugar maple-basswood forest).

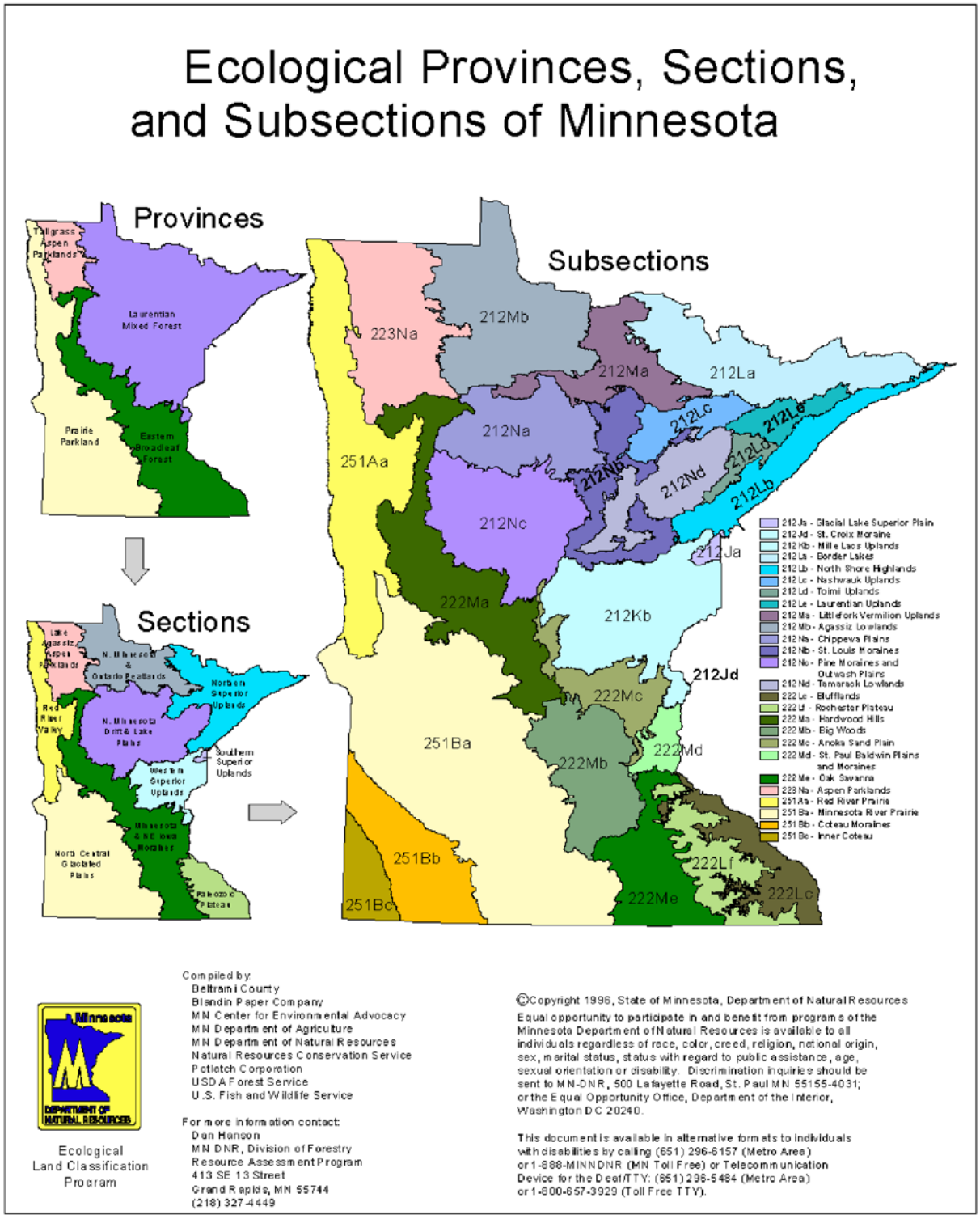
II. Purpose of an Ecological Classification System

- Defines the units of Minnesota's landscape using a consistent methodology.
- Provides a common means for communication among a variety of resource managers and with the public.
- Provides a framework to organize natural resource information.
- Improves predictions about how vegetation will change over time in response to various influences.
- Improves our understanding of the interrelationships between plant communities, wildlife habitat, timber production, and water quality.

III. End Products

- Maps and descriptions of ecological units for provinces through land types.
- Field keys and descriptions to determine which communities are present on a parcel of land.
- Applications for management for provinces through communities.
- Mapping of province, section, subsection, and land-type association boundaries is complete throughout Minnesota (See map on next page).

Figure A: Ecological Provinces, Sections, and Subsections of Minnesota, 1999



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APPENDIX C

Glossary

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

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

Age class: An interval, commonly 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).

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

Animal aggregations: A concentration of animals (of rare or common species or a mixture of rare and common) that occurs during part or all the species life cycle, such that when these animals are in these aggregations, they are highly vulnerable to disturbance. Examples are colonial water bird nesting sites, bat hibernacula, and mussel beds.

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.

Annual work plan: The annual work responsibilities at the area (i.e., Division of Forestry administrative boundary) documented for the fiscal year.

Area forest resource management plan (AFRMP): Successor to timber management planning (TMP), recognizing that TMP discussions and decisions affected or included a lot more than the decision to harvest. This should not be confused with the comprehensive FRMPs developed for a number of areas in the mid-to late-1980s.

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. The initial round of Subsection Forest Resource Management Plans (SFRMP) will focus primarily on trends and conditions of forest resources. Standard core assessment information sources and products have been defined.

Basal area: 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 an 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 MCBS Statewide Biodiversity Significance Rank):* The Minnesota County Biological Survey uses a statewide ranking system to evaluate and communicate the biodiversity significance of surveyed areas (MCBS Sites) to natural resource professional, state and local government officials, and the public. MCBS 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. (*Draft definition 3/24/2004*)

> ***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 the Abest of the rest@, such as sites with 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 MCBS 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.

Board foot: A unit of measuring wood volumes equaling 144 cubic inches. A board foot is commonly used to measure and express the amount of wood in a tree, sawlog, veneer log, or individual piece of lumber. For example, a 16-inch diameter at breast height (DBH) standing tree that is 80 feet tall, contains approximately 250 board feet of wood and a tree with a 30-inch DBH and 80 feet tall contains about 1000 board feet or one metric board foot (MBF). A piece of lumber one cubic foot (1 foot x 1 foot x 1 inch) contains one board foot of lumber.

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

Carr: Deciduous woodland or scrub on a permanently wet, organic soil. A carr develops from a bog, fen or swamp.

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 filter: Management of lands from a local to landscape scale that addresses the needs of all or most species, communities, environments, and ecological processes. In using a coarse filter approach (Hunter,

1990), it assumes that a broad range of habitats encompassing the needs of most species needs will be met, and their populations will remain viable on the landscape.

Coarse woody debris: Stumps and fallen tree trunks or limbs of more than 6-inch diameter at the large end.

Cohort: a group of trees developing after a single disturbance, commonly consisting of trees of similar age.

Collaboration: A group in which members identify with the group and seriously consider the group's overall charge. Group members assume collective responsibility for outcomes, are interdependent, and have a joint ownership of decisions.

Common forest inventory: Also, known as CCSA (Common Cooperative Stand Assessment). Forest inventory stand data compiled by the Minnesota Interagency Information Cooperative from public agencies including the Minnesota DNR, Superior and Chippewa National Forests, and county land departments (2001). The common format contains the common attributes found in the state, federal, and counties forest inventories.

Competition: The struggle between trees to obtain sunlight, nutrients, water and growing space. Every part of the tree, from the roots to the crown, competes for space and food.

Comprehensive DNR subsection plans: Address Minnesota Department of Natural Resources (DNR) programs and activities within the subsection. Involves programs and activities of multiple DNR divisions, not just the Division of Forestry.

Comprehensive Division of Forestry SFRMPs: Address other aspects of forest resource management on DNR Forestry lands (e.g., recreation, land acquisition/sales, fire management, private forest management).

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: A change through forest management from one tree species to another within a forest stand or site.

Cooperative stand assessment (CSA): The forest stand mapping and information system used by the DNR 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 4 feet high, 4 feet wide, and 8 feet long, measuring 128 cubic feet, including bark and air space. Actual volume of solid wood may vary from 60 to 100 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 feet 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 type 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 species is aspen would be called an aspen cover type.

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

Critical habitat: habitat or habitat elements that must be present and properly functioning to assure the continued existence of the species in question.

Crop tree: any tree selected or retained to be a component of a future commercial harvest.

Cruise: (v) A survey of forestland to locate timber and estimate its quantity by species, products, size, quality, or other characteristics. (n) An estimate derived from such a survey.

Cubic foot: A wood volume measurement containing 1,728 cubic inches, such as a piece of wood measuring one foot on a side. A cubic foot of wood contains approximately six to 10 usable board feet of wood. A cord of wood equals 128 cubic feet.

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

Desired future forest composition (DFFC) goals: Broad vision of landscape vegetation conditions in the long-term future. For the purposes of the initial round of subsection planning, DFFC goals will focus on future desired forest composition looking ahead 50 years. DFFC goals may include aspects like 1) the amount of various forest cover types within the subsection, 2) age-class distribution of forest cover types, 3) the geographic distribution of these across the subsection, and the related level of management for even-aged forest, 4) extended rotation forest, etc.

Disturbance: Any event, either natural or human induced, that alter 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 a 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 succession 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. (See Appendix A.)

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 MCBS at the completion of work in a given county or 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.

Ecologically important lowland conifers (EILC): includes stands of black spruce, tamarack, and cedar, including stagnant lowland conifer stands, that are examples of high quality native plant communities (NPC) that are representative of lowland conifer NPC's found in the subsections. The designated EILC stands will be reserved from treatment during this 10-year planning period. Future management/designation of these stands is yet to be determined.

Ecosystem based management: The collaborative process of sustaining the integrity of ecosystems through partnerships and interdisciplinary teamwork. Ecosystem based management seeks to sustain ecological health while meeting social and economic needs.

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. (Draft definition 3/24/2004, 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).

Evenflow: Providing a relatively consistent amount of timber (or other products) in successive management periods.

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

Extended rotation forests (ERF): Forest stands for which the harvest age is extended beyond the normal or economic harvest age. ERF provides larger trees, old forest wildlife habitat, and other nontimber values. Additional details regarding management of ERF on DNR-administered lands is contained in the DNR Extended Rotation Forest Guidelines (1994). **Prescribed ERF** is the cover type acreage designated for management as ERF. Stands designated as ERF will be held beyond the recommended normal rotation (harvest) age out to the established ERF rotation age(s). A stand of any age can be prescribed as ERF. **Effective ERF** is defined as the portion of the prescribed ERF acreage that is actually over the normal rotation age for the cover type at any one time.

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

Fen: Peatlands that receive water both from precipitation and ground water, which has percolated through mineral soil, are classified as fens. The water supply in a fen is only slightly acidic or nearly neutral, and it carries minerals and other nutrient content. Fens look like watery meadows, with sedges, reeds, grass-like plants, occasional shrubs, and scattered, stunted trees.

Fine filter: Management that focuses on the welfare of a single or only a few species rather than the broader habitat or ecosystem. For example, individual nests, colonies, and habitats are emphasized. A *fine filter* approach (Hunter, 1990) considers the specific habitat needs of selected individual species that may not be met by the broader coarse filter approach.

Forest Inventory and Analysis (FIA): A statewide forest survey of timber lands jointly conducted by the DNR 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 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. Part of the DNR's **FOR**estry **I**nformation **S**ys**T**em (FORIST).

Forest land: Consists of all lands included in the forest inventory from aspen and pine cover types to stagnant conifers, muskeg, lowland brush, and lakes.

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 access, 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.

FORIST: The **FOR**estry **I**nformation **S**ys**T**em (FORIST) is a collection of integrated spatial applications and datasets supporting day-to-day operations across the Division of Forestry. The first two parts of the system are in operation: Forest Inventory Module (FIM) and Silviculture and Roads Module (SRM). A Timber Sales Module is scheduled to be operational in 2006.

Fragmentation: Breaking up of large and contiguous ecosystems into patches separated from each other by different ecosystem types. Breaking up a contiguous or homogeneous natural habitat 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. For example, a conifer-dominated forest (or portion of it) is fragmented by clearcutting if it is converted to another type, such as an aspen-dominated forest.

Fully-stocked stand: A forest stand in which all growing space is effectively occupied but having ample space for development of the crop trees.

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: An area in which a specific plant or animal normally lives, grows and reproduces; the area that provides a plant or animal with adequate food, water, shelter and living space.

Herbivory: Plant communities resulting from the browsing and grazing of wildlife. A plant-animal interaction whereby an organism eats some or all of a plant and the plant responds immediately (stress, decline, or death) or over time (evolutionary adaptation). Herbivory occurs both above and below ground. As defined for the issues concerned with herbivory in the plan; the influence by dominant herbivores on forest composition, structure, forest dynamics and spatial patterns. Dominant herbivores include beaver, deer, moose, hares, rabbits, small mammals, and forest tent caterpillars.

High Conservation Value Forest: Areas of biological or cultural significance which are managed per the FSC forest certification program standards.

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 is an exemplary representative of the native plant community diversity prior to European settlement.

High-risk, low-volume (HRLV): HRLV stands are identified based on one or more of the following: 1) stands coded as high risk in FIM forest inventory, 2) significant insect or disease damage to the main species in the stand, 3) stands over normal rotation age at time of survey with total stand volume eight cords per acre (low volume), or 4) very old stand, e.g., aspen over than 80 years old.

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 clear-cutting 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 major harvest with the primary objective of improving the quality of the remaining forest stand.

Issue: A natural resource-related concern or conflict that is directly affected by, or directly affects, decisions about the management of vegetation on lands administered by the DNR divisions of Forestry and Fish and Wildlife. Relevant issues will likely be defined by current, anticipated, or desired resource conditions and trends, threats to resources, and vegetation management opportunities. The key factor in determining the importance of issues for SFRMP is whether vegetation management issues can address the issue in whole or substantial part on DNR-administered lands.

Landform: Any physical, recognizable form or feature of the earth's surface, having a characteristic shape, and produced by natural causes. Examples of major landforms are plains, plateaus, and mountains. Examples of minor landforms are hills, valleys, slopes, eskers, and dunes. Together, landforms make up the surface configuration of the earth. The "landform" concept involves both empirical description of a terrain (land-surface form) class and interpretation of genetic factors ("natural causes"). (An Ecological Land Classification Framework for the United States, 1984, p. 40).

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 ECS, and Minnesota Forest Resources Council (MFRC) regional landscapes. The issue being addressed usually defines the type and size of landscape to be used.

Landscape region: A geographic region that is defined by similar landforms, soils, climatic factors, and potential native vegetation. The landscape region used for this planning effort is the subsection level of the ECS.

Landscape Study Area (LSA): A large geographic area identified by the MCBS as a core area for the MCBS survey process in northern Minnesota. The LSA is intended to represent some of the landscapes within an ecological subsection (a unit in Minnesota's ECS. A LSA 1) generally captures the range of environmental gradients and ecological conditions found in large landscapes, 2) generally encompasses the range of native plant community complexes that exhibit repeatable patterns at the landform or ecological land-type association (LTA) scale, 3) exhibits the potential for intact landscape level processes to occur, 4) contains representative native plant communities functioning under relatively undisturbed conditions, and 5) often contains habitat for rare species. An LSA area is typically thousands of acres and contains two to several MCBS sites. A LSA may encompass portions of one or more ecological LTAs and

lie in more than one county. LSAs are identified prior to MCBS field surveys and boundaries are modified during the survey process. At the completion of the MCBS surveys, a LSA becomes a macrosite, two or more sites, or a combination of macrosites and sites. In some cases a LSA is eliminated from further survey consideration during the MCBS survey process.

Land Type Association (LTA): Divisions within Subsections that are delineated using glacial landforms, bedrock types, topographis roughness lake and stream distributions, wetland patterns, depth to groundwater table, soil parent material, and pre-European settlement vegetation.

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.

Macrosite: A large area, generally thousands of acres, containing two or more sites that have some geographical and ecological connection relevant to conservation planning. MCBS sites within a macrosite are generally close to one another but are not necessarily contiguous. Thus, macrosites may contain some disturbed areas. In northern Minnesota, MCBS macrosites correspond to the final (post field-evaluation) boundaries of LSAs. (Areas less than 2,000 acres formerly labeled "preserve designs " are also macrosites).

Managed acres: Timberland acres that are available for timber management purposes.

Management pool: In this plan, the acres available for timber management purposes.

Marketable timber: Merchantable timber that is accessible now.

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.

Maximum rotation age: In this plan, the maximum age at which a forest cover type will retain its biological ability to regenerate to the same cover type and remain commercially viable as a marketable timber sale.

Mean Annual Increment (MAI): Average annual growth of a stand up to a particular age. It is calculated by dividing yield at that age by the age itself (e.g., the mean annual increment for a stand at age 50 with 25 cords per acre total volume: 25) 50 years = 0.5 cords per year).

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.

MCBS Sites: Areas of land identified by Minnesota County Biological Survey (MCBS) 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 site provides a geographic framework for recording and storing data and compiling descriptive summaries.

Minnesota Forest Resources Plan (MFRP): Statewide DNR strategic forest resources plan. Includes statewide vision, mission, preferred future, goals, strategies and objectives. For each of the division's programs, it includes goals, statewide direction, and major strategies and objectives.

Minnesota TAXA: Minnesota Taxonomy Database maintained by the DNR Division of Ecological Services.

Minnesota Wildlife Resource Assessment Project (MNWRAP): A wildlife species database and related information system that provides the overall data management, framework, analysis functions, and long-term support for statewide, landscape, and site level wildlife resource assessment efforts. It will cover the total spectrum of wildlife diversity and habitat associations in Minnesota.

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

Mixed forest conditions: In this plan, refers to vegetative composition and structure that is moving toward the mix and relative proportion (e.g., dominated by, common, occasional, or scattered) of species found in the native plant community for that site. Tree species mix and proportion depends not only on the targeted growth stage (based on the rotation age for the desired cover type) but also species found in older growth stages.

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.

Multiple use: Using and managing a forested area to provide more than one benefit simultaneously. Common uses may include wildlife, timber, recreation, and water.

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 physiognomy, hydrology, landforms, soils, and natural disturbance regimes (e.g., wild fires, wind storms, normal flood cycles).

Natural area: An area of land, with significant native biodiversity, where a primary goal is to protect, enhance or restore ecological processes and Native Plant Community composition and structure. An MCBS *Site* of Outstanding or High biodiversity significance is often recommended for nomination as a natural area. For these Sites, an MCBS *Ecological Evaluation* is written to characterize the ecological significance of the Site as a whole and to serve as a guide for conservation action by the various landowners. Sites (or portions of Sites) that are recommended as natural areas may be identified by the

landowner or land management agency for conservation activities such as designation as a (city, county, state, private) park, non-motorized recreation area, scientific and natural area, reserve, special vegetation management (e.g. natural disturbance based forest management for maintenance of mature growth stage), etc. (*Draft definition 3/24/2004*)

Natural Area Registry (NAR) Agreement: a memorandum of understanding between the Ecological Services Division and another governmental unit. The other governmental unit can be Division of Forestry, Wildlife, or Parks, depending on who the land administrator is for the parcel in question. It can also be city, county, tribal, or federal government. The NAR generally identifies the site, explains its significance, sets a proposed management direction, and states that before any management contrary to that direction occurs, the parties will get together and talk about it first. It is not a binding agreement. Examples of NAR's: an old growth yellow birch stand in Crosby-Manitou State Park; the South Fowl Lake cliff community on Division of Forestry land in Cook County; and a ram's-head orchid site on Hubbard County land.

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, *non-game species* include amphibians, reptiles, and those mammal and bird species that are not hunted or trapped.

Non-timber forest products: Foods, herbs, medicinals, decoratives and specialty items also known as special forest products. Special forest products might include berries, mushrooms, boughs, bark, Christmas trees, lycopodium, rose hips and blossoms, diamond willow, birch tops, highbush cranberries, burls, conks, Laborador tea, seedlings, cones, nuts, aromatic oils, extractives.

Normal Rotation Age (NRA): For even-aged managed cover types, the rotation age set by the SFRMP Team for non-ERF timberland acres. It is based on the culmination of mean annual increment (CMAI), other available data related to forest productivity that also considers wood quality, and local knowledge.

Old forest: A forest stand of any particular forest cover type is considered old forest whenever its age exceeds the normal rotation age established by the landscape team for that cover type. In this plan, it does not include designated old growth, state park lands, etc.

Old 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, made up of several to many stands that are managed for old-growth, special management zone (SMZ), and extended rotation forest (ERF) in the vicinity of designated old growth stands.

Old-growth forests: Forests defined by age, structural characteristics, and relative lack of human disturbance. These forests are essentially free from catastrophic disturbances, 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 Guidelines (1994).

Operational planning: What specifically will happen. The specific actions (i.e., projects, programs, etc.) that will be taken to move towards the desired future established by the various sources of strategic direction. Examples include stand examination lists, road projects, recreational trail/facilities projects, staffing, annual work plan targets, etc. Operational planning is also referred to as tactical planning.

Overmature: A tree or even-aged stand that has reached an age where it is declining in vigor and health and reaching the end of its natural life span resulting in a reduced commercial value because of size, age, decay, and other factors.

Overstocked: The situation in which trees are so closely spaced that they are competing for resources, resulting in less than full-growth potential for individual trees.

Overstory: The canopy in a stand of trees.

Partial cut: A cutting or harvest of trees where only some of the trees in a stand are removed.

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.

Precautionary Principle: This principle establishes that a lack of information does not justify the absence of management measures. On the contrary, management measures should be established in order to maintain the conservation of the resources.

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 (clear-cut, 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 5- to-12 inches diameters at breast height are used.

Pure forest or stand is defined as composed principally of one species, conventionally at least 80 percent based on numbers, basal areas, or volumes.

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 Features Database is maintained by the Natural Heritage and Nongame Research Program and is comprised of locational records of the following features:

- **Animal aggregations**. Certain types of animal aggregations, such as nesting colonies of waterbirds (herons, egrets, grebes, gulls and terns), bat hibernacula, prairie chicken booming grounds, and winter bald eagle roosts are tracked regardless of the legal status of the species that comprise them. The tendency to aggregate makes these species vulnerable because a single catastrophic event could result in the loss of many individuals.
- **Geologic features**. Noteworthy examples of geologic features throughout Minnesota are tracked if they are unique or rare, extraordinarily well preserved, widely documented, highly representative of a certain period of geologic history, or very useful in regional geologic correlation.
- **Natural communities**. Natural communities are functional units of landscape that are characterized and defined by their most prominent habitat features - a combination of vegetation, hydrology, landform, soil, and natural disturbance cycles. Although natural communities have no legal protection in Minnesota, the Natural Heritage and Nongame Research Program and the Minnesota County Biological Survey have evaluated and ranked community types according to their relative rarity and endangerment throughout their range. Locations of high quality examples are tracked in the Rare Features Database.

Rare animals. All animal species that are listed as Federally endangered or threatened (except the gray wolf) are tracked, as well as all birds, small mammals, reptiles, amphibians, mussels, and butterflies that are listed as State endangered, threatened or special concern.

Rare plants. Rare plants tracked are 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 species: A plant or animal species designated as **endangered, threatened,** or 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 wind and/or fire event.

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).

Regional landscapes: MFRC established eight regional landscapes covering Minnesota based on ecological, socio-economic, and administrative factors. These landscapes were established to undertake landscape-based planning and coordination across all forest ownerships. The subsections included in this plan are in the Northeast Landscape Region.

Release: Freeing a tree, or group of trees, from competition that is overtopping or closely surrounding them.

Relevés: Vegetation survey plot data.

Representative Sample Areas (RSAs): RSAs are designated to serve one or more of the following purposes:

- Establish and/or maintain an ecological reference condition;
- Create or maintain an under-represented ecological condition; and/or,
- Protect an area that is sensitive, rare or unique.

Research Natural Areas (RNAs): Areas within national forests that the U.S. Forest Service has designated to be permanently protected and maintained in natural condition (e.g., unique ecosystems or ecological features, rare or sensitive species of plants and animals and their habitat, and high-quality examples of widespread ecosystems).

Reserved forestland: Forestland withdrawn from timber utilization through statute, administrative regulation, or designation.

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 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 factors.

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.

Sanitation cut: A cutting made to remove trees killed or injured by fire, insects, disease, or other injurious agents (and sometimes trees susceptible to such injuries) for the purpose of preventing the spread of insects or disease.

Sapling: A tree that is 1 inch to 5 inches in diameter at breast height.

Sawlog: A log large enough to produce lumber or other products that can be sawed. Its size and quality vary with the utilization practices of the region.

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

Scarify: To break up the forest floor and topsoil preparatory to natural regeneration or direct seeding.

Scientific and Natural Areas (SNAs): Areas established by the DNR, Division of Ecological Services 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, which bears seed; specifically, a tree left standing to provide the seed for natural regeneration.

Selective 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.

Silviculture and Roads Module (SRM): The SRM provides a database and application through which field foresters can record planned and actual forest development prescriptions (e.g., site preparation, tree planting projects, timber harvest, road maintenance, etc.) and follow-up surveys. SRM supports the geographic description of the extent of a development project separate from FIM stand boundaries. A variety of maps and other reports can be generated by the development system. SRM will also produce maps and reports that roll up forestry area data to the regional or statewide level. Part of the DNR's **FOR**estry **I**nformation **S**ys**T**em (FORIST).

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.

Soil productivity: The capacity of soils, in its normal environment, to support plant growth.

Special concern species: A plant or animal species that is extremely uncommon in Minnesota, or has a 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 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.

Stand: A contiguous group of trees similar in age, species composition, and structure, and growing on a site of similar quality, to be a distinguishable forest 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: 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 will be 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 as determined by the subsection team. Criteria will likely be based on include rotation ages, site index, basal area, cover type composition, understory composition, location, etc. Factors considered in developing stand-selection criteria will include: 1) desired forest composition goals, 2) timber growth and harvesting, 3) old-growth forests, 4) extended and normal rotation forests, 5) riparian areas, 6) wildlife habitat, 7) age and cover type distributions, 8) regeneration, 9) thinning and 10) prescribed burning needs.

State forest road: Any permanent road constructed, maintained, or administered by the DNR for the purposes of accessing or traversing state forest lands.

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

Strategic planning: A process to plan for desired future states. Includes aspects of a plan or planning process that provide statements and guides for future direction. The geographic, programmatic, and policy focus can range from very broad and general to more specific in providing tiers/levels of direction. Strategic planning is usually long term (i.e., at least five years, often longer). It usually includes an assessment of current trends and conditions (e.g., social, natural resource, etc.), opportunities, and threats; identification of key issues; and the resulting development of goals (e.g., desired future conditions), strategies, and objectives. Vision and mission statements may also be included.

Stumpage: The value of a tree as it stands in the forest uncut; uncut trees standing in the forest.

Stumpage price: The value that a timber appraiser assigns to standing trees or the price a logger or other purchaser is willing to pay for timber as it is in the forest.

Subsection: A subsection is one level within the 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. Subsections areas are generally one to four million acres in Minnesota, with the average being 2.25 million acres. Seventeen subsections are scheduled for the SFRMP process.

Subsection Forest Resource Management Plan (SFRMP): A DNR plan for vegetation management on forest lands administered by DNR Divisions of Forestry and Fish and Wildlife that uses ECS subsections as the basic unit of delineation. DNR lands administered by other divisions, e.g., Trails and Waterways, may be included at the discretion of the administrator. Initial focus will be to identify forest stands and road access needs for the duration of the 10-year plan. There is potential to be more comprehensive in the future.

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 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.

Tactical planning: See operational planning.

Temporary access: A temporary access route for short-term use that will not be needed for foreseeable future forest management activities. It is usually a short, temporary, dead-end access route.

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. **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 harvest 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 nonforest land.

Timber management plan: The same thing as vegetation management if used with the SFRMP process.

Timber Management Planning (TMP): Successor to the TMP information system (TMPIS). Recognizes the entire timber management planning process as being more than just the computerized system. Incorporates GIS technology and an interactive process with other resource managers.

Timber Management Planning Information System (TMPIS): Circa mid-1980s. Original computerized system for developing 10-year stand treatment prescriptions by area.

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.

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

Two-aged stand: a stand with trees of two distinct age class separated in age by more than 20 percent of the rotation age.

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

Understocked: A stand of trees so widely spaced that even with full growth potential realized, crown closure will not occur.

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 with 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.

Vegetation growth stage: The vegetative condition of an ecosystem resulting from natural succession and natural disturbance, expressed as vegetative composition, structure and years since disturbance. The vegetation growth stage describes both the successional changes (i.e., the change in the presence of different tree species over time) and developmental changes (i.e., the change in stand structure overtime due to the regeneration, growth, and mortality of trees). Vegetation growth stages express themselves along the successional pathways for a particular ecosystem depending on the type and level of natural disturbance that has occurred. Forest tree and other vegetation composition, habitat features, and wildlife species use change with the various growth stages.

Vegetation management plan: In the process of developing the 10-year stand examination list, many decisions and considerations go beyond identifying what timber will be cut (i.e., broader than timber management). This includes designation of old growth, extended rotation forests, riparian areas, desired future forest composition, visually sensitive travel corridors, etc., all of which are intended to address wildlife habitat, biodiversity, and aesthetic and other concerns. Prescriptions assigned to stands reflect decisions based on these multiple considerations and are broader than decisions relative to final harvest (e.g., ERF designation, uneven-aged management, thinning, regeneration, underplanting, prescribed burning, etc.).

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 DNR, Division of Fish and 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.

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APPENDIX D

Acronyms

AFRMP	Area Forest Resource Management Plan
AMA	Aquatic Management Area
BMP	Best Management Practices
BT	Bearing Tree
CAR	Corrective Action Request
CMAI	Culmination of Mean Annual Increment
CMT	Commissioner's Management Team (DNR)
CO_2	Carbon Dioxide
CSA	Cooperative Stand Assessment
CWCS	Comprehensive Wildlife Conservation Strategy
DBH	Diameter at Breast Height
DFC	Desired Future Condition
DFFC	Desired Future Forest Composition
DMT	Division Management Team (DNR)
DNR	Department of Natural Resources
DOF	Division of Forestry (DNR)
DOQ	Digital Orthophoto Quadrangle
DRG	Digital Raster Graphics
DRS	Data Resource Site
EAB	Emerald Ash Borer
ECS	Ecological Classification System
EERF	Effective Extended Rotation Forest
EILC	Ecologically Important Lowland Conifers
ELCP	Ecological Land Classification Program
ERF	Extended Rotation Forestry
ETS	Endangered, Threatened, or Special Concern
FHM	Forest Health Monitoring
FIA	Forest Inventory and Analysis
FIM	Forest Inventory Module
FORIST	Forest Information System
FRIT	Forest Resource Issues Team
FSC	Forest Stewardship Council

FTC	Forest Tent Caterpillar
FY	Fiscal Year
GAP	Gap Analysis Program
GDS	General Direction Statement
GEIS	Generic Environmental Impact Statement
GIS	Geographic Information System
GM	Gypsy Moth
HCVF	High Conservation Value Forest
HRLV	High-Risk/Low-Volume
HWDs	Hardwoods
HH	Hardwood Hills Subsection
JPBW	Jack Pine Budworm
LCMR	Legislative Committee on Minnesota Resources
LSA	Landscape Study Area
LSL	Laminated Strand Lumber
LTA	Land Type Association
MACLC	Minnesota Association of County Land Commissioners
MAI	Mean Annual Increment
MBF	Thousand Board Feet
MCBS	Minnesota County Biological Survey
MDA	Minnesota Department of Agriculture
MFRC	Minnesota Forest Resources Council
MFRP	Minnesota Forest Resources Plan
MIM	Minnesota and Northeast Iowa Morainal Section
MnTAXA	Minnesota Taxonomy Database
MnWRAP	Minnesota Wildlife Resource Assessment Project
MRA	Maximum Rotation Age
NAPP	National Aerial Photography Program
NAR	Natural Area Registry Agreement
NCFES	North Central Forest Experiment Station
NHIS	Natural Heritage Information System
NHNRP	Natural Heritage & Nongame Research Program
NPC	Native Plant Community
NRA	Normal Rotation Age
NRCS	Natural Resource Conservation Service
O_3	Ozone

OFMC	Old Forest Management Complex
OG	Old-growth
OHV	Off-Highway Vehicles
OLA	Open Landscape Area
OSB	Oriented Strand Board
RMT	Regional Management Team
RMZ	Riparian Management Zone
RNAs	Research Natural Areas
RNV	Range of Natural Variability
RSA	Representative Sample Area
RSPS	Remsoft Spatial Planning System
SBW	Spruce Budworm
SFRMP	Subsection Forest Resource Management Plan
SFI	Sustainable Forestry Initiative
SGCN	Species in Greatest Conservation Need
SI	Site Index
SMA	Special Management Area
SMC	Special Management Complex
SMZ	Special Management Zone
SNA	Scientific and Natural Area
SNN	Shipstead-Newton-Nolan Act
SONAR	Statement of Need and Reasonableness
SPP	Species
SRM	Silviculture and Roads Module
SWG	State Wildlife Grant
TLCB	Two-lined Chestnut Borer
TMP	Timber Management Plan
TMPIS	Timber Management Plan Information System
TNC	The Nature Conservancy
TSI	Timber Stand Improvement
TSM	Timber Stand Module
USDA-FS	Unites States Department of Agriculture – Forest Service
USDA-APHIS	Unites States Department of Agriculture – Animal and Plant Health Inspection Service
USFS	United States Forest Service
USFS-NRS	United States Forest Service-Northern Research Station

WMA	Wildlife Management Area
WPA	Waterfowl Production Area