June 2010: Part 1 Minnesota Department of Natural Resources

Minnesota Forest Resource Assessment

Important facts, information, trends and conditions about Minnesota's Forests

A Minnesota Forest Resources Assessment Plan to identify forest-related conditions, trends, threats and opportunities in Minnesota and act as a companion document to the Minnesota Forest Resources Strategies Plan (Part 2). June 2010

Acknowledgements:

This document was written and compiled by Helen Cozzetto with oversight by Jon Nelson both with DNR Forestry. Mary Hoff provided edits. The document was produced with input and contributions from many natural resources leaders, agencies, organizations and stakeholders including the US Forest Service (USFS) - Mike Prouty, Sherri Wormstead, Martina Barnes, Dennis McDougall, Teri Heyer, Tom Luther, Jill Johnson (S&PF) and Pat Miles - Forest Inventory & Analysis (FIA); Chippewa National Forest - Rob Harper, Don Rees; Superior National Forest - Mary Shedd; Bureau of Indian Affairs (BIA) - Robert Lintelmann; Grand Portage Tribe Forester- Timothy Miller; Red Lake Tribe Forester -Thomas Castonguay; US Fish & Wildlife Service (USFWS) - Paul Richert, Tex Hawkins, Jane West, Tom Cooper, Tony Sullins, Tamara Smith; National Park Service (NPS) - Mike Ward, John Snyder; US Army Corps of Engineers (USACE) - Randy Urich; Natural Resources Conservation Service (NRCS) - Ginger Kopp, Mike Greenheck; Soil and Water Conservation Districts (SWCD) - Brad Matlack, LeAnn Buck; Board of Water & Soil Resources (BWSR) - John Jasche, Dan Steward, Jim Lemmerman; University of Minnesota Department of Forestry - Mike Kilgore, Lee Frelich; Minnesota Department of Agriculture (MDA) - Rob Sip, Geir Friisoe; The Nature Conservancy (TNC) - Art Norton; Minnesota Forest Resource Council (MFRC) - Dave Zumeta, Lindberg Ekola, Leslie McInenly; Minnesota Forest Resource Partnership (MFRP) - Kathleen Preece, Jim Marshall ; Minnesota Forest Industries and Minnesota Timber Producers Association (MFI/TPA) - Wayne Brandt; Associated Contract Loggers & Truckers of Minnesota (ACLT) – Scott Dane; Minnesota Shade Tree Advisory Committee (MNSTAC) - Katie Himanga, Kameron Kytonen; Minnesota State Technical Committee-Ginger Kopp, Mike Greenheck; Minnesota Forest Stewardship Committee – Andrew Arends, Les Everett; Sustainable Forests Education Cooperative (SFEC) - Mike Kroenke; Minnesota Logger Education Program (MLEP) - Dave Chura; Minnesota Society of Arboriculture (MSA) - Jim Vaughan; Utility Arborist (UA) - Dave Auchter; Great River Greening - Deborah Karasov; and Minnesota Department of Natural Resources (DNR)-Laurie Martinson, Dave Epperly, Bob Tomlinson, Jon Nelson, Keith Jacobson, Alan Jones, Ron Stoffel, Andrew Arends, Clarence Turner, Timothy Aunan, Dennis Kepler, Ken Holman, Greg Spoden, Dick Peterson, Mark Lindquist, Anna Dirkswager, Rebecca Barnard, Rick Dahlman, Dick Rossman, Doug Miedtke, Barb Meyer, BJ Glesener, Beth Donat, Pat Matuseski, Meg Hanisch, Keith Simar, John Faulkner, Jana Albers, Greg Nelson, Mike Carroll, Steve Hirsch, Jim Manolis, Andy Holdsworth, Bart Richardson, Steve Colvin, Kurt Rusterholz, Jane Norris, Ann Pierce, Melissa Driscoll, Kathy Don Carlos, Katie Haws, Wayne Edgerton, Peter Jacobson, Pat Rivers, Jade Templin, Chris Scharenbrioch, Dan Hanson, Adele Smith, Stephen Schott.

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Document produced by:
Minnesota Department of Natural Resources
500 Lafayette Road
St. Paul, MN 55155-4040

Minnesota Department of Natural Resources
500 Lafayette Road • St. Paul, MN • 55155-40

June 18, 2010

Dear Interested Citizen:

I am pleased to present to you the first edition of the Minnesota Forest Resource Assessment (Part 1-Assessment) and Minnesota Forest Resource Strategies (Part 2-Strategies). This is the first effort under new requirements of the 2008 Federal Farm Bill (Farm Bill). The Farm Bill requires that each state complete a state assessment and resource strategies document by June 2010 in order to continue receiving federal funding through the federal Cooperative Forestry Assistance Act.

The Farm Bill requirement for states to undertake this effort is driven by growing pressures on the nation's forests and a growing scarcity of available resources. The intense competition for scarce federal, state and other resources accentuates the need to make sure that available resources are focused on the greatest priority needs. Integration and spirited cooperation among programs and organizations that share common objectives is paramount to the optimal use of available resources. It is with that spirit that the Minnesota Assessment and Strategies documents have been developed.

It is important to note that these documents are not intended to be a comprehensive compilation or compendium of information about Minnesota's forests and forest management strategies. Rather they are intended to provide a broad general overview of the main trends, conditions, and issues affecting Minnesota's forests and correlating general response strategies that might be employed. The vast majority of the information presented has been gathered from numerous existing sources (i.e., reports, surveys, studies) and ongoing efforts, repackaged and reformatted for this effort. The 2008 Farm Bill requires periodic updates, so it is also important to view these as "living" documents subject to change as new information becomes available. At a minimum, the documents will need to be revised every five years.

The Minnesota Assessment and Strategies documents are the result of efforts and review by numerous agencies, organizations, and individuals engaged in forest management in Minnesota. I want to extend my thanks to those who have taken the time to make this a richer product. I hope that the documents and the dialogue initiated with their development will serve as a useful resource for the many ongoing efforts within Minnesota's forestry community.

If you have any suggestions for improving this effort or corrections to information that has been presented, please be sure to submit your thoughts to Helen Cozzetto (Helen.cozzetto@state.mn.us).

Thank you for your continued interest in Minnesota's forests.

Sincerely,

Dave Epperly, Director
MNDNR Division of Forestry

Contents

Chapter 1: Introduction

Minnesota is situated at the confluence of three ecological provinces including: the Laurentian Mixed Forest Province - which straddles the northeastern part of the state and is a broad ecotone between the deciduous forest and boreal forest biomes; the Eastern Broadleaf Forest Province - which is situated throughout the central part of the state; and the Prairie Parkland Province - which occupies the western border of the state. Overall, the state is nearly one-third forested (16.7 million acres) and ranks in the top twenty forested states by acreage in the nation.[1] Forests, forest-related industries and use of forests for a variety of purposes have been part of the state's history even before statehood in 1858.

The 1800s saw large portions of the future state being transformed by logging and subsequent land clearing for settlement and agriculture, which prompted several efforts to preserve outstanding forest landscapes while encouraging sustainable methods of timber harvesting. In 1832 the headwaters of the Mississippi were discovered and in 1891 this 32,000 acre area was permanently established as Itasca State Park to protect these headwaters and some of the last remaining virgin pine forests. This state park is the second oldest in the nation after the New York's Adirondacks State Park. In 1902, the first national forest reserve east of the Mississippi was established in Minnesota. That reserve became the Chippewa National Forest in 1908 and now contains over 1.6 million acres. Only 667,000 of the 1.6 million acres are administered by the National Forest Service (NFS) and the rest is in other ownerships. (see http://www.fs.fed.us/land/staff/lar/2008/TABLE_4.htm). This was followed in 1909 by the establishment of the Superior National Forest, which contains over 3.9 million acres, of which 2.095 million acres are administered by the NFS (including the plus 1 million acres Boundary Waters Canoe Area Wilderness). The state followed by designating another 4.9 million acres as state forest lands which are now contained primarily within the statutory boundaries of 58 state forests.

The profession of Forestry was first practiced in the state under the federal guidance of the US Department of Agriculture (USDA) and was followed in 1911 by the state's establishment of the Minnesota Forest Service which was later renamed the Division of Forestry under the state Department of Natural Resources (DNR). Forestry practices and forestry professionals are now employed at all levels of federal, state, county and city governments and are committed to practice sustainable forestry within Minnesota.

The 2008 Federal Farm Bill[2] requires each state to complete a "*Statewide Forest Resource Assessment"* (Assessment) and "*Statewide Forest Resource Strategies"* (Strategies) by June 2010 to continue receiving funds under the Cooperative Forestry Assistance Act.(CFAA)[3] As stated by the Northeastern Area Association of State Foresters (NAASF), each state should work collaboratively with key partners and stakeholders to develop a statewide forest resource assessment based on a comprehensive analysis of forest-related conditions, trends, threats and opportunities in the state and focus on landscape areas with the greatest opportunity to address shared management priorities and achieve measurable outcomes.

Forest sustainability is a goal of many forestry organizations across the United States and throughout the world. Minnesota forest lands have a long history of being managed with the primary consideration given to long-term ecosystem integrity and sustaining healthy economies and human communities. Forest resource policy and management decisions are based on credible science, community values, and broad-based citizen involvement.[4]

Managing forests sustainably involves recognizing interconnections among ecological, social, and economic systems to preserve options for future generations while meeting the needs of the present. Many organizations are turning to a criteria and indicators (C&I) approach to help describe forest sustainability. One of the most

[1] National Association of State Foresters. 2004.
[2] The Food, Conservation, and Energy Act of 2008, commonly referred to as the Farm Bill, was enacted June 19, 2008.
[3] The cooperative Forest Assistance Act provides authority for the S&PF Programs.
[4] Minnesota Forest Resource Council

notable efforts using the C&I approach is the "*Montreal Process"*[5]*,* which both the NAASF and the USFS Northeastern Area, State and Private Forestry (NA) have endorsed in efforts to achieve sustainability.

However, there have been concerns expressed about how these international criteria and indicators could be used at regional and state levels, particularly in regards to the applicability of the framework at these scales and the availability of data to support them. As the request of the NAASF, the Northeastern Forest Resource Planners Association (NFRPA) and the NA formed a workgroup to address these issues and provide guidance and a sourcebook for all 20 states in the Northeast and Midwest to follow[6].

Minnesota decided to follow the recommendations from NAASF and use the criteria and indicators framework developed in the "*Sourcebook"* [7] as the basis for its assessment document.

Minnesota started with the base set of indicators identified in the "*Sourcebook"* and revised and added indicators to best reflect major current conditions and trends affecting forests of the state. The revised set of indicators, organized around the seven criteria from the "*Montreal Process'*, were subsequently reviewed by a broad number of partners and stakeholders.

[5] The "*Montreal Process Criteria and Indicators* "are a series of seven criteria and 67 indicators that were developed out of the 1992 Earth Summit in Rio de Janeiro, Brazil. In 1995, the United States was one of the 12 countries to sign a document establishing the criteria and indicators to track forest sustainability for temperate and boreal forests around the world.
[6] USFS- Northeastern Area State and Private Forestry and Northeastern Forest Resource Planners Association; "*Sourcebook on Criteria and Indicators of Forest Sustainability in the Northeastern Area"*
[7] USDA-USFS State and Private Forestry. 2002. "*Sourcebook on Criteria and Indicators of Forest Sustainability in the Northeastern Area.* " NA-TP-03-02. 64p.

Chapter 2: Forest Conditions and Trends

Introduction

The following seven criteria set from national and international levels (commonly referred to as the "*Montreal Process Criteria and Indicators*") and developed by the USDA FS into a "*Sourcebook on Criteria and Indicators of Forest Sustainability in the Northeastern Area* " (2002), are being used as a template to monitor the sustainability of Minnesota's forests. These seven criteria of forest sustainability are used because: 1. they provide broad goals for sustainable forest management, encompassing ecological, social, and economic aspects of forests; 2. they are agreed to and monitored at multiple levels; 3. related state-level data are compiled and will be available on-line.

Criterion 1: Conservation of Biological Diversity

Biological diversity refers to variety in the natural environment as in, the number and kinds of life forms, their genetic makeup, and in the habitats where they live. Generally, greater diversity means a greater potential to adapt to changes. To preserve biological diversity, animal and plant species must be able to freely interact with one another and with their environment. There must be the right and wholesome foods per species, clean water, and adequate shelter in sufficient amounts spread across the landscape. Biological diversity is often studied at ecosystem, species, and genetic levels[8].

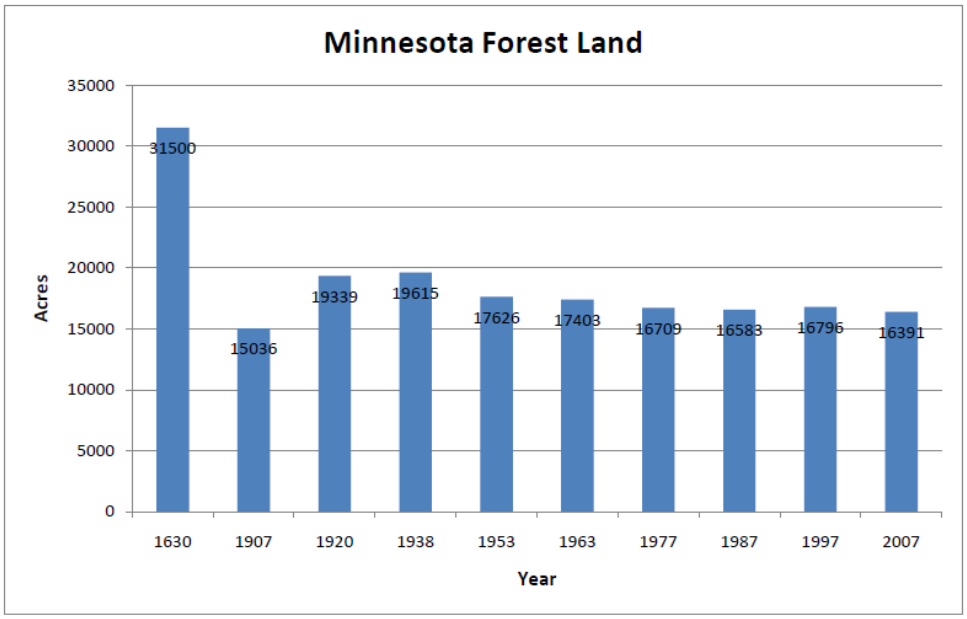
This criterion ties to the national theme of *Conserving and Managing Working Forest Landscapes for Multiple Values and Uses.*

Indicator 1: Forest Land Trends

Minnesota is among the top twenty forested states by acreage[9] in the nation. Forests occupy one-third of Minnesota's land base. Prior to continuous European settlement around 1850, approximately 31.6 million acres of land (46%) in the state was forested. As the graph below (Figure 1) indicates, land clearing through logging and burning for agriculture and settlement in the late 1800s, resulted in the loss of about ½ of the state's pre-settlement forests. Forest lands recovered somewhat over the next 60 years, dropped again between the 1950's and the 1970s, but have remained relatively stable over the past 30 years.

[8] NAASF- "*Suggested Framework for Statewide Forest Resource Assessments,"* November 2008
[9] National Association of State Foresters. 2004.

- Figure 1. State Forest Land Changes [10]



FIA

Notes:

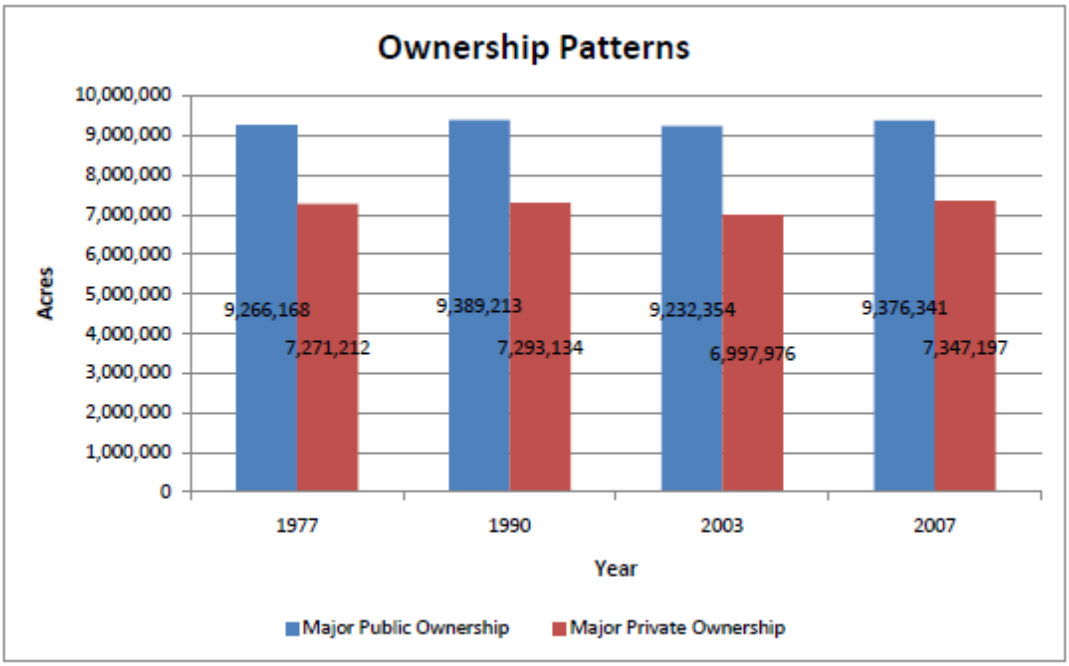
- Estimates for 1630, 1907 and 1938 include forest area for regions that would become the 50 states within the current United States.
- Estimates for 2007 and historical years have been adjusted for forest definition change to minimum 10% cover and removal of chaparral as a forest type. Refer to 1997 RPA tables for historic estimates prior to this change.
- Data for 1997 based on Smith et al. (2001). Adjusted for removal of chaparral type.
- Data for 1987 based on Waddell et al. (1989). Adjusted for removal of chaparral type.
- Data for 1977 based on USDA Forest Service. (1982). Adjusted for removal of chaparral type.
- Data for 1963 based on USDA Forest Service. (1965). Adjusted for removal of chaparral type.
- Data for 1953 based on USDA Forest Service. (1958). Adjusted for removal of chaparral type.
- Data for 1938 based on US Congress. (1938). Adjusted for removal of chaparral type.
- Data for 1920 based on Capper Report. Adjusted for removal of chaparral type.
- Data for 1907 based on Kellogg (1909). Adjusted for removal of chaparral type.

In 2009, there are approximately 16.7 million acres of forest land (31% of the total state land base), of which 15.4 million acres are classified as "timberland" or lands capable of producing timber (20+ cu ft industrial wood crop per acre per year). Approximately 822,296 acres of this forest land is reserved by statute, administrative regulation, or designation from timber harvesting. Much of this set-aside land is within the Boundary Waters Canoe Area Wilderness (960,000 total acres) and Voyageurs National Park (218,054 total acres).[11]

Recent annual Forest Inventory Analysis (FIA) data indicates that forest land acreage may be increasing slightly in the state from approximately 16,230,000 acres in 2004 to 16,723,532 acres in 2009, due in part to some agricultural lands reverting back to forest lands.

[10] Francis J. Marschner (1882 -1966). "*The Original Vegetation of Minnesota* " created in 1930 as interpreted from Public Land Survey notes.
[11] FIA

• Figure 2. Public and Private Forest land Ownership 1977-2007

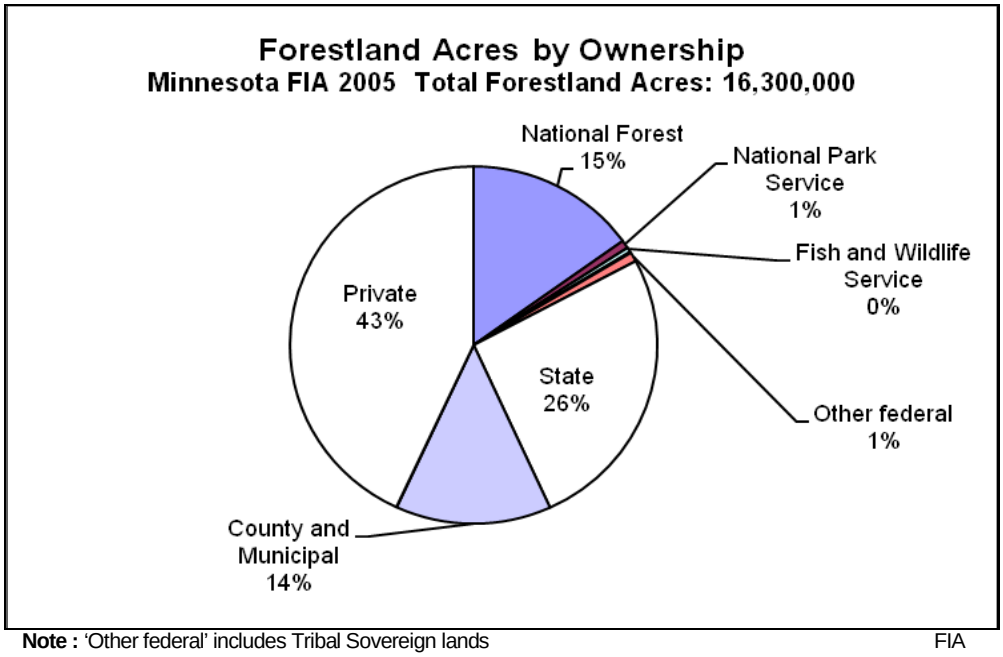


FIA

Minnesota forest land ownerships patterns are indicating a slight trend towards more private ownership, as the chart above reveals. (Figure 2) 2005 FIA data indicates that 43% of forest land ownership was in private hands. (Figure 3). Recent FIA data for 2008 suggested that private ownership increased to 46%. This is most likely driven by the corresponding increase in total forest land due to private agricultural lands reverting to forest (i.e. the amount of public forest land has remained stable). Overall, the ratio of public to private forest land has remained relatively stable over the past 30 years. However, the nature of private ownership has recently been changing due to two primary factors including:

- Divestiture of forest industry land ownership
- Parcelization of non-industrial private forest lands

• Figure 3. Forest land Acres by Ownership



Note : 'Other federal' includes Tribal Sovereign lands FIA

Indicator 2: Forest Density

There are many ways to report forest density including stocking, basal area/acre, trees/acre, volume/acre, and tree biomass in tons/acre. The methodology FIA used for calculating stocking has changed over the years and is only suitable for trend analysis on data collected after 1998. This report has used FIA data to calculate the number of trees per acre to obtain a trend sampling for this indicator. (Table 1)

FIA data shows that the density of forests is increasing in Minnesota. The perceived large increase in density from 1977 and 1990 to 2003 can be explained by a change in the way the data was calculated. There is no data available for 1977 or 1990 that uses the same criteria for measurement as the 2003-2007 data. One explanation is that some forests in Minnesota are younger and heavily skewed towards aspen, which accounts for the increased density. However, this does not indicate that forest lands are healthier or that forest bio-diversity is increasing. Further research is needed in this area.

• Table 1. Average Live Tree Biomass Per Acre on Timberland

Inventory Year	**Number of All Live Trees on Timberland** (trees/acre)	**All Live Merchantable biomass on Timberland Oven-dry** (short tons/acre)	**All live tree and sapling above ground biomass**	**Volume of All Live Trees on Timberland** (cu ft/acre)
1977	570.4	15.9	25.2	1,048.6
1990	573.4	17.9	27.3	1,159.2
2003	755.2	17.3	27.1	1,106.7
2007	776.1	17.3	27.3	1,090.9

FIA

Indicator 3: Fragmentation/Parcelization of Forest Lands

Forest fragmentation occurs when a large contiguous forest land mass is divided into smaller tracts through sale and subdivision, construction of roads, clearing of forests for agriculture or housing or other commercial developments, and represents a degree to which forested areas are interspersed with non-forested areas. Temporary fragmentation can also occur as a result of timber harvesting or natural processes such as fire and flooding.

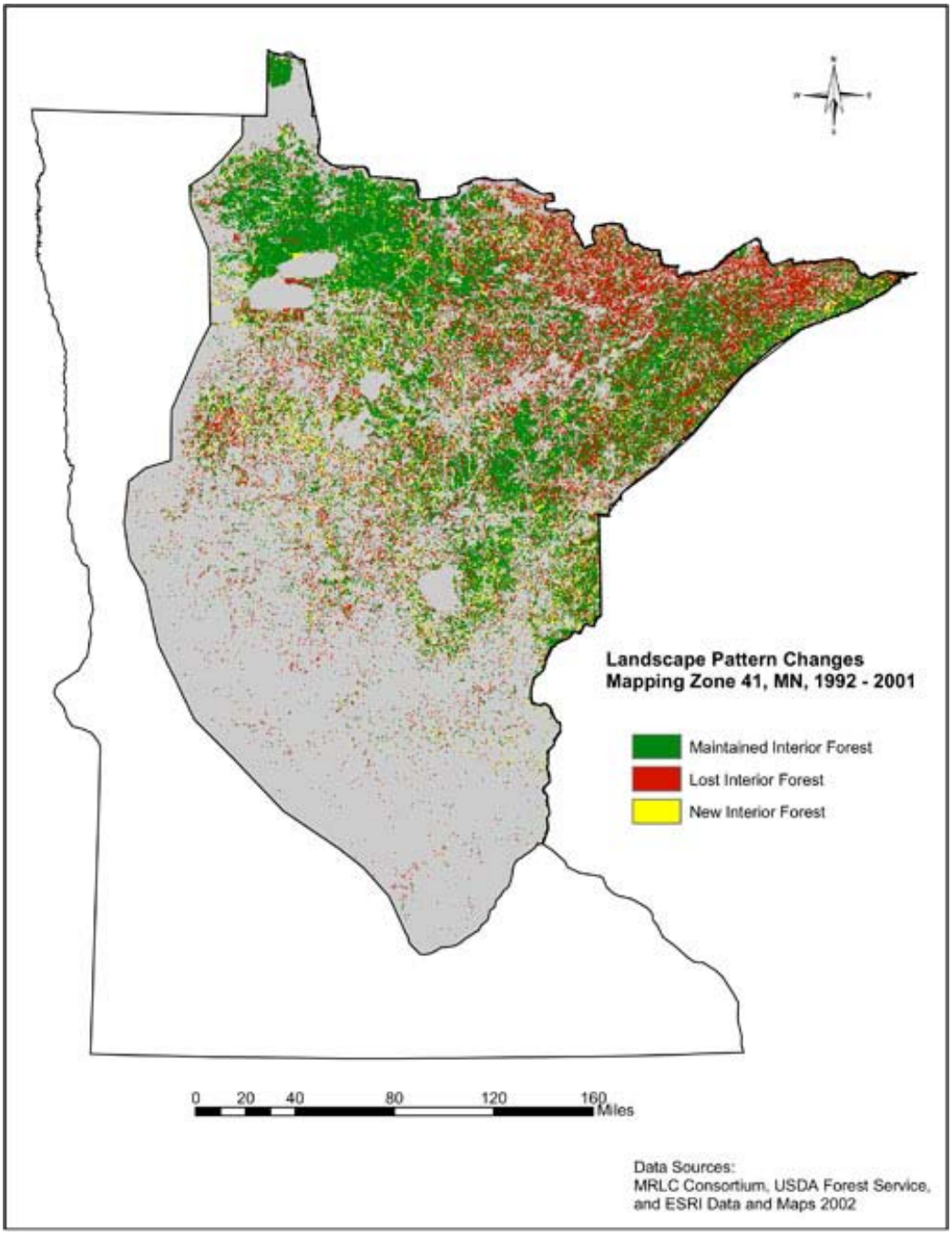
Fragmentation of forest lands is a major concern for the state and the management of natural resources. Large contiguous land tracts have been sub-divided, reduced in size, and isolated from each other. Although the state maintains a robust amount of forest lands, many are private tracts now under pressure for subdivision or sale, due to changing industry priorities and market conditions.

One driver of fragmentation is key natural disturbances and events which can change the composition and cover canopy of an intact forest system. An example would be the 1999 Boundary Waters natural disaster blowdown which caused major loss of interior forest in a large part of the border lakes area of the state.

The following map (Figure 4) describes one method of measuring recent landscape patterns by tracking changes in the state's interior forests[12]. As shown, the only remaining large tracts of unfragmented forest are concentrated in the northern portions of the state, where population is small and forest tracts were traditionally held by a few large industrial landowners.

[12] FIA

• Figure 4. Fragmentation of Forest Land



In contrast, parcelization of forest land occurs when large single owner land holdings are divided into smaller pieces that are subsequently owned by multiple parties. These multi-ownerships do not necessarily translate into physically changing landscapes or loss of forest canopy but refer to the degree to which the size of forest land parcels diminish over time.

In 1982, an estimated 131,000 owners held 5.1 million acres of private forest land.[13] By 2003, the number of private landowners had swelled to an estimated 173,000 families and individuals owning 5.3 million acres or 42

[13] Carpenter 1986

percent of Minnesota's forest land.[14] The average landholding size decreased from 39 acres in 1982 to 31 acres in 2003.[15]

By 2008, approximately 46% of Minnesota forest lands were in private hands. Private ownership of forest lands has been increasing due to reversion of forest lands, primarily in the southern and western portions of the state. This land, which is distributed among both individuals and organizations, faces increasing development pressures, at the same time that it is being passed onto a new generation of forest landowners with varying management goals that differ from their predecessors.

Overall, development and fragmentation of forest lands can impede timber and wildlife management options, increase the risk of wildfire, restrict public recreational access, and reduce the habitat value of forest lands.[16]

Trend data indicates that as more landowners are buying up forest lands, the parcel size is decreasing and management objectives are also changing to reflect less timber harvest objectives on these lands. Other management objectives such as wildlife habitat or recreation objectives seem to be increasing, but further long-term data is needed to confirm these observations.

Indicator 4: Sale of Forest Industry Lands

The sale of large timber company holdings in Minnesota is part of a national trend. Forest land ownership in Minnesota has changed significantly in recent years. Between 1989 and 2003, land owners sold 540,000 acres of private forest land. Area of land sold during that period increased an average of 4% per year.[17] In northern Minnesota, timber and mining companies have divested themselves of thousands of acres of forest lands to investors, who value these lands not for natural resources alone, but for their potential to provide a return on investments through real estate development and other options such as timber investment management organizations[18] (TIMO) and real estate investment trusts[19] (REIT). These lands are intermingled with state and county forests.

Since 1998, more than 400,000 acres of industrial forest lands have been sold, which represents 2.5% of the forest land base in the state. (Table 2). Nearly 1 million acres of large, intact private industrial timber parcels are at risk of being sold and subdivided into smaller parcels for resale.[20]

- Table 2. Recent Large Scale Forest Land Sales in Minnesota

Year of Land Sales	Number of Acres	Industrial Company
1998	30,000	Louisiana Pacific
2003	70,000	Consolidated Paper
2005	309,000	Boise Cascade
2008	23,500	Potlatch Corporation

MN DNR

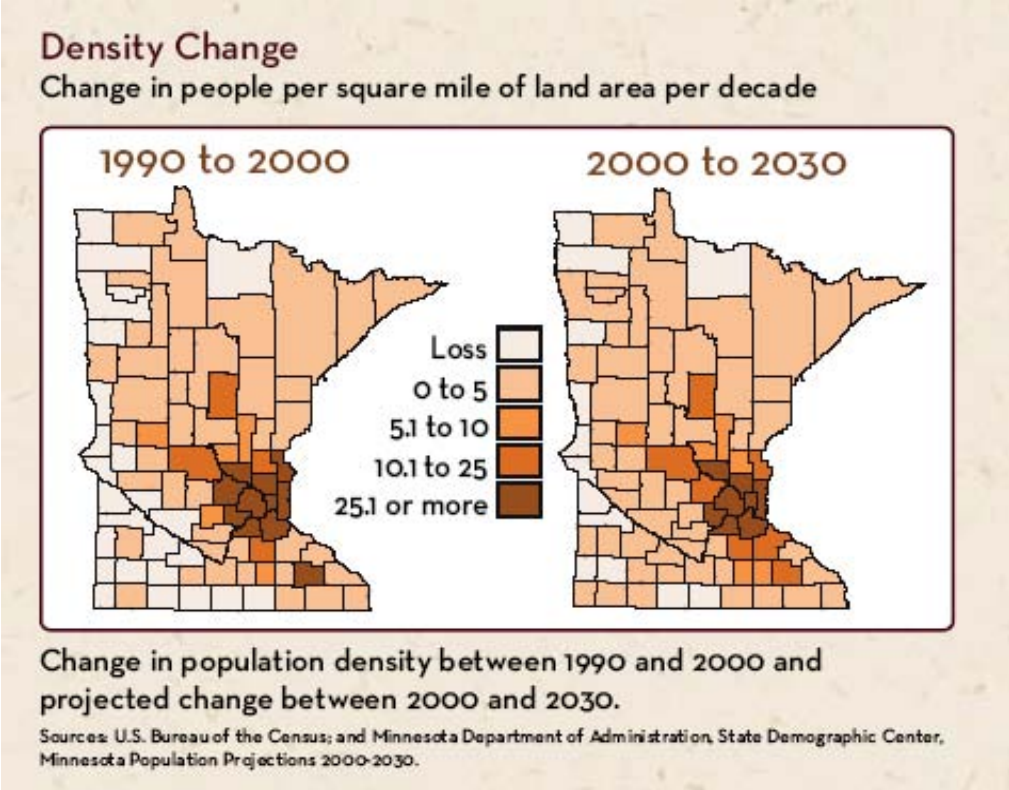
Indicator 5: Housing Density Projections

Minnesota has the fastest growing population in the Upper Midwest states. Minnesota's population is expected to grow by more than 1 million people by 2030. (Figure 5). With population growth and associated development

[14] Butler and Leatherberry 2004
[15] 1999-2003 FIA report
[16] 1999-2003 FIA report http://www.treesearch.fs.fed.us/pubs/17334
[17] M. Kilgore and D. MacKay. 2006
[18] A timber investment management organization (TIMO) is similar to a mutual fund, except that it owns timberlands instead of stocks. Typical investors are large pension funds, endowments, banks, and individuals. Source: MFRC 2005 Annual Report.
[19] A real estate investment trust holds land for investment purposes and buys or sells land as investments regardless of their timber or natural resources potential.
[20] FIA

pressures on forest lands, come increased potential for forest loss and fragmentation.[21] These altered land uses affect timber production, ecosystem and habitats and outdoor recreation opportunities. A major projected trend in Minnesota is the conversion of forest lands around urban centers to other uses as a result of projected population growth and associated development. From 1982 to 1997, urban land expanded by 27%. Until the 2007 downswing in the national economy, the average acres lost to urban development was approximately 1500 annually, mostly around the growing metropolitan areas of Minneapolis-St. Paul. Although recent estimates of acres lost to urban development are not yet available, population growth in Minnesota is expected to continue to concentrate in the Minneapolis/St. Paul metropolitan area (Twin Cities) and the corridor between Rochester and St. Cloud. Increased second-home development is also expected to continue along the Lake Superior shoreland (North Shore region) and forested areas of the state that border lakeshores including the Brainerd/Bemidji corridor and Metro 1-35 to Duluth corridor. New development patterns are altering land and water conditions. For instance, as lakeshores develop, shorelands lose their ability to support forests, fish, wildlife and clean water. A recent analysis by the DNR Local Grants Unit indicated that an additional 10,000 acres of land will need to be acquired in the Twin Cities growth area alone, in order to meet regional standards for regional park/acres per person.[22]

- Figure 5. Density Change 1990-2000, Projected 2000-2030



Urban growth around the Twin Cities corridor indicates that the southern and central portions of the state face the most pressure on forest land retention. The state is actively pursuing alternatives such as conservation easements to preserve forestlands around highly urban areas.[23]

Density projections for the upper one third of the state remain relatively stable but could see increasing changes to housing density, if large forest industry tracts continue to be sold to TIMOs and REITs for future rural and

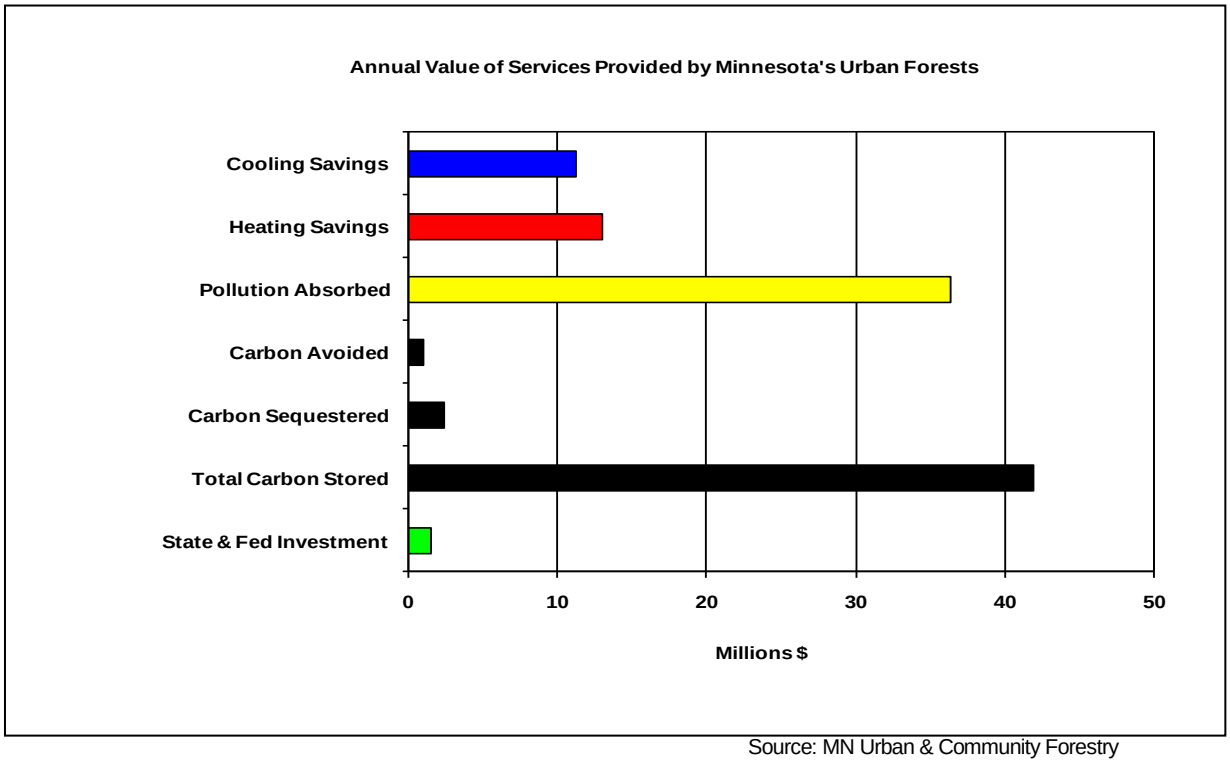
[21] MN DNR *"Strategic Conservation Agenda 2009-2013"*
[22] MN DNR *"Strategic Conservation Agenda 2009-2013"*
[23] Metro Greenways. http://www.dnr.state.mn.us/greenways/index.html)

lakeshore developments. The largest efforts to date to retain these large blocks of working forests has been through conservation easements focused on industry lands in the upper third of the state. Further discussion on conservation easements can be reviewed under Indicator 40.[24]

Indicator 6: Urban Areas

Minnesota's urban forests have an estimated 128 million trees, which have a compensatory (replacement) value of $80 billion and provide environmental services conservatively estimated at $6.5 billion to community residents every year. (Figure 6). They remove thousands of tons of air pollution and reduce heating and cooling expenses to the state's residents, thereby avoiding production of additional carbon each year.

- Figure 6. Annual Value of Services Provided by Minnesota's Urban Forests



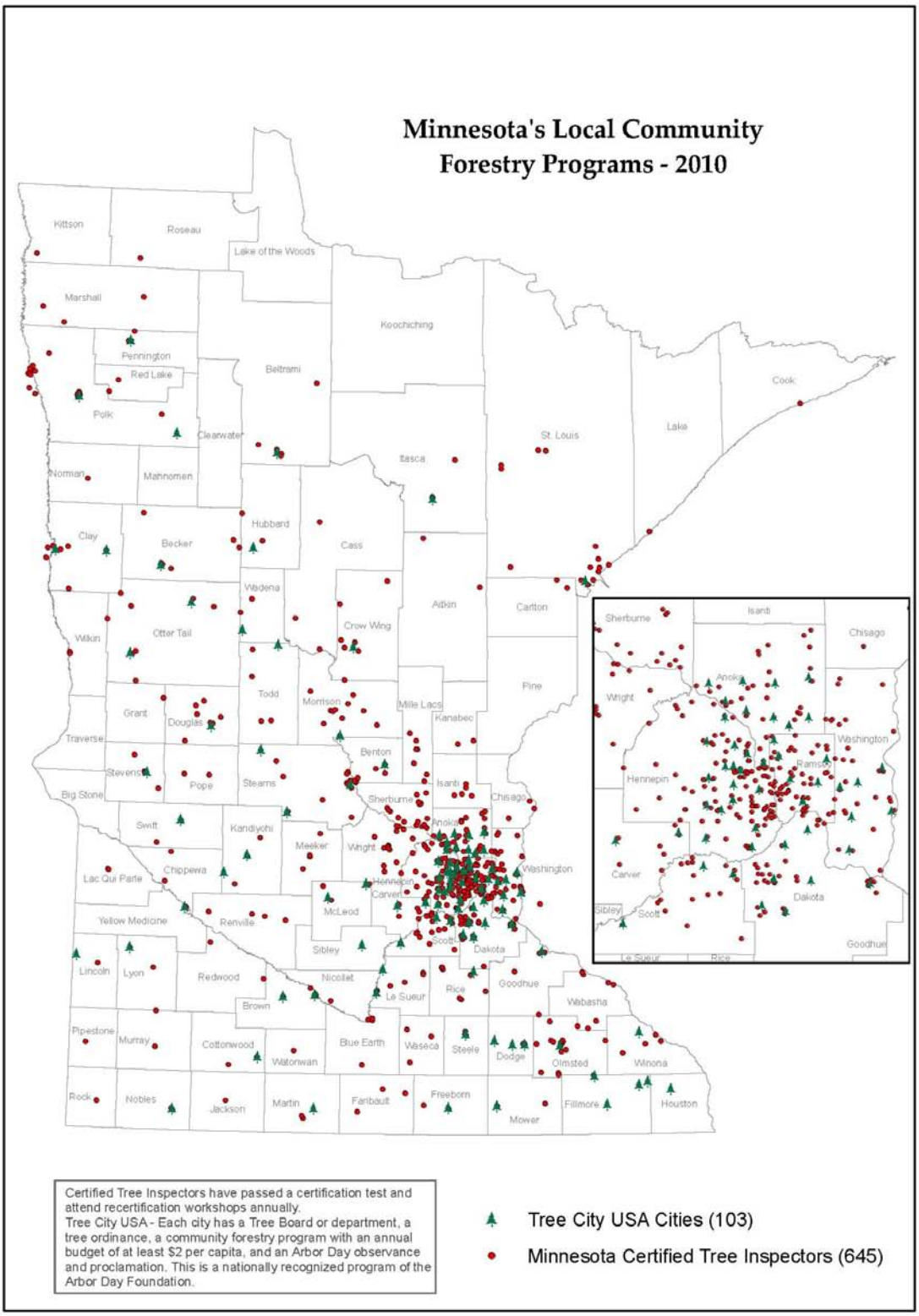
Source: MN Urban & Community Forestry

Urban Community Forestry Program

The objective of state assistance is to improve the protection and management of community forests by building the technical capacity of local programs and private vendors. This is accomplished primarily through the 34-year-old Tree Inspector program, which serves over 800 tree workers and arborists in nearly 500 communities statewide. State partners have also provided training for 180 emerald ash borer (EAB) first detectors in cooperation with the Minnesota Department of Agriculture (MDA) and University of Minnesota, to enhance local pest monitoring capabilities statewide. Figure 7 shows the location of Tree City USA communities and certified tree inspectors throughout the state. These people represent the front line for monitoring and managing threats to urban tree health and are a critical link between communities and other levels of forest management in Minnesota.

[24] "*Forests for the Future*." http://www.dnr.state.mn.us/forestlegacy/index.html).

• Figure 7. Minnesota's Local Community Forestry Programs



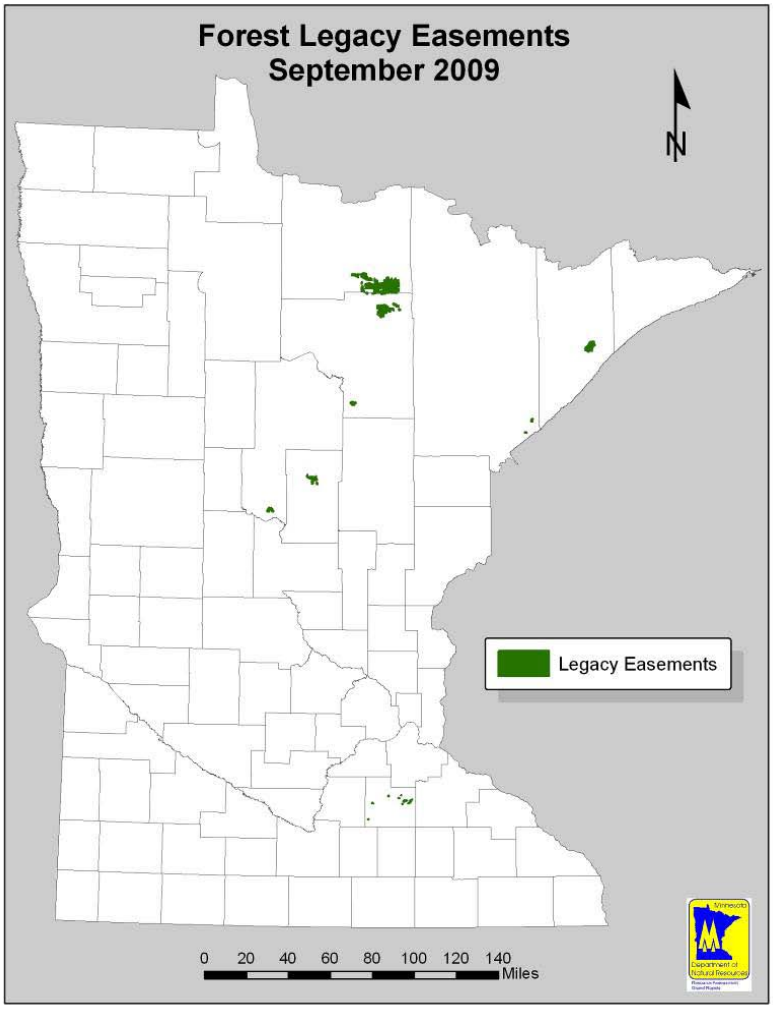
Indicator 7: Protected Forest Land

Protected forest lands are defined to include all publically-owned forest lands as well as some private lands under long-term conservation easements that protect them from development. There are approximately one million acres of forest lands that are projected to be protected from future development as publically-owned forests (e.g. federal, state and county) or private lands under long-term or permanent conservation easements (e.g. Forest Legacy conservation easements and lands held by conservation organizations).

In Minnesota, timber companies have owned and managed forest lands for over a century and been committed to stewardship of these lands. However, the shifting economics of the forest products industry and escalating real estate prices have forced unprecedented changes in forest land ownership and priorities for forest management.

Recent large and small-scale forestland sales are altering the reserved forest land outlook for the state. As a result, the Minnesota Forests for the Future Program (MFF) was established by the Minnesota Legislature in 2008 (Minnesota Statutes, chapter 84.66) to identify and protect private, working forest for their timber/economic values, recreational values and habitat values using conservation easements, fee title and other tools. (Figure 8). This program is new and will be able to provide trend data in the future.

- Figure 8. Forest Legacy Easements (Sept. 2009)

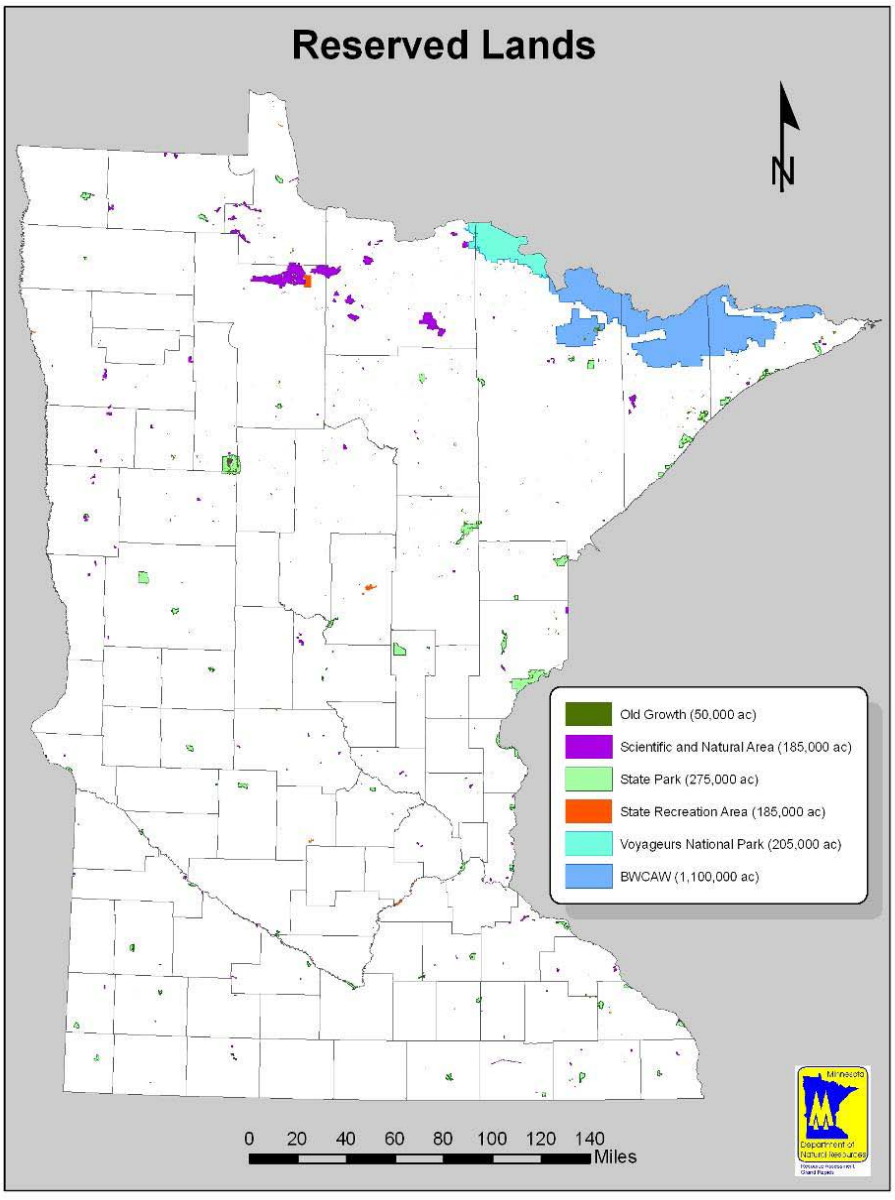


MN DNR

Indicator 8: Reserved Lands

Reserved lands are a subset of protected forest lands. In Minnesota, approximately 5 % of forest land is reserved from industrial/commercial timber production under a variety of laws and land protection programs. The largest land tract is the Boundary Waters Canoe Area at 960,000 total acres, which is under the federal jurisdiction of the USDA Forest Service. Voyageurs National Park at 218,000 total acres, is under the federal jurisdiction of the National Park Service. State reserved lands include those within the boundaries of state parks, state natural areas and DNR designated old growth forest stands. The current total of reserved lands that are off-limits for timber harvest is 1.1 million acres, of which 822,000 acres are currently considered forested. [25] (Figure 9).

- Figure 9. Reserved Lands



MN DNR

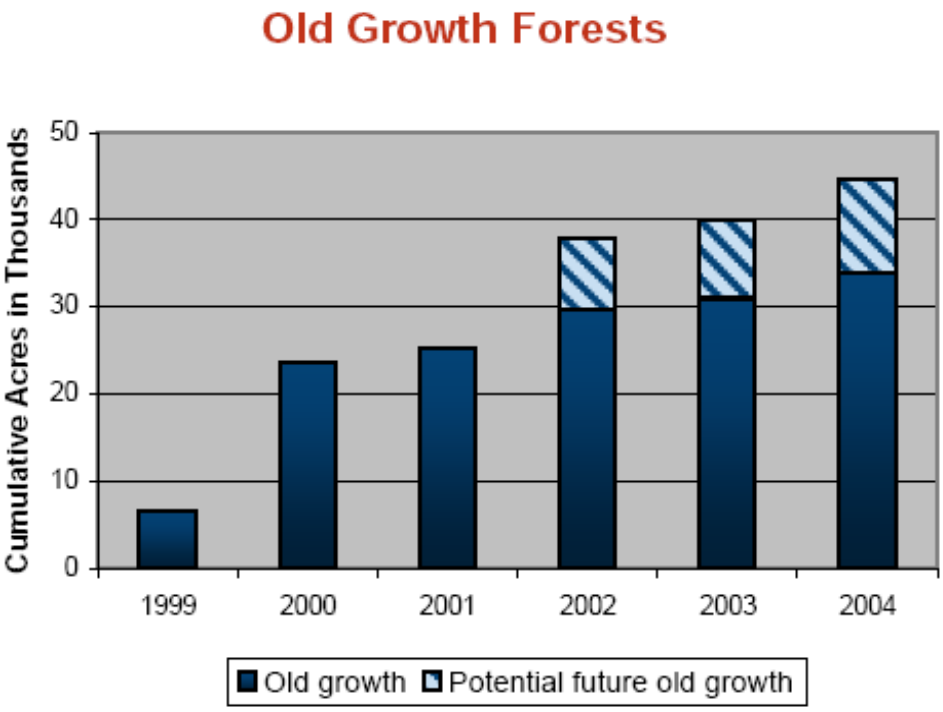
[25] FIA

Old Growth Forests

Old-growth forests are unique, rare and nearly vanished ecological communities in Minnesota. They are defined by age, structural characteristics, and relative lack of human disturbance. These forests are essentially free from catastrophic disturbances and contain trees that are generally over 120 years old. They also contain remnants of plant life that once covered 51 % of the state's forested regions. Historic records and photos indicate that the harvest of these forest ecosystems delivered immense wealth to individuals and government, speeding the development of the state's early economy.

Today, a percentage of the remaining ecologically significant old-growth forests are protected from harvest and represent new values in modern forest management. (Figure 10). The state is in the process of reviewing all old growth cover types for protection consideration. As this process is not yet complete, the following represents a baseline target that was set previously by the state.

- Figure 10. Old Growth Forests



Old-growth forest acres on DNR lands. DNR will maintain a 44,000-acre network of old-growth forest sites.

Indicator 9: Federally Listed Forest Associated Species

The federal Endangered Species Act of 1973 as amended (16 USC 1531-1544) requires the US Department of the Interior to identify species as endangered or threatened according to a set of definitions and set of restrictions pertaining to those species. This act is administered by the US Fish and Wildlife (USF&WS) and identifies eleven species that occur in Minnesota. As of 2009 these include:

- Birds: piping plover (T), piping plover prairie sub-population (E) piping plover Great Lakes population (E) Fish: Topeka shiner (E), Mollusks: Higgins eye (E), winged mapleleaf (E), Butterflies & Moths: Karner blue butterfly (E), Vascular Plants: dwarf trout lily (E), western prairie fringed orchid (T), Leedy's roseroot (T), prairie bush clover (T), Mammals: Gray Wolf (T per court order 7/1/09), Canada Lynx (T)

One species (the Bald Eagle) was delisted in 2007. One new species (the Canada Lynx) was added in 1998. Of these above listed species five are found in the state's forests including Gray Wolf, Canada Lynx, Karner blue butterfly, dwarf trout lily and Leedy's roseroot). On July 1, 2009, in response to a legal challenge, the US Fish and Wildlife Service has re-listed the gray wolf as a threatened species in the state. The settlement suspends implementation of the Minnesota wolf management program and puts management back under the authority of the US Fish and Wildlife Service. Minnesota's wolf population, which is primarily located in the northern forested areas of the state, is currently estimated at over 2900 animals and has remained stable for the past ten years. This makes the state's gray wolf population one of the highest in the country.

Other species that are candidates for future federal listing in Minnesota include; Eastern massasauga (*Sistrurus catenatus catenatus*), Sheepnose (*Plethobasus cyphyus*), Spectaclecase (*Cumberlandia monodonta*), and Dakota skipper (*Hesperia dacotae*).[26]

Further information on all of Minnesota's endangered species and designated critical habitats are available through http://www.fws.gov/midwest/Endangered/lists/minnesot-cty.html

Current inventory data indicate diverse and abundant forest habitat (snags, coarse woody debris, and forest patterns) to support numerous wildlife species across Minnesota. Data also supports that both young forests and mature forests are increasing across the state.[27] For species that depend on continuous forest cover in mature forests, there is evidence that the area of mature forest is increasing across Minnesota but that the area of interior forests has decreased. [28] For species that require both the cover of mature forests and foraging areas of non-forest environments, the continued maturation and fragmentation of Minnesota's forests will undermine the maintenance of these habitat intermixes.[29]

While this document focuses on the state's forests and terrestrial species that are intertwined with forest lands, federally listed freshwater mollusks and other sensitive aquatic species do occur in waterways adjacent to state forests in the St. Croix and Mississippi River watersheds.[30]

Trends for federally listed species appears to be holding steady and there have been successes in the delisting of two species recently including the Peregrine Falcon (1999) and the Bald Eagle (2007). However, continued land fragmentation and development are putting increased pressure on animal, plant, amphibian, fish and mollusk species within fragile forested watersheds, especially close to wildlife-urban interfaces.

Indicator 10: State Listed Forest Associated Species

Congress mandated that partnerships within states and territories develop wildlife action plans to manage their species in greatest conservation need (SGCN)[31]. Minnesota's plan was completed in 2006. About one-quarter (292) of Minnesota's more than 1,100 known wildlife species are identified in this wildlife action plan as species in greatest conservation need because they are rare, their populations are declining, or they face serious threats of decline. All of Minnesota's listed animal species were included as SGCN. Minnesota's endangered species statute (Minnesota Statutes, section 84.0895) requires the DNR to adopt rules designating species meeting the statutory definitions of endangered, threatened, or species of special concern.

- A species is considered **endangered** if the species is threatened with extinction throughout all or a significant portion of its range within Minnesota.
- 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.
- 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

[26] USFWS
[27] FIA
[28] FIA
[29] DNR Eco Resources
[30] USFWS
[31] SGCN: defined as native species whose populations are rare, declining, or vulnerable to decline and are below levels desirable to ensure their long-term health and stability.

requirements and deserves careful monitoring of its status. Species on the periphery of their range that are 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.

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 may be allowed by permit issued by the DNR; plants on certain agricultural lands and plants destroyed in consequence of certain agricultural practices are exempt; and the accidental, unknowing destruction of designated plants is exempt. Species of special concern are not protected by the act or associated rules.

- Table 3. 1988 Endangered, Threatened and Species of Concern

Group	Endangered	Threatened	Special Concern	TOTAL
Mammals	0	1	16	17
Birds	6	2	19	27
Amps & Reptiles	1	2	14	17
Fish	0	0	16	16
Mollusks	2	0	2	4
Arthropods	8	8	18	34
Vascular Plants	60	57	111	228
TOTALS	77	70	196	343

MN DNR

- Table 4. 2008 Endangered, Threatened and Species of Special Concern

Group	Endangered	Threatened	Special Concern	TOTAL
Mammals	0	1	14	15
Birds	7	6	15	28
Amps & Reptiles	2	3	9	14
Fish	0	1	20	21
Mollusks	10	15	5	30
Arthropods	8	6	35	49
Vascular Plants	69	69	144	282
TOTALS	96	101	242	439

MN DNR

Note: While the above charts (Tables 3,4) indicate the number of species that are either endangered, threatened or of special concern in the state and their changes over the past twenty years, they are not identified by habitat need and no data for species specific to forest habitats are available currently. This is considered a data gap at this time.

In March 1984, the first state list of endangered, threatened and species of special concern became official. The first revision of this list occurred in 1996. A second revision is currently in draft stage and includes consideration of the following tree species for listing -hemlock, butternut, swamp white oak and Kentucky coffeetree. In 1996, some species were removed from the list due to their populations being determined to be healthy, but other species were added to the list. This created a net increase of 96 species in the 1996 list. However, several new species taxonomic groups were examined and species placed on the list, so the numbers are not directly comparable.

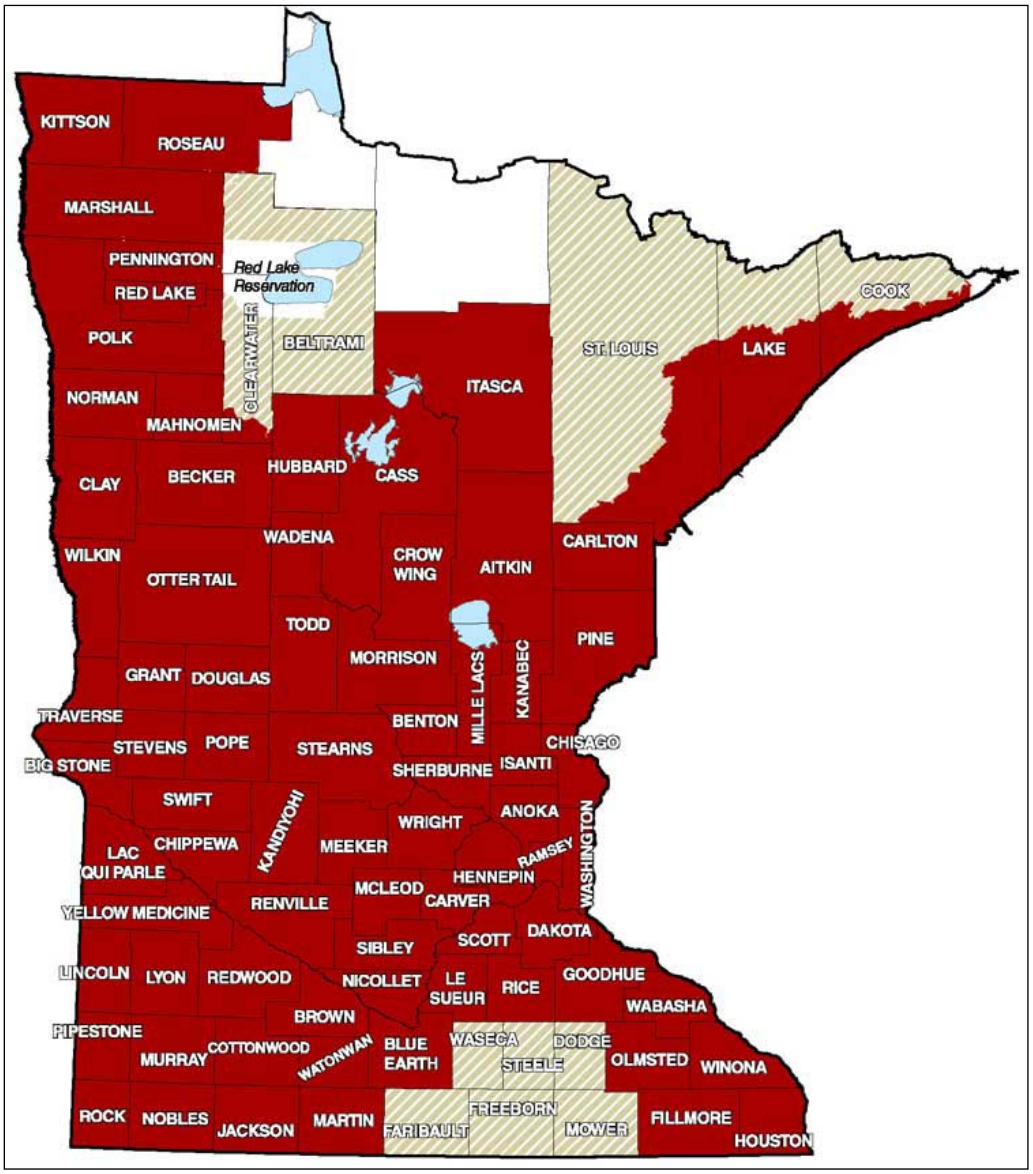
Maintaining the full range of native plants and animals, including insects, reptiles and aquatic species in Minnesota, is critical for biological, ecological, genetic, educational and aesthetic reasons. Animals such as the brown bear, bison, passenger pigeon and more than 50 species of plants have been lost from the state since European settlement. Habitat loss has been and continues to be the major cause of endangerment.

The following map (Figure 11) shows the status of the current County Biological Survey, which was begun in 1987 to systematically survey and map the rare biological features of the state. The goal of the survey is to identify significant natural areas and to collect and interpret data on the distribution and ecology of rare plants, animals and native plant communities. This information is used to identify sensitive areas, which in turn can provide strategies for protection. (Figure 12). While a majority of counties have been surveyed, there still needs to be work done to complete the entire state. This process is complimented by the recently completed "*Field Guides to Native Plant Communities of Minnesota"* and on-going ecological classification system (a cooperative endeavor between DNR and USFS), which can be accessed through www.dnr.state.mn.us/ecs/

- Figure 11. County Biological Survey Status

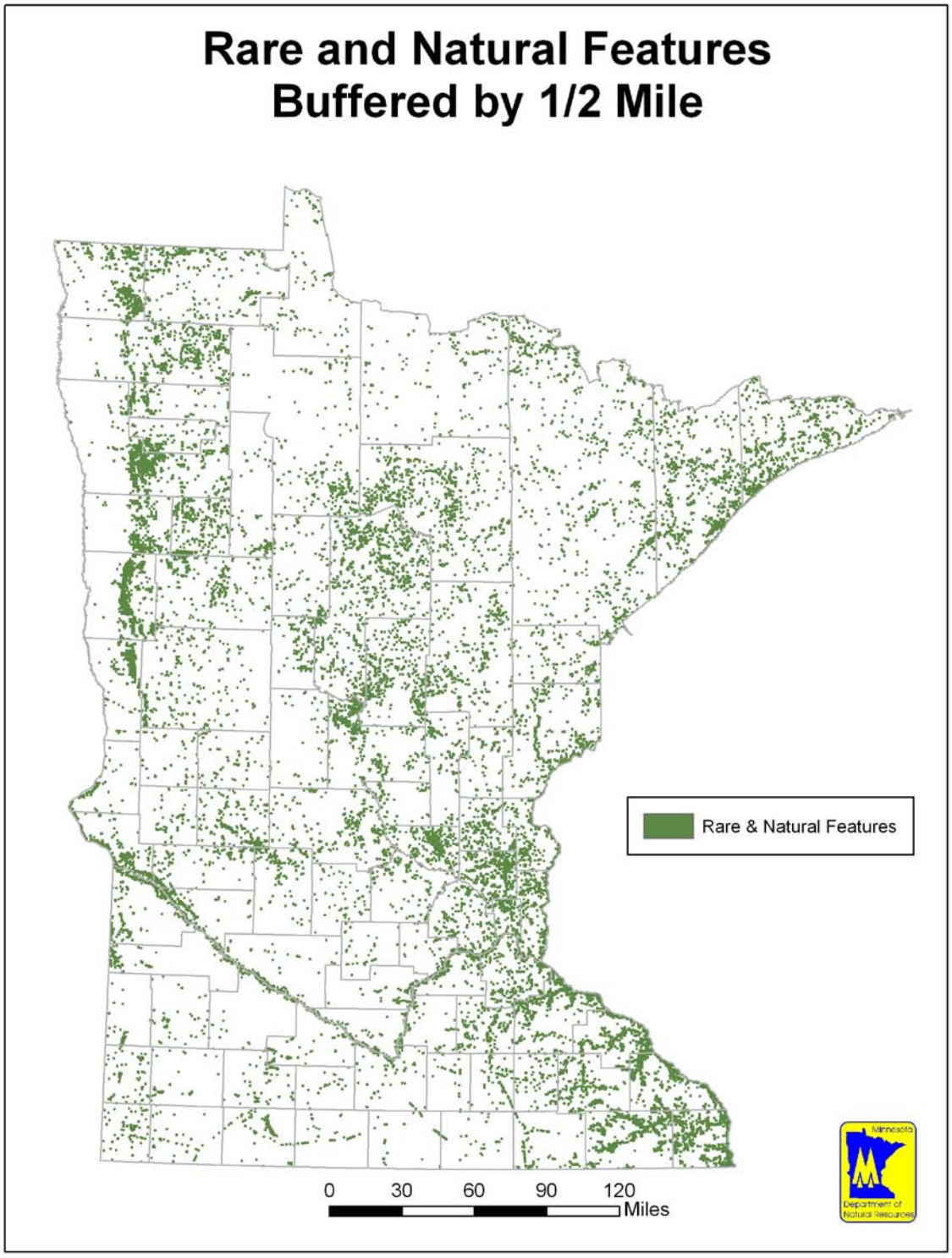
Survey completed 1987-2008

Survey in progress 2009



Source: MN DNR

- Figure 12. Location of Known Rare and Natural Features



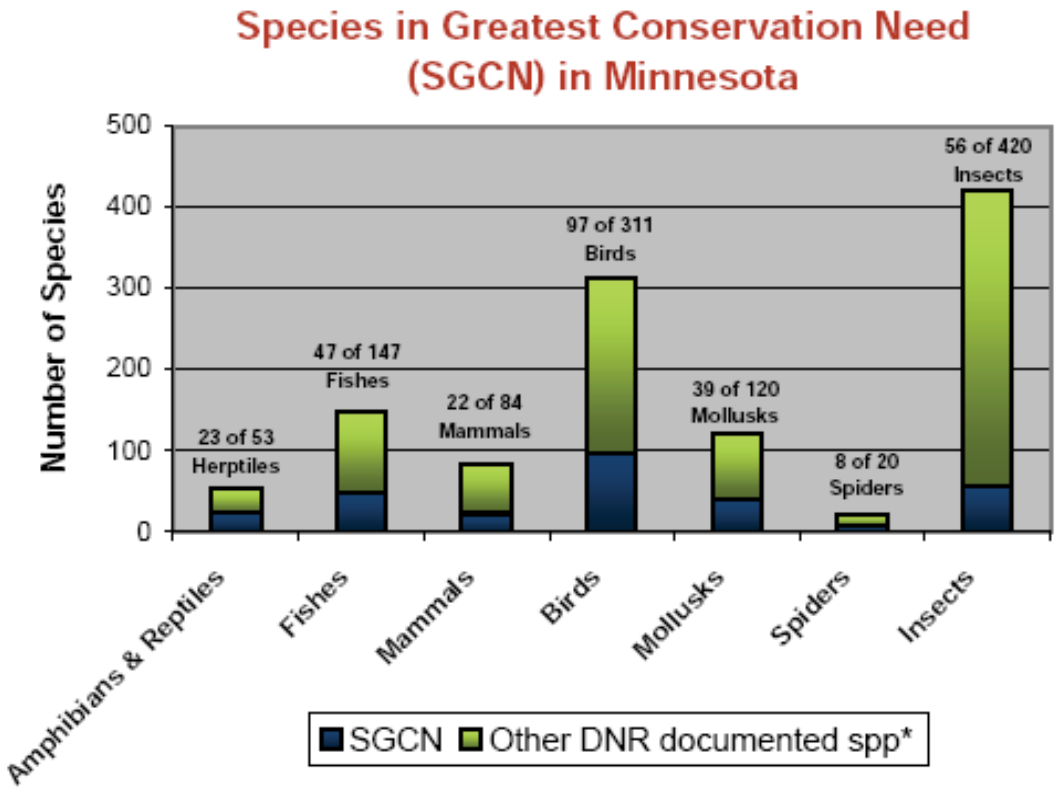
MN DNR

Tomorrow's Habitat for the Wild and Rare – An Action Plan for Minnesota Wildlife

In 2006, a consortium of over 100 conservation groups under the coordination of the DNR produced a comprehensive document called "*Tomorrow's Habitat for the Wild and Rare – An Action Plan for Minnesota Wildlife".* This strategic action plan focuses on managing Minnesota's populations of species in greatest conservation need (SGCN) and the challenging task of balancing these needs of conserving wildlife habitat with the increasing population growth of the state.

"Tomorrow's Habitat for the Wild and Rare" is based on a series of analyses that examined the needs of all 292 SGCN and identified key habitats that benefit them. These analyses were conducted in each of Minnesota's 25 ecological subsections including the forest lands. Monitoring will continue to be applied and will provide more detailed information in the future.[32]

- Figure 13. Species of Greatest Conservation Need



About one-quarter of the nearly 1,200 of Minnesota's wildlife species assessed are identified as species in greatest conservation need. Habitat conservation is important for these rare and declining species. *Note: the documented species numbers underestimate the total number of invertebrate species in Minnesota.

MN DNR

For further information and species lists refer to DNR *Rare Species Guide* www.dnr.state.mn.us/rsg

[32] "*Tomorrow's Habitat for the Wild and Rare*". www.dnr.state.mn.us/cwcs

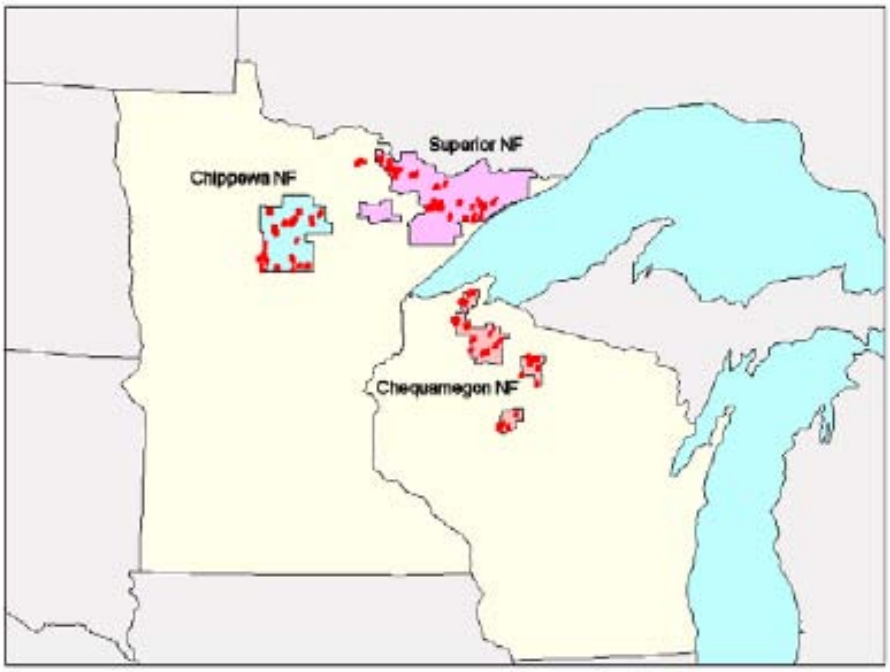
Indicator 11: Bird Populations

Forest birds are tracked through a collaborative effort between the DNR, the Natural Resources Research Institute (University of Minnesota at Duluth) and three national forests in the region (Chippewa National Forest (NF), Superior NF in Minnesota; Chequamegon NF in Wisconsin). Annual surveys have been conducted since 1991 in both Minnesota national forests. The goal is to sustain forest resources and bird diversity in western Great Lakes forests. Of the 163 species trends calculated in 2006, 28 (17%) changed in 2007. Twenty-five of the changes were positive, with 16 new increasing trends and 9 previously decreasing trends changed to stable. The percent of increasing species on each national forest ranged from 21% in the Chequamegon NF to 30% in the Superior NF. The percent of decreasing species ranged from 16% in the Superior NF to 19% in the Chippewa NF. For further information refer to the Natural Resources Research Institute at www.nrri.umn.edu

The "*Minnesota Breeding Bird Atlas"* is the most extensive survey conducted for the state's nesting birds. The atlas is a major collaborative effort by multiple agencies and organizations interested in bird conservation. This effort is important to complete as Minnesota is the only state along the Mississippi Flyway without a bird atlas. The atlas will document which bird species breed in Minnesota, where they breed, and identify areas of high bird diversity worthy of protection. This effort is in process and will provide valuable information in the future. For further information refer to www.mnbba.org In addition, data from the North American breeding bird survey reflects population status for birds across the entire Minnesota landscape. Summaries of population trends for woodland and successional/scrub (i.e.young forest habitat) breeding birds are available. (Figure 14) For further information refer to http://www.mbr-pwrc.usgs.gov/bbs/trend/guild07.html

US Fish and Wildlife Service also coordinates the American woodcock singing ground survey (GS) which monitors woodcock populations throughout their breeding range including Minnesota. The annual woodcock status report is available through http://www.fws.gov/migratorybirds/NewReportsPublications/PopulationStatus

- Figure 14 Forest Breeding Birds in Minnesota and Wisconsin National Forests



Locations of forest breeding bird point counts in northern Minnesota and Wisconsin 1991-2007
National Resources Research Institute

Bird populations' trends in Minnesota have been tracked for several decades. Data is available for both migratory and non-migratory species and is part of an overall inventory of North American species.

The number of breeding waterfowl in a portion of Minnesota has been estimated each year since 1968. Procedures used are similar to those used elsewhere across waterfowl breeding grounds.

Bird species data are updated and added to the Natural Heritage Information System as it becomes available from miscellaneous field observation and Minnesota county biological surveys (MCBS). At this point MCBS is nearing geographical completion of the state, with remaining unsurveyed areas primarily in extreme northern Minnesota. Outside of the unsurveyed areas, there is no systematic addition of data on bird species.

In 2009, there are six endangered bird species identified in Minnesota including: Baird's sparrow, Henslow's sparrow, Sprague's pipit, chestnut-collared longspur, king rail and burrowing owl. There are seven threatened species including: piping plover, trumpeter swan, peregrine falcon, loggerhead shrike, Wilson's phalarope, horned grebe, and common tern. There are thirteen species of special concern including: Nelson's sharp-tailed sparrow, short-eared owl, red-shouldered hawk, yellow rail, cerulean warbler, Acadian flycatcher, common moorhen, bald eagle, Franklin's gull, marbled godwit, American white pelican, Louisiana waterthrush, Forster's tern, greater prairie-chicken, and hooded warbler.

For further information and species lists refer to DNR "*Rare Species Guide*" www.dnr.state.mn.us/rsg

Indicator 12: Mammal Populations

The state's mammal populations are tracked through both game and non-game species programs. Two species have seen dramatic increases over the past 25 years. These include whilte-tail deer, which was almost wiped out in the late 1960s to a current level of over 1.1 million and black bears, which have shown a three-fold increase since the early 1980s. Both species are considered game in the state.

Although Minnesota has the highest number of gray wolves in the lower 48 states,(only Alaska is higher), both the gray wolf and the Canada lynx are listed as threatened in the state and are intrinsically linked with northern boreal forests of north eastern Minnesota. Conservation measures such as the "*Lynx Conservation Assessment and Strategy"*[33]*,* have been incorporated into both the Chippewa and Superior National Forests management plans.

Information on gray wolves is available through http://www.fws.gov/midwest/wolf .
Information on Canada lynx is available through http://www.fws.gov/midwest/Endangered/mammals/lynx

Two other large game species have shown dramatic declines in the state including elk and moose. Elk were abundant in herds in pre-settlement time, but are now confined to two small herds of around 200 animals total, in the northwest portion of the state. Moose, which were a symbol of Minnesota's abundant forest land species have plummeted in numbers and are near extinction in the northwest. Less than 85 animals remain in that region. In the northeast forested areas, there are greater numbers (approximately 6500) and research is being conducted to determine if this decline is due to climate change and global warming. A recently established Moose Advisory Committee (MAC), considered by a narrow majority, to designate moose as a species of special concern. View this report at http://files.dnr.state.mn.us/fish_wildlife/moose/mac/macreport.pdf

Mammal species data are updated and added to the Natural Heritage Information System as it becomes available from miscellaneous field observation and MCBS. At this point MCBS is nearing geographical completion of the state, with remaining unsurveyed areas primarily in extreme northern Minnesota. Outside of the unsurveyed areas, there is no systematic addition of data on mammal species.

In 2009, one mammal species, the eastern spotted skunk has been identified as being state threatened. Fourteen mammal species have been identified as species of special concern including the gray wolf, elk, least

[33] Ruediger et al 2000

shrew, mountain lion, prairie vole, woodland vole, least weasel, northern myotis, plains pocket mouse, heather vole, eastern pipistrelle, smokey shrew, northern bog lemming, and northern pocket gopher.

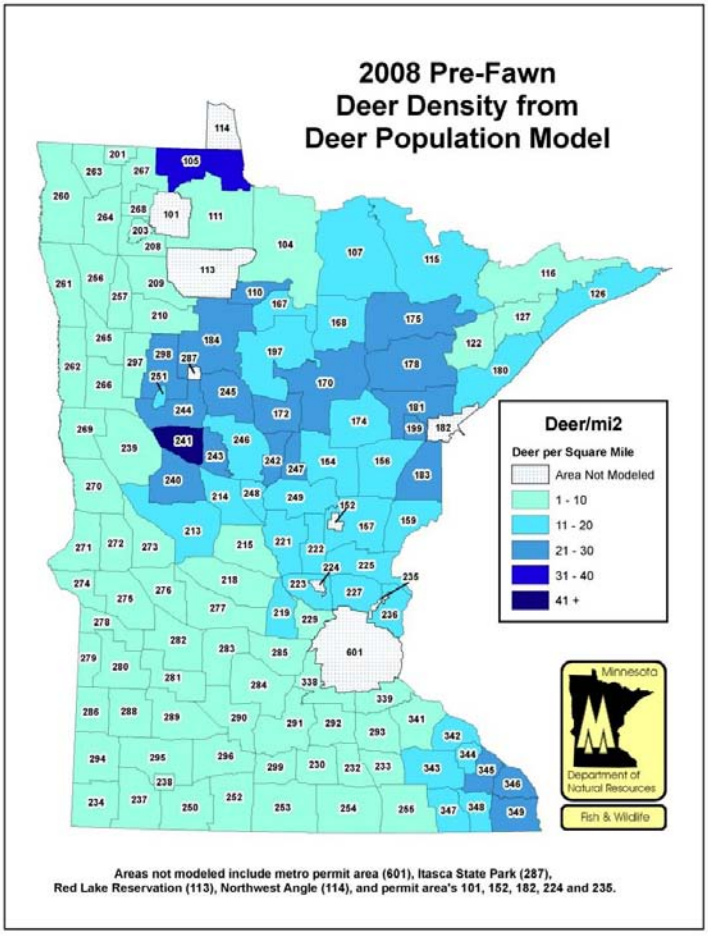
For further information and species lists refer to DNR "*Rare Species Guide"* www.dnr.state.mn.us/rsg

White Tail Deer

White-tailed deer (*Odocoileus virginianus*) populations in many places in Minnesota are not low enough to allow for the regeneration of forests and the development of desired plant communities and wildlife habitats. The Minnesota Division of Forestry attempts to protect seedlings from deer browse on about 7-9,000 acres each year. This effort is not always completely successful, often requiring interplanting or re-planting and has a huge budget impact. Attempts at alternatives to "traditional" site preparation and planting have proven to have marginal success. Further trials have been initiated, however, no matter what method of regeneration is employed, high deer populations are problematic.

In general, deer densities in excess of 20 per square mile appear to decrease native plant species richness (number of species present), native plant species abundance (number of individuals present), and native plant species composition of an affected area. [34] Current estimates of deer populations in Minnesota show many areas well above this level. (Figure 15).

- Figure 15 Whitetail Deer Density by County



[34] Stephen B. Jones: "*Whitetails are changing our woodlands - increasing white-tailed deer population may cause imbalance in the forest ecosystem*. " (American Forests. www.FindArticles.com. 23 June 2009).

Indicator 13: Plant Populations

In 2009, plants represented the largest group of state endangered, threatened and species of greatest concern in the state. Vegetative groups include vascular plants, lichens, mosses and fungi and are identified in separate categories. There are 57 endangered vascular plants, 8 endangered lichens, 1 endangered moss, and 3 endangered fungi for a total of 69 endangered plants. There are 66 threatened vascular plants, and 3 threatened lichens for a total of 69 threatened plants. There are 133 vascular species of special concern, 6 lichen species of special concern, 2 mosses species of special concern and 3 fungi species of special concern for a total of 144 plant species of special concern. Because this group is so large, individual species are recorded through the "*Rare Species Guide".* For further information refer to www.dnr.state.mn.us/rsg.

Plant species data are updated and added to the Natural Heritage Information System as it becomes available from miscellaneous field observation and MCBS. At this point MCBS is nearing geographical completion of the state, with remaining unsurveyed areas primarily in extreme northern Minnesota. Outside of the unsurveyed areas, there is no systematic addition of data on plant species.

State native plant species are experiencing increased pressures to viable populations including climate change, invasive species, fragmentation & parcelization, and development pressures, all of which pose increased threats. Research is being conducted to predict future tree and forest species, which could result from climate change and increasing threats to forest health. For example, four scenarios for the northern boreal forests include[35]:

- Very warm and dry which would favor a transition to savanna-like conditions.
- Very warm and wet which would favor hardwood forest with savanna patches.
- Moderately warm and dry which would favor oak and pine savannas with a few patches of pine forest.
- Moderately warm and wet which would favor boreal and hardwood stands.

[35] www.forestry.umn.edu/courses/FR3203/Climate-change%20and%20adaptation.pdf

Criterion 2: Maintenance of Productive Capacity of Forest Ecosystems

The importance of this criterion is that productive forests supply important goods and services to society. They help prevent soil erosion, produce oxygen, filter pollutants, protect and enhance water quality, and offer a haven for recreation and spiritual renewal. Forests supply lumber and wood for homes, furniture, papermaking, and fuel. Other products include cones, boughs, herbs, medicines, and foods such as mushrooms and berries. Forest productivity varies according to the amount of forestland available, and its fertility, health, environmental pollutants, location along the urban to rural continuum, past and present uses, and management of the forests. Managing forests sustainably means balancing resource production with the ecosystem's capacity to renew and sustain itself. Measuring and tracking the amount of forest land available for producing goods and services, the productivity of that forest land, and the amount, quality, and type of trees and other plants growing there is critical to determining whether we are balancing production and long term ecological health and the capacity of forest products markets to utilize timber and other forest products.[36]

This criterion ties to the national theme of *Conserving and Managing Working Forest Landscapes for Multiple Values and Uses.*

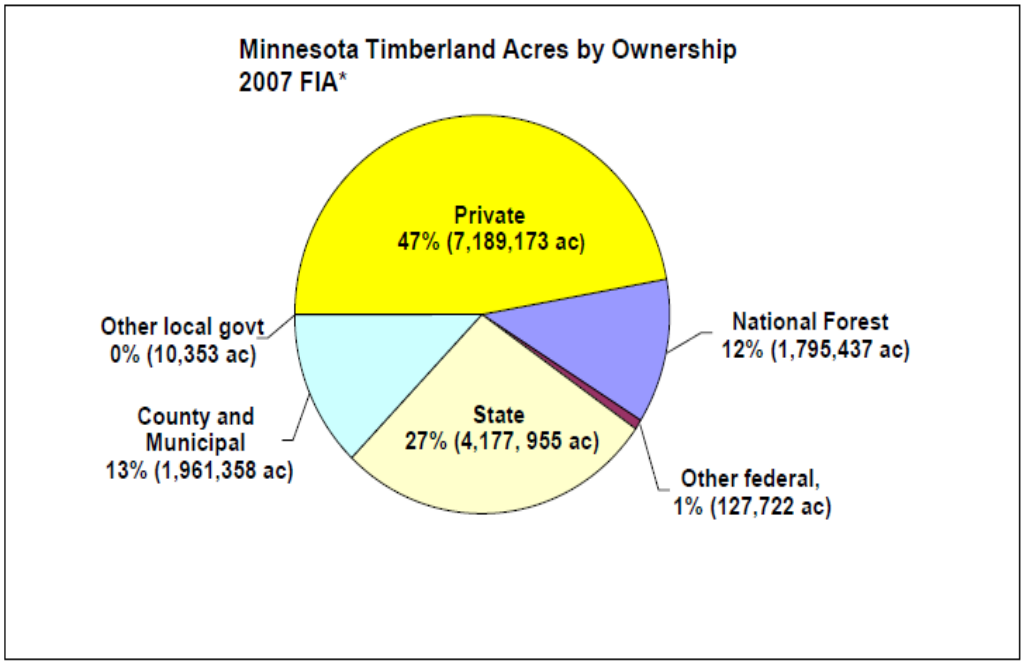
Indicator 14: Trends in the Amount and Condition of Timberland

Minnesota has approximately 15 million acres of forestland that is classified as timberland. Timberland is forest land that is productive enough to produce 20 cubic feet per acre (1.4 cubic meters per hectare) per year of wood at culmination of mean annual increment (MAI). Timberland excludes forest lands that are reserved from harvesting by statute, administrative regulation, or designation.

Although FIA inventory figures indicate increasing acreages of productive timberland in Minnesota, this appears to largely be due to FIA inventory adjustments and not actual trends in the forest resource. Timberland acreage actually appears to be largely stable, with the possibility of a very small increase on private lands due to reversion of agricultural lands to forest lands in the southern and western portions of the state. (Figure 16).

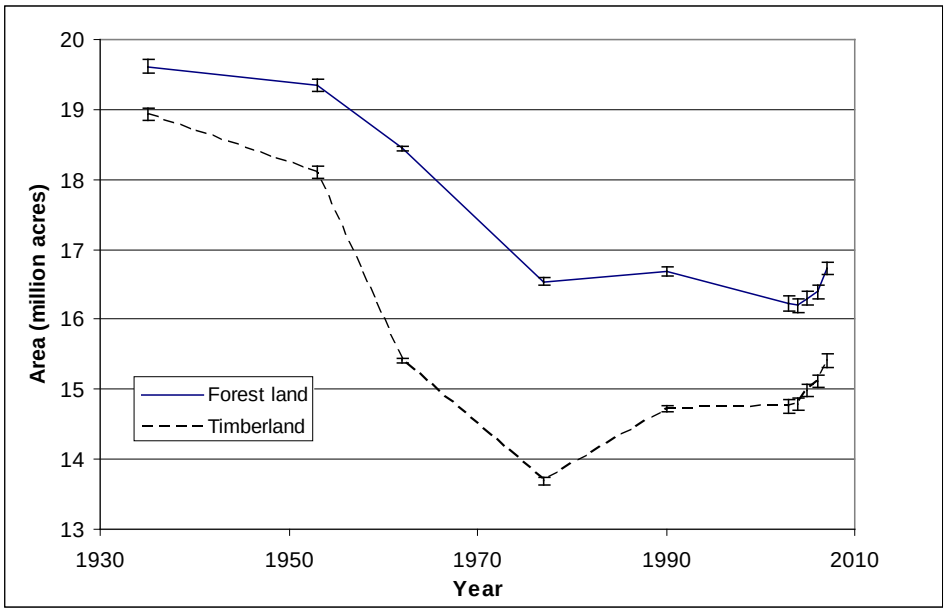
[36] NAASF – *"Suggested Framework for Statewide Forest Resource Assessments".* November 2008

• Figure 16. Minnesota Timberland Acres by Ownership*



*Source: 2007 FIA Database Provided by USFS Northern Research Station [37]

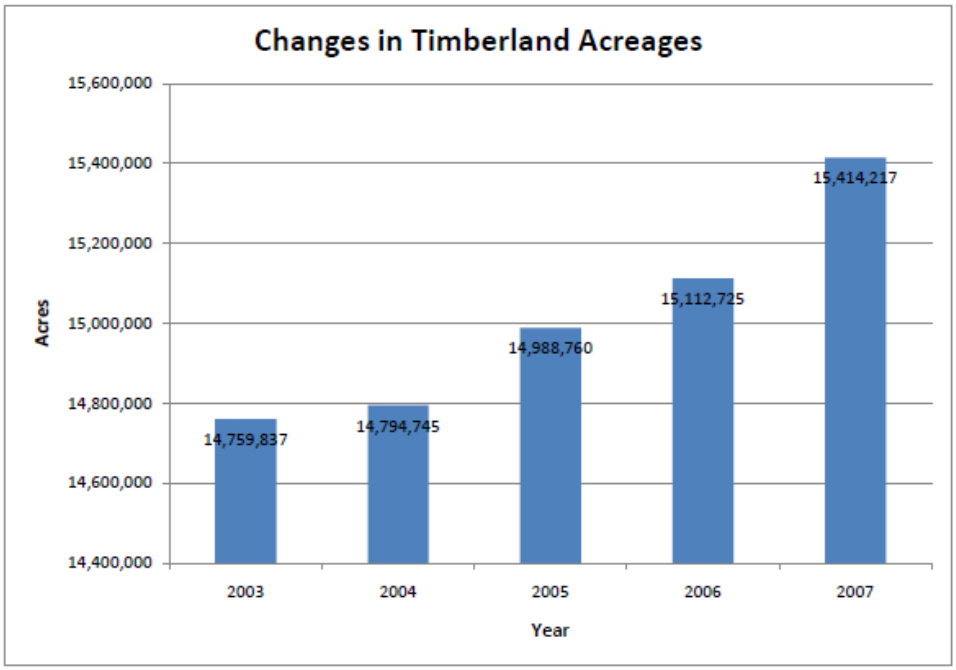
• Figure 17. Changes in Timberland Acreages (1930-2010)



MN DNR

[37] The FIA database ownership figures shown above appear to be in error and will be corrected in next year's report. Specifically, it is likely that approximately 460,000 acres will be corrected from state to county ownership. Source: DNR communication & FIA analyst -Pat Miles.

• Figure 18. Changes in Timberland Acreages (2003-2007)



FIA inventory

Although both of the above figures (Figures 17, 18) indicate a significant upward trend in timberland acreage, it appears that the large majority of this is due to changes in FIA inventory, and not to an actual change in the resource. Timberland acreage is stable, with the possibility of a very slight increase on private lands in the southern and western portions of the state. (Table 5)

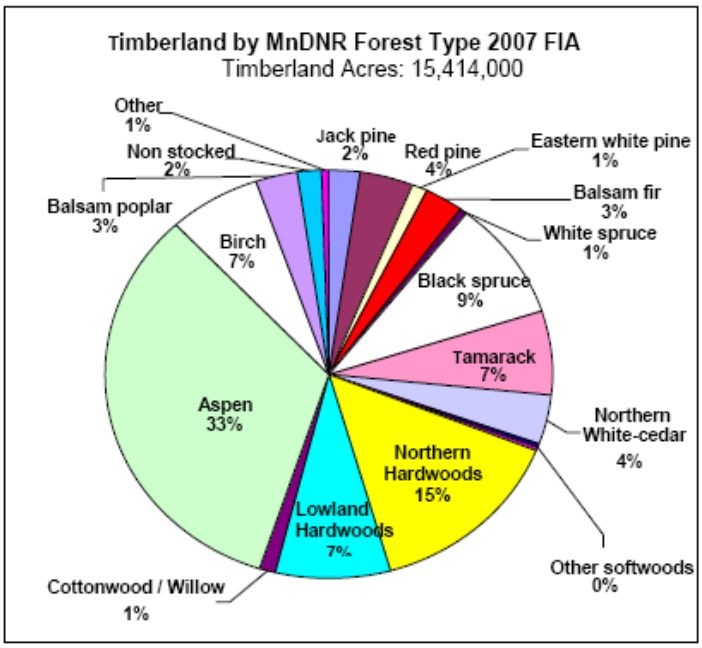
• Table 5. Comparison of Forest Land and Timberland

Comparison of Forest land and Timberland				
Year	**Forest land**	**Forest land +/-acres** (in millions)	**Timberland**	**Timberland +/-acres** (in millions)
1935	19615	99	18934	95
1953	19344	90	18098	90
1962	18445	34	15412	31
1977	16537	53	13695	53
1990	16681	60	14723	53
2003	16230	113	14760	102
2007	16724	84	15414	92

FIA

Current forest land types are shown below by percent of cover (Figure 19). Aspen represents the greatest percent of forest cover in the state and is also the species of greatest industrial use by a wide margin over other species. The aspen resource is the source for all engineered wood mills, which are located exclusively in Minnesota. It is an extremely important resource to the pulp and paper industry and the solid wood industrial segment. Many of Minnesota's largest mills were specifically designed to utilize aspen for manufacturing products and processes.[38]

- Figure 19. Timberland by Forest Type



Source: 2007 FIA Database Provided by USFS North Central Forest Experiment Station.

Timberland acreage has been relatively stable in Minnesota for many years. Changes in forest type acreages and condition tend to occur slowly over time. As discussed above, these changes have proven difficult to track through FIA, due to changing inventory design and procedures prior to the implementation of the annual inventory design in 1999. However, some trends are evident. Several of note include:[39]

- A continuing trend to greater acreages in older age classes in many forest types
- Establishment of a more evenly distributed age class structure in the aspen forest type in place of one heavily weighted to older ages seen prior to 2000 (though significant acreages in older age classes remain)
- Reduction in balsam fir forest type acreage
- Reduction in jack pine forest type acreage

New research is being conducted by the University of Minnesota's Institute on the Environment to track forest cover type changes due to climate or global warming and the increasing effects of invasive species on tree types. In 2008 the institute published a report entitled *Minnesota Statewide Conservation and Preservation Plan*. Appendix IV is entitled *Regional Climate Change Adaptation Strategies for Biodiversity Conservation in Minnesota* and addresses climate change adaptation planning that may help ecosystems and species accommodate climate change. To review this paper go to http://environment.umn.edu/scpp

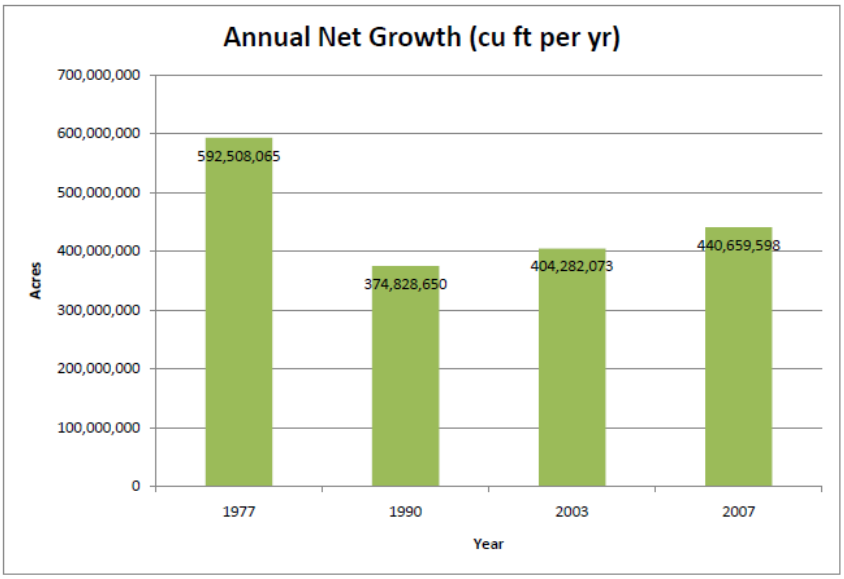
[38] Minnesota Forest Resources Annual report - 2008
[39] DNR Marketing & Utilization program

In the future, cover type migration shifts precipitated by climate change, could affect timberland harvesting projections and future silviculture practices. This is a new area of research and can be used as a baseline only at this time. For further information refer to http://www.forestry.umn.edu/courses/FR3203/Climate-change%20and%20adaptation.pdf

Indicator 15: Trends in Annual Timber Removals vs. Net Growth

Overall net growth for all species continues to outpace harvest levels and total removals. According to 2007 FIA figures, annual gross growth of growing stock on timberland was approximately 8.87 million cords. Annual mortality was approximately 3.10 million cords. Annual net growth is equal to gross growth less mortality, or 5.77 million cords per year. (Figure 20). According to mill and fuel wood survey data and recent Minnesota Forest Industry (MFI) data, the volume of wood harvested and utilized by industry and fuel wood users was approximately 3.2 million cords in 2006, and falling to an estimated 2.8 million cords in 2008.[40]

- Figure 20. Annual Net Growth of Growing Stock on Timberlands (All Ownerships)



FIA Inventory

Annual net growth of growing stock on timberlands has fallen compared to 1977 levels, but has increased by approximately 17% since 1990.

State Forest Product Utilization & Marketing Program

The purpose of this program is to support strong wood product markets and the practice of sustainable forestry, by providing information and marketing assistance to forest product businesses and forest landowners. Target audiences include wood-using companies, employees and associations, loggers, natural resources professionals, government agencies, landowners, economic development groups. Virtually all program activities are accomplished through collaboration or partnerships with several partners including the USFS, Forest Industry, University of Minnesota, counties, and a variety of nongovernmental organizations.

The purpose for the program's activities is to:

- Foster a positive impact on sustainable forestry
- Analyze and disseminate information on forestry, forest resources and forest industry.
- Provide marketing assistance to forest-product producing companies and landowners.

[40] Minnesota Forest Resources report. December 2008

- Assist in market development and maintenance for Minnesota forest products, with an emphasis on undervalued forest resources.
- Assist with environmental review for proposed wood product expansions.

For further information refer to http://www.dnr.state.mn.us/forestry/um/index.html.

Criterion 3: Maintenance of Forest Ecosystem Health and Vitality

Forest health describes the overall condition of forests and trees and how well they recover from stress. Many factors affect forest health; some are natural, including insects and diseases, and severe weather or catastrophic events such as ice storms, tornados, straight-line winds, floods and droughts. Some are human induced such as development, which causes changes in soil hydrology and reduces the size of forest patches, in effect destroying habitat for native species. External stressors that affect tree physiology and reduce tree vigor cause the greatest problems. Stressors come and go, and the likelihood of their occurrences cannot be accurately predicted, making forest health difficult to assess at a single point in time. For example, many native are cyclical and peak outbreaks can often be predicted. However, abiotic stressors on the trees, influence the impact of the native insects and it is these abiotic stressors that are difficult to predict.[41]

This criterion ties to the national theme of *Protecting Forests From Threat.*

Indicator 16: Tree Mortality and Damage Type

Tree mortality occurs as a result of adverse weather, disease, insects (native and exotic), senescence, competition, succession, fire, animal activity and human activities. While insects are responsible for only a small percentage of the primary cause of mortality, they work in combination with diseases, pathogens and other damage factors to weaken trees and make them vulnerable to decline or death. Data collection is almost always based on single causes or damage, not complex combinations of factors, thereby making assertions or trend predictions difficult. For example, the newest threat of insect infestations by European gypsy moth and emerald ash borer (EAB) will have devastating effects on Minnesota's forests that at present cannot yet be determined.

The average annual growing-stock mortality on timberland for Minnesota in 2007 was 242 million cubic feet or roughly 1.6 % of the 2007 volume. Mortality expressed as a percent of volume for the 12 most abundant species (by cubic foot volume) in the state in 2003 is shown in Table 6 below.

[41] Alan Jones. DNR Forest Development Health and Use Supervisor. August 26, 2009

• Table 6. Tree Species Mortality Rates

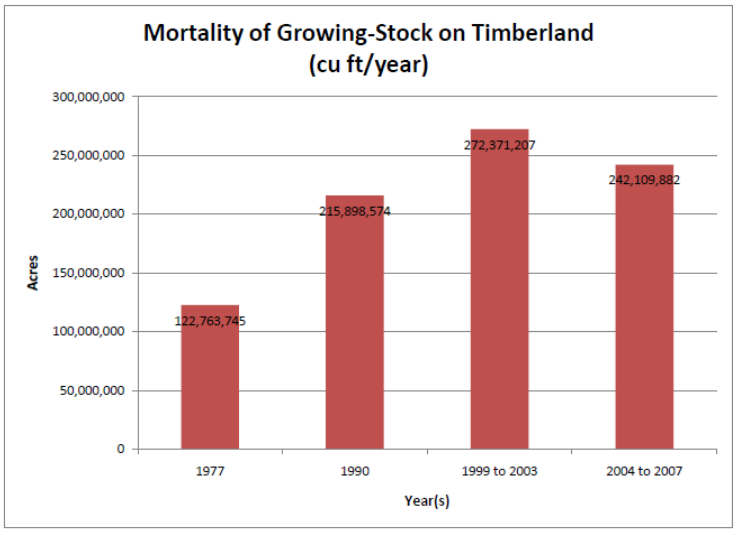
Species	Growing-Stock volume on timberland (cuft)	Annual mortality of growing-stock on timberland (cuft)	Pct mortality
quaking aspen	3,054,211,200	74,444,022	2.4
paper birch	1,004,684,098	22,423,802	2.2
red pine	919,015,833	2,056,836	0.2
northern white-cedar	869,245,844	4,584,104	0.5
black ash	845,435,615	4,541,104	0.5
American basswood	791,801,933	4,230,668	0.5
black spruce	774,990,095	15,945,308	2.1
northern red oak	753,103,727	5,481,506	0.7
bur oak	711,583,940	2,111,160	0.3
tamarack (native)	650,203,369	11,033,105	1.7
balsam fir	625,013,940	28,407,824	4.5
sugar maple	509,820,972	4,758,752	0.9
red maple	413,637,907	3,140,149	0.8
eastern white pine	365,437,412	2,488,671	0.7
jack pine	355,683,648	9,672,076	2.7
balsam poplar	355,071,267	19,589,182	5.5

FIA 2007

Mortality rates for balsam poplar were the greatest at 5.5 % and the least for red pine at 0.2 %.
Mortality rates increased from 208 million cubic feet per year in 1990 to 272 million cubic feet per year in 2003. The average annual mortality reported in 2003 expressed as a percentage of the 2003 volume is 1.8 %, which is much higher than the rate reported for the 1977 inventory (1.2 %) or for the 1990 inventory (1.3 %). (Figure 21).The rate of 1.8 % is also much higher than the mortality rates for both Iowa (0.8 %) and Wisconsin (0.9 %).[42]

[42] FIA

• Figure 21. Mortality of Growing-Stock on Timberland (cu ft/year)



Source: FIA

The mortality rate as a percent of volume varies by landowner class. The rate is highest for national forests (2.1 % for Chippewa NF and Superior NF), followed by state and local governments (1.9 % combined). (Table 7)

• Table 7. Mortality Rates by Ownership 2007

Ownership	Growing stock volume Timberland	Growing Stock mortality Timberland	Mortality as per cent of volume
Total	14,794,461,704	242,109,880	1.64
National Forest	1,982,105,001	34,051,968	1.72
National Park Service	85,279,134	1,281,281	1.50
Bureau of Land Mgmt	2,044,769	-	na
Fish and Wildlife Service	92,940,938	750,969	0.81
Dept of Defense	19,575,810	1,261,969	6.45
Other federal	128,250,193	1,756,500	1.37
State	3,476,895,522	61,585,066	1.77
County and Municipal	1,871,913,853	30,488,067	1.63
Other local govt	9,241,505	29,610	0.32
Private	7,126,214,980	109,250,167	1.53
Other	0	1,654,283	na

Source: FIA

Mortality in Minnesota forests is due to a combination of factors addressed above but also including increasing ages some of the state's forests. Development pressures around the metro core, specific insect infestations and catastrophic events over the past ten years have also contributed to mortality rates and will continue to cause major disruptions in forest health. Single large weather events such as the 1999 Boundary Waters blow down and continued drought throughout select areas of the state have caused serious damage to thousands of acres. In the 1970s and 1980s, Dutch elm disease, was responsible for an almost total eradication of urban and rural

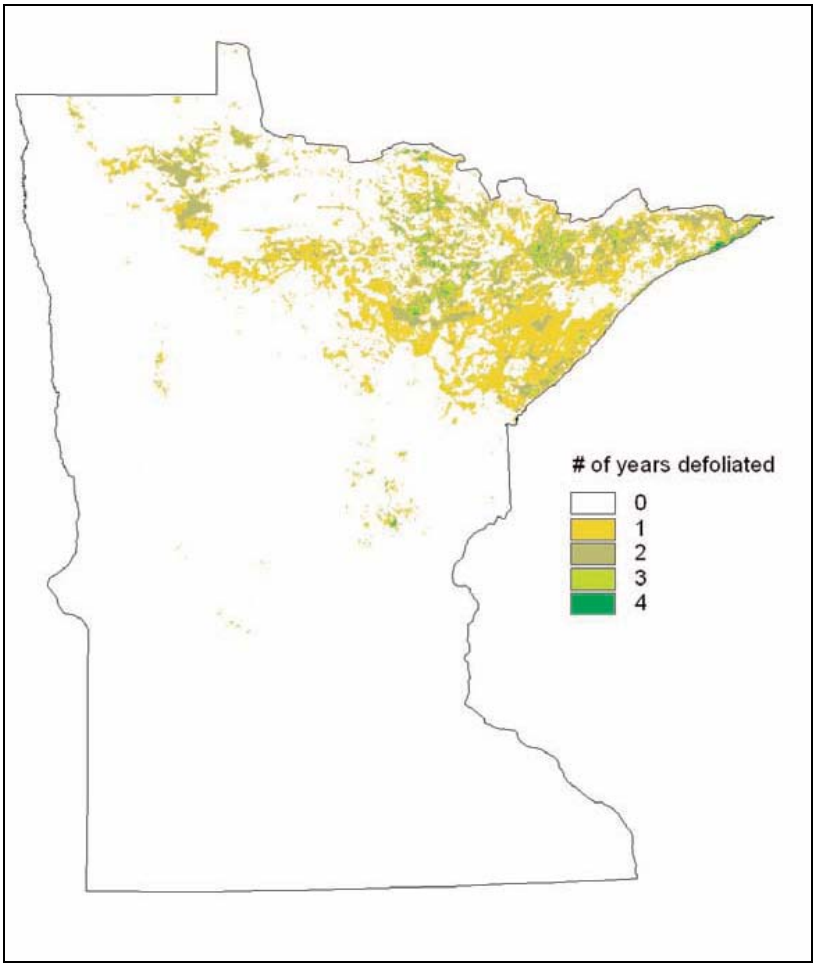
elm trees. With the 2009 discovery of EAB in the state, all ash species are under a severe forest health warning in all urban, rural and forest land environments.

Indicator 17: Native Insects and Diseases

Native forest insects and disease organisms influence forest ecosystem dynamics as pests and abiotic stressors, but they also serve a beneficial role in natural processes. Many native insects and diseases are an essential natural component of healthy forests and contribute to compositional, structural, and functional diversity. They selectively affect tree growth, mortality rates, and alter forest composition, structure and succession. They thin and prune host populations, thereby reducing density and competition. Through decay and biomass decomposition, they contribute significantly to carbon cycling, nutrient cycling, and energy flows in forest ecosystems. Insects and disease organisms serve as food for many invertebrates and vertebrates. Many species of birds and some mammals consume tree-feeding insects, as well as making use of structural habitat for shelter and nesting. For example, woodpeckers are attracted to trees with decay, where they excavate cavities for nesting. Some mammals use dead and rotted wood to roost, nest or forage.

Native forest insects and diseases are problems or pests, when their occurrence interferes with human desires. Native insects and diseases can reduce timber productivity, lumber grade, site aesthetics, wildlife habitat, water quality, outdoor recreation activities, and increase the hazard of falling trees and the occurrence of fire hazards, etc. (Figure 22).

- Figure 22. High Incidence of Defoliation for All Species



Source: Mapped by aerial survey, 1999-2003 (FIA)

Data for 2003 Forest Inventory and Analysis for Minnesota indicated that 37% of the wood volume produced from all tree species was lost annually due to mortality. 53% of that loss can be directly attributed to native insects and diseases, which translates into over 143 million cubic feet of wood.[43]

Indicator 18: Exotic Invasive Species

Trees and forests play a critical role in helping the state meet its environmental goals and reduce adverse impacts of global climate change. The term "invasive species" has been defined as any aquatic or terrestrial species that "may cause economic or environmental harm, pose human health risks, or threaten natural resources and their use in the state".[44] Invasive species are regarded the fastest growing threat to biodiversity of forested lands in the United States and are second only to habitat loss in human-related 'causes of extinction'. Failure to quickly detect and eradicate invasive forest pests could cost hundreds of millions of dollars and result in serious harm to Minnesota's environment and economy. While focus is often on invasive insect species and pathogens such as sudden oak death, exotic earthworms (there are no native Minnesotan species) are beginning to pose serious threats to the state's hardwood forests. In addition, invasive plant species such as garlic mustard and European buckthorn are establishing themselves in some parts of the state and becoming a growing concern for forest management.

For further information see "*Minnesota's Forest Invaders – A Guide to Invasive Species* "available at www.dnr.state.mn.us/invasives/index.html

Exotic invasive species arrive in Minnesota forests via various means. Because of global trade and increased travel, new pests threaten the health and survival of many tree species. Invasive species have the potential to adversely affect all natural resources, making this one of the most devastating threats to forest health in general.

Invasive Species of Special Concern

There are two exotic pests that are of particular concern for the current and future health of Minnesota's forest lands including European gypsy moth and emerald ash borer. Both pose enormous threats in terms of defoliation and risks of mortality and could dramatically change the cover type and composition of the state's forest resources.

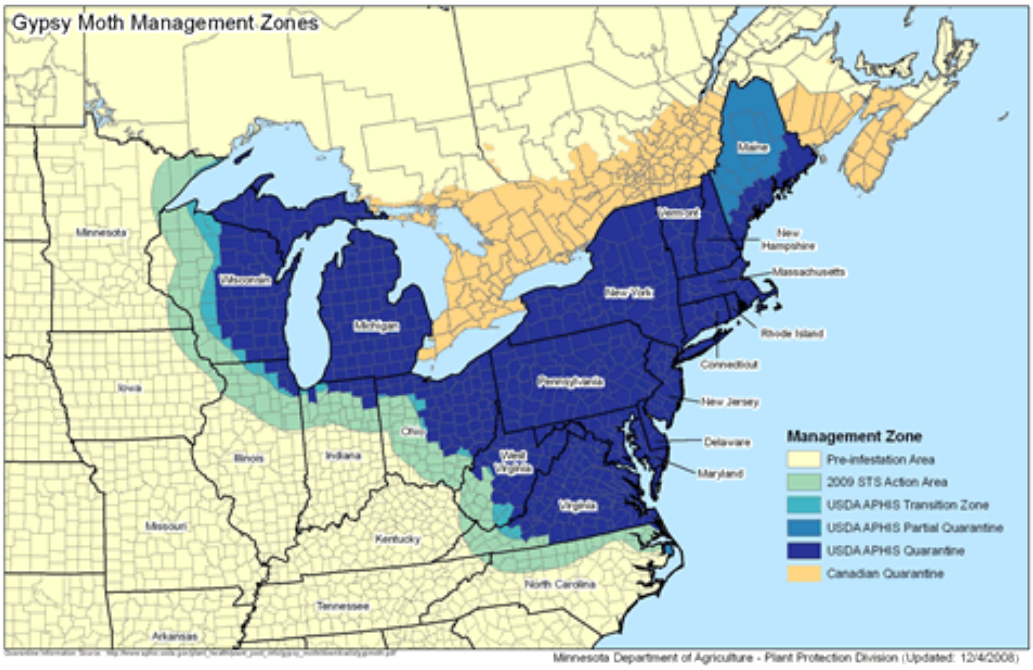
Gypsy Moth

The European gypsy moth was accidentally introduced into Massachusetts in 1869. Since that time the pest has been slowly moving westward. Over the past 30 years, Minnesota has discovered and eradicated small gypsy moth populations primarily in southern Minnesota. Recently, large moth catches have been made along the North Shore of Lake Superior, although no alternative life stages have been recovered and it is uncertain whether or not a resident population exists in Minnesota. Despite this, concerted inter-agency control operations have been carried out in response to the high trap catches. The threat however, to Minnesota's forest lands is ever present. (Figure 23).

Gypsy moths defoliate tree species causing their decline and mortality, which if left unchecked, could change the composition of the areas of the state's forest lands, particularly the oak forest in southern and central Minnesota. A major concern is for a simultaneous outbreak of gypsy moth and forest tent caterpillar in the aspen forests of the state. Significant mortality could occur under this scenario. Preferred species for food sources include oaks, aspen, basswood, paper birch and tamarack.

[43] FIA 1999-2003 report
[44] MN DNR

• Figure 23. Multi-State Gypsy Moth Management Zones



Source http://www.mda.state.mn.us/plants/pestmanagement/gypsymoth.htm

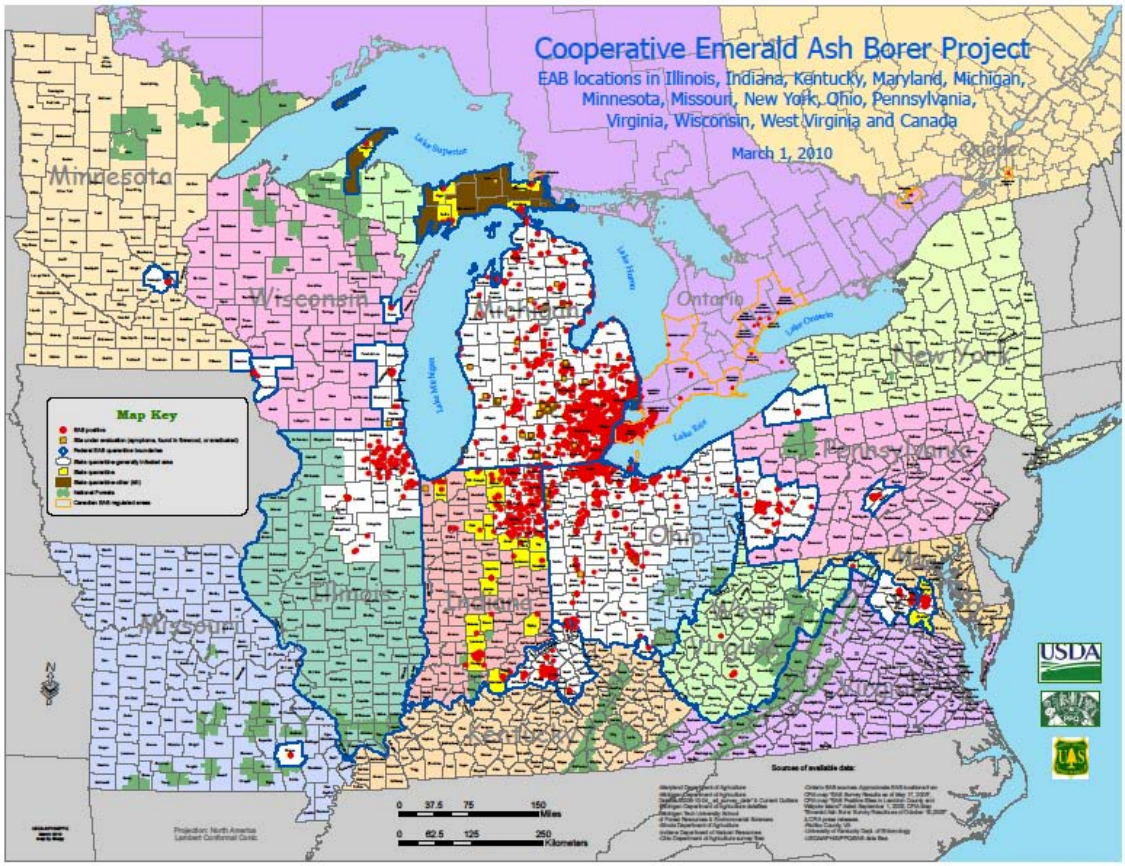
Emerald Ash Borer

Emerald Ash Borer (EAB) is an exotic insect that destroys ash trees. This invasive species was accidentally brought to the United States from Asia in the 1990s. It was first discovered in Michigan in 2002, but it is thought to have been in that state undetected as much as a decade previously. Since the original detection in Michigan it has been found in Ontario, Canada, and the states of Ohio, Indiana, Illinois, Maryland, Pennsylvania, West Virginia, Virginia, Missouri, Wisconsin and now Minnesota. (Figure 24).

In April 2009, an emerald ash borer infestation was found in southeast Wisconsin, close to the Minnesota border. This precipitated a concerted response from both the Minnesota Department of Agriculture (MDA) and DNR to quarantine and monitor the Minnesota county of Houston, in order to contain the spread of this exotic pest. On May 13, 2009, an infestation was discovered in Minnesota in the metro area of St. Paul, just northeast of the intersection of Interstate 94 and Highway 280. At this time both the MDA and the federal government have issued quarantines in Ramsey and Hennepin counties that prohibits the movement out of these counties of firewood, ash nursery stock, ash timber, and any other article that could help spread EAB.

It is expected that EAB will have a huge effect on Minnesota's forest lands and urban landscapes. Minnesota has more ash trees than any other state except Michigan and New York. Minnesota's forests are home to 754 million black ash, 178 million green ash and nearly 2 million white ash. Another 3 million ash trees grow in cities and towns around the state. Ash trees make up 7.2% of the trees in Minnesota forests and 2.3 % of the trees in the state's communities. Some Minnesota communities are particularly vulnerable to EAB since up to 60% of their tree populations are ash planted in response to the loss of elms due to Dutch elm disease 20 to 30 years previously.

- Figure 24. Multi-state Emerald Ash Borer Locations as of March 2010



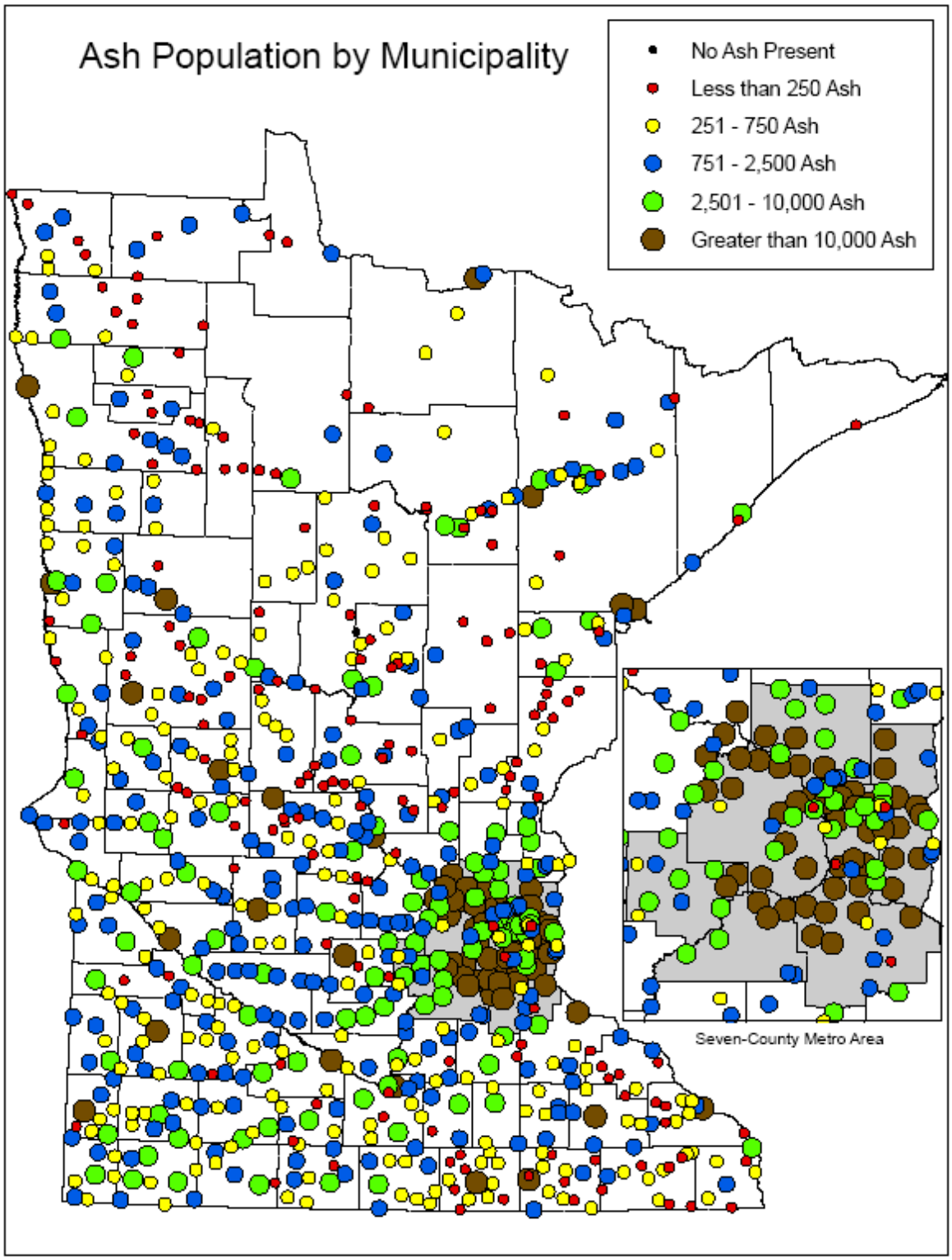
Source http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/index.shtml

Rapid Assessment of Ash Resources in Minnesota Communities

Many smaller communities in Minnesota have little or no information on species composition and health of street and yard trees. In 2006, DNR undertook a project intended to characterize at low cost the abundance, size and condition of the *Ulmus* and *Fraxinus* resource in residential and commercial areas of Minnesota municipalities. On-the-ground sample surveys were conducted of more than 750 separate communities across the entire state to gather the data.

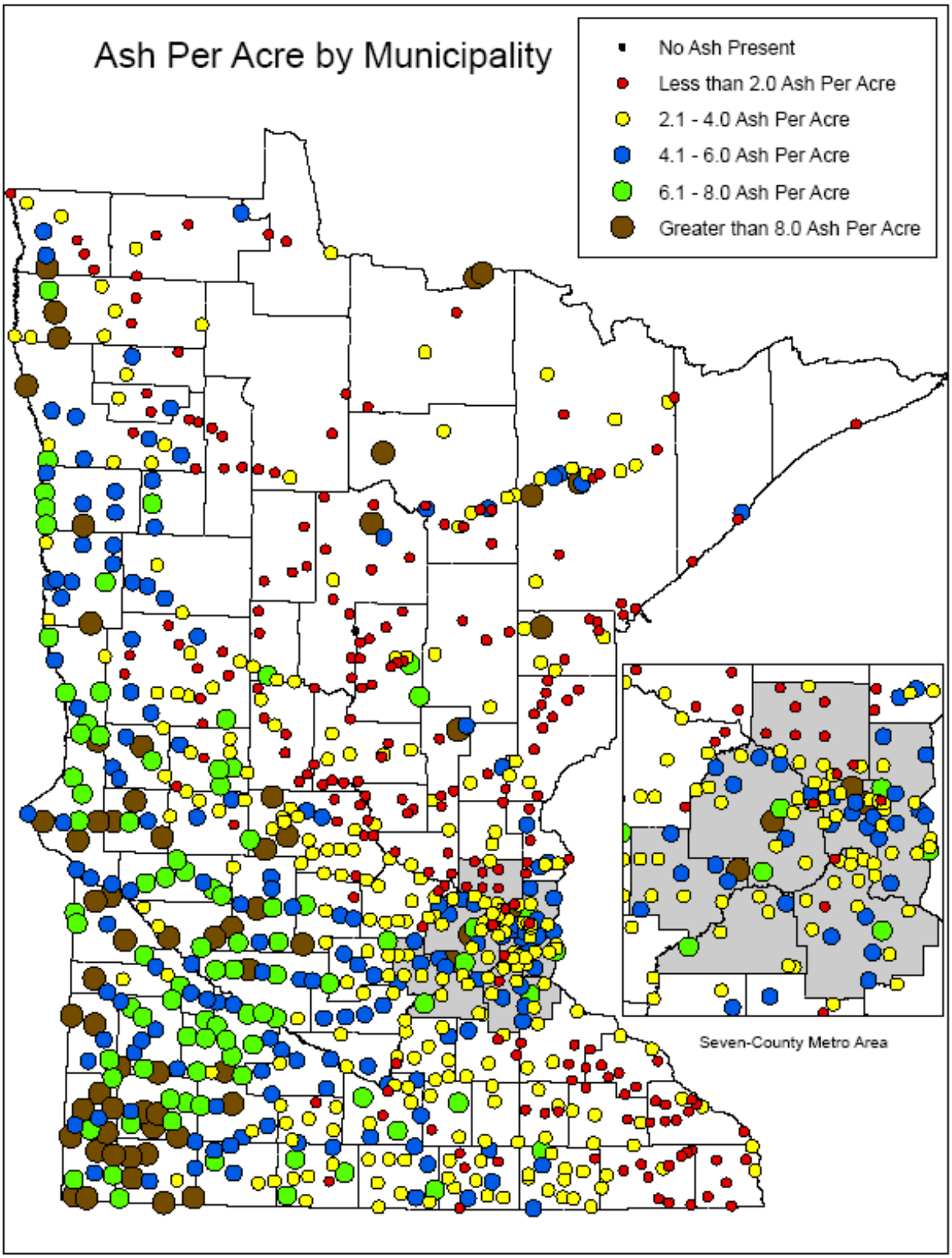
The following maps (Figures 25, 26) graphically summarize the survey data for community ash resources, both population and density. This survey data is available on-line for communities to use in estimating costs communities will face in removing and replacing their ash resource. An expanded version of this survey is planned for all common tree genera, and will give Minnesota towns a baseline tree inventory from which to plan for management of their forest resources.

• Figure 25. Ash Population by Community



Source: MN DNR

• Figure 26. Ash Per Acre by Municipality



Source: MN DNR

Indicator 19: Climate Change

Climate change is predicted to have direct impacts on Minnesota's forests, grasslands, wetlands, lakes and streams. Climate change can also intensify the negative effects of other factors influencing natural resources, such as the frequency and intensity of wildfires, the spread of invasive species, and the impact of fish and wildlife diseases.

Since the early 1980's, the average annual temperature in Minnesota has risen slightly over 0.5 degree F in the southern part of the state, to a little over 1 degree F in the northern half of the state (based on current climate modification models). Temperatures are projected to continue to rise. Warmer temperatures will directly affect growing conditions, vegetation patterns, lake water levels, and wildlife populations. Climate change may also result in more extreme events such as severe windstorms, heavy rains, extended droughts, and wildfires.

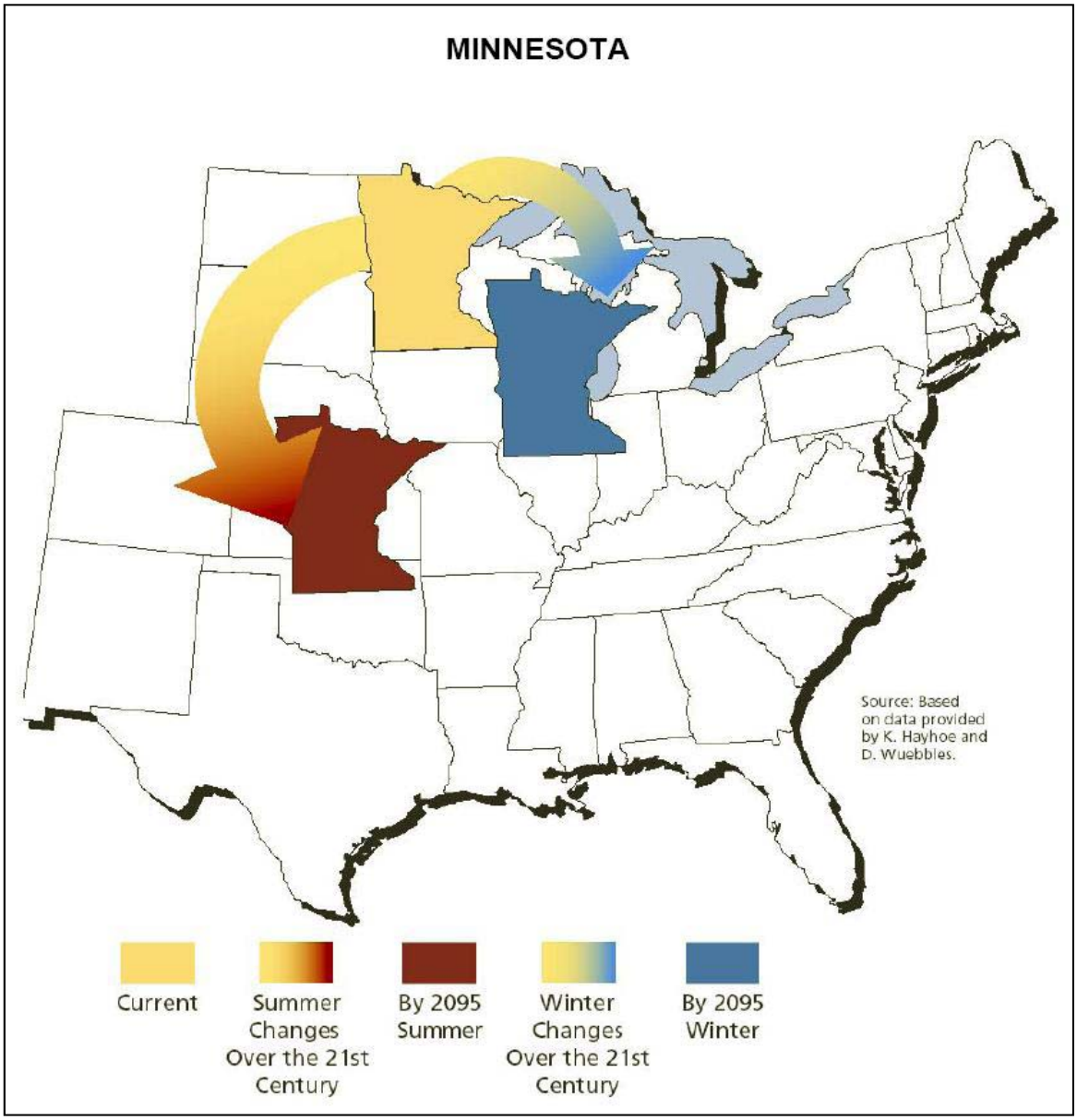
Climate change poses great challenges to natural resource management. It is impacting the health and productivity of lands and waters including the plants and animals that depend on these landscapes. Climate change threatens what natural lands provide such as clean water and habitats, forest products, and outdoor recreation opportunities. The threat of climate change and increased temperatures from vegetative cover loss converted to pavement, asphalt or concrete, will further exacerbate the effects of invasive species. Projections to date show that the ranges of major northern tree species such as black and white spruce and balsam fir are shifting northeastward out of the state. Forests may become savannas, and hardwood forests may persist mainly on north-facing slopes in some areas. Drying wetlands and warming lakes and rivers will have dire consequences on many plant, fish and wildlife populations. Mammal species such as Canada lynx are particularly vulnerable to the effects of climate change as they live in boreal forests, which could disappear in the future as new southern species and invasive species move in and alter the existing landscapes.[45]

The governor's Minnesota Climate Change Advisory Group recently highlighted the role land management can play in reducing greenhouse gases. Therefore, preventing conversion of forest lands and protecting wetlands and peat lands plays an important role in capturing and storing large quantities of greenhouse gases from the atmosphere.

In the last decade, scientists have noted that climate change is affecting the environment in the temperate forests across North America. Climate change predictions for Minnesota include: increased levels of CO2 and O3 in the atmosphere; milder winters; longer but drier growing seasons; higher humidity in summer months; more frequent and severe wind storms and thunderstorms; less percolation of rain water into the soil; and more forest canopy blowdown (from severe wind storms) events. These indicators and the map below portray the state's summer climate as increasingly resembling current Kansas summer conditions. (Figure 27).

[45] USFWS

• Figure 27. Projected Trends in Climate Change

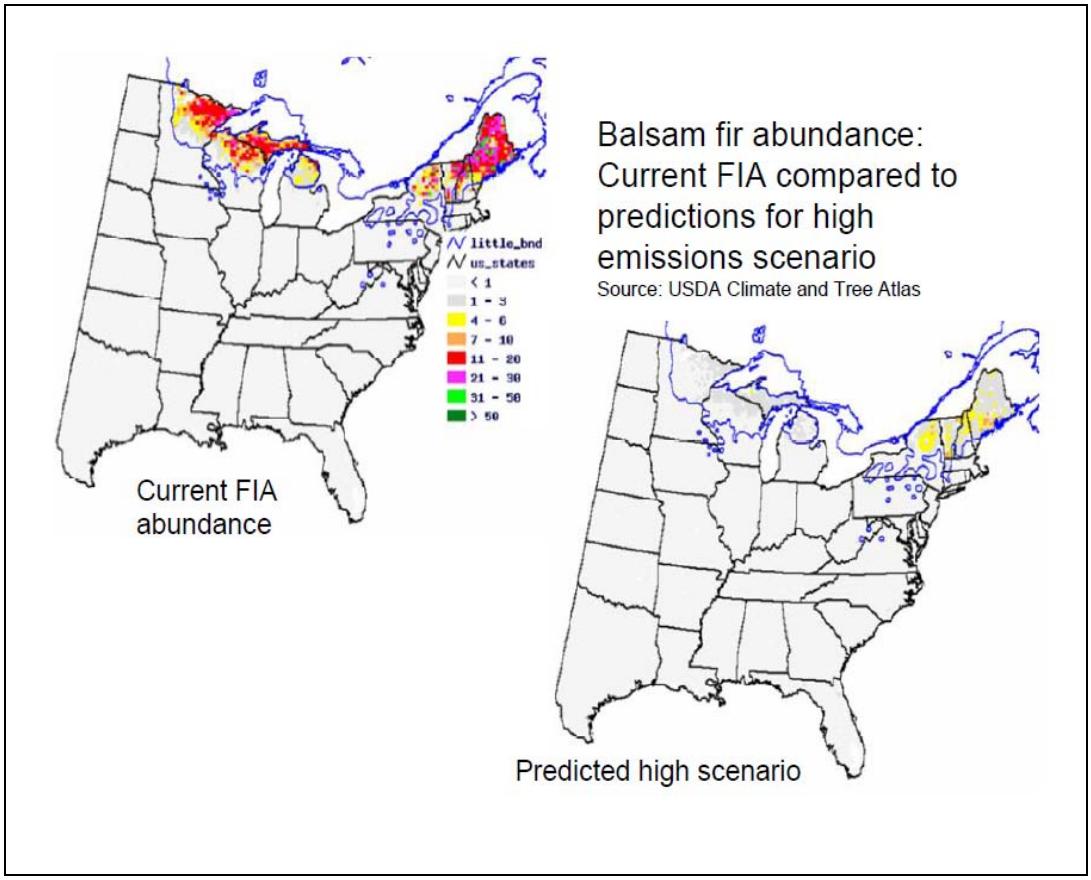


State Climate Dept

Climate Change Effects on Forest Tree Species

The USFS has developed a series of maps showing where climate change is likely to have effects for over 130 tree species in the Northeast. (Figure 28). In Minnesota, 12 of the 22 forest species will have hotspots of change, where that tree species will be under stress and the population is likely to diminish. An example of this change is shown below related to predicted habitat changes for Balsam Fir in Minnesota. These tools will be useful for forest management in the future, but at present, it is too early to identify tree species habitat change trends in relation to climate change. Both Superior NF and Chippewa NF are concerned with retention of the boreal or coniferous cover types as they are sensitive to warmer climates and already represent the southerly tip of these biomes. Climate change on tree species will also directly affect other species such as the Canada lynx, which is particularly vulnerable to the effects of changes within their boreal forest environment. For further information on tree species and climate change refer to: USDA "*Climate and Tree Atlas"* available at www.nrs.fs.fed.us/atlas/tree

• Figure 28. Predicted Habitat Shifts for Balsam Fir



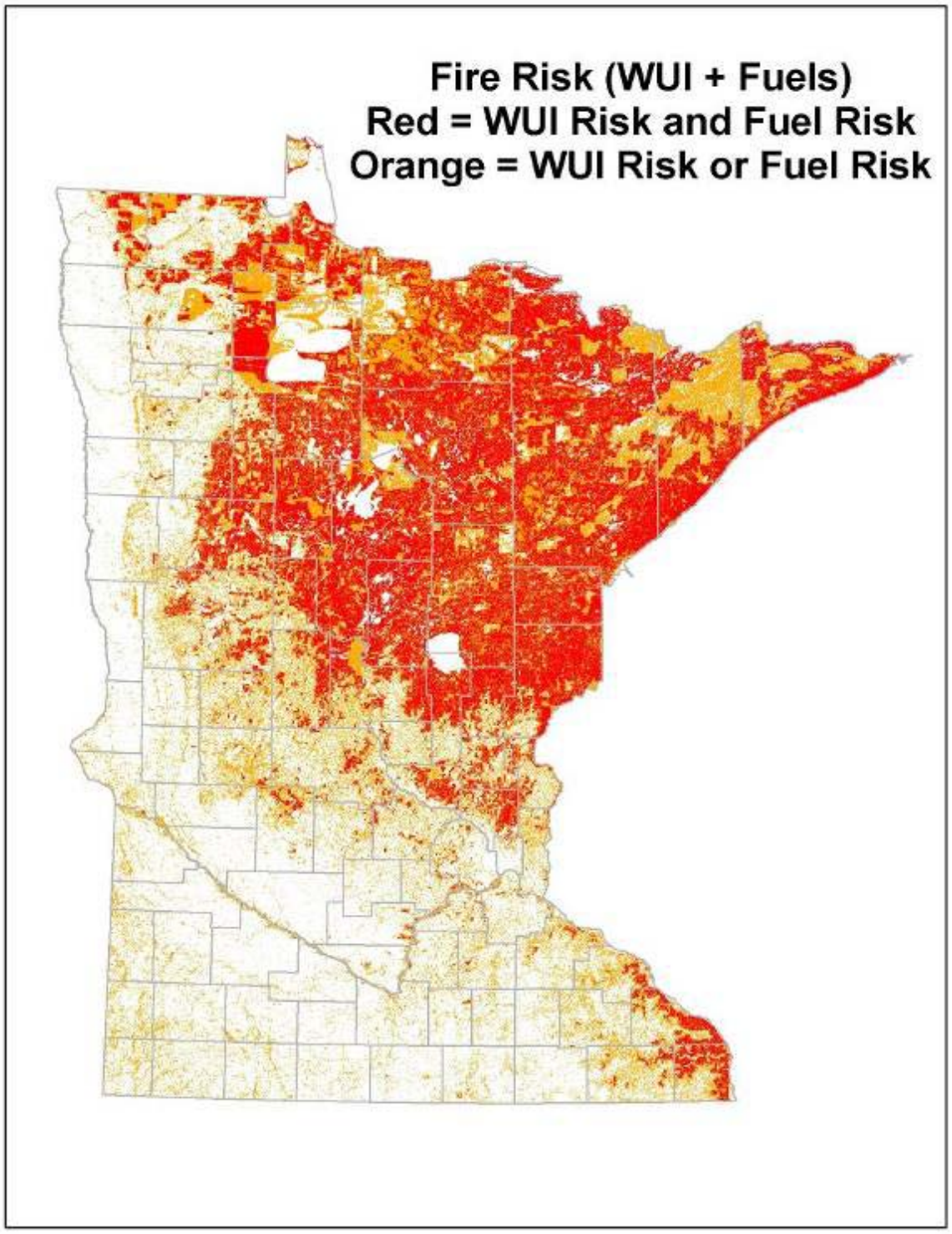
FIA

Indicator 20: Wildfire Risk Assessments

Minnesota has an average of 6,900 wildfires annually depending on yearly weather conditions. The DNR typically responds to an average of 1,600 of these wildfires each year. These wildfires range from small brush fires to those that destroy forest timber and public or private properties. (Figure 29). All of these wildfires contribute to high costs in terms of lost revenue, destroyed properties and human power needs. (Figure 30). Over 98 % of wildfires are caused by humans and most are preventable. The other 2 % are caused by weather conditions conducive to wildfire starts coupled with moderate to severe drought conditions. Drought conditions in the state are episodic and tracked by the Minnesota State Climatology Office and the US Drought Monitoring.

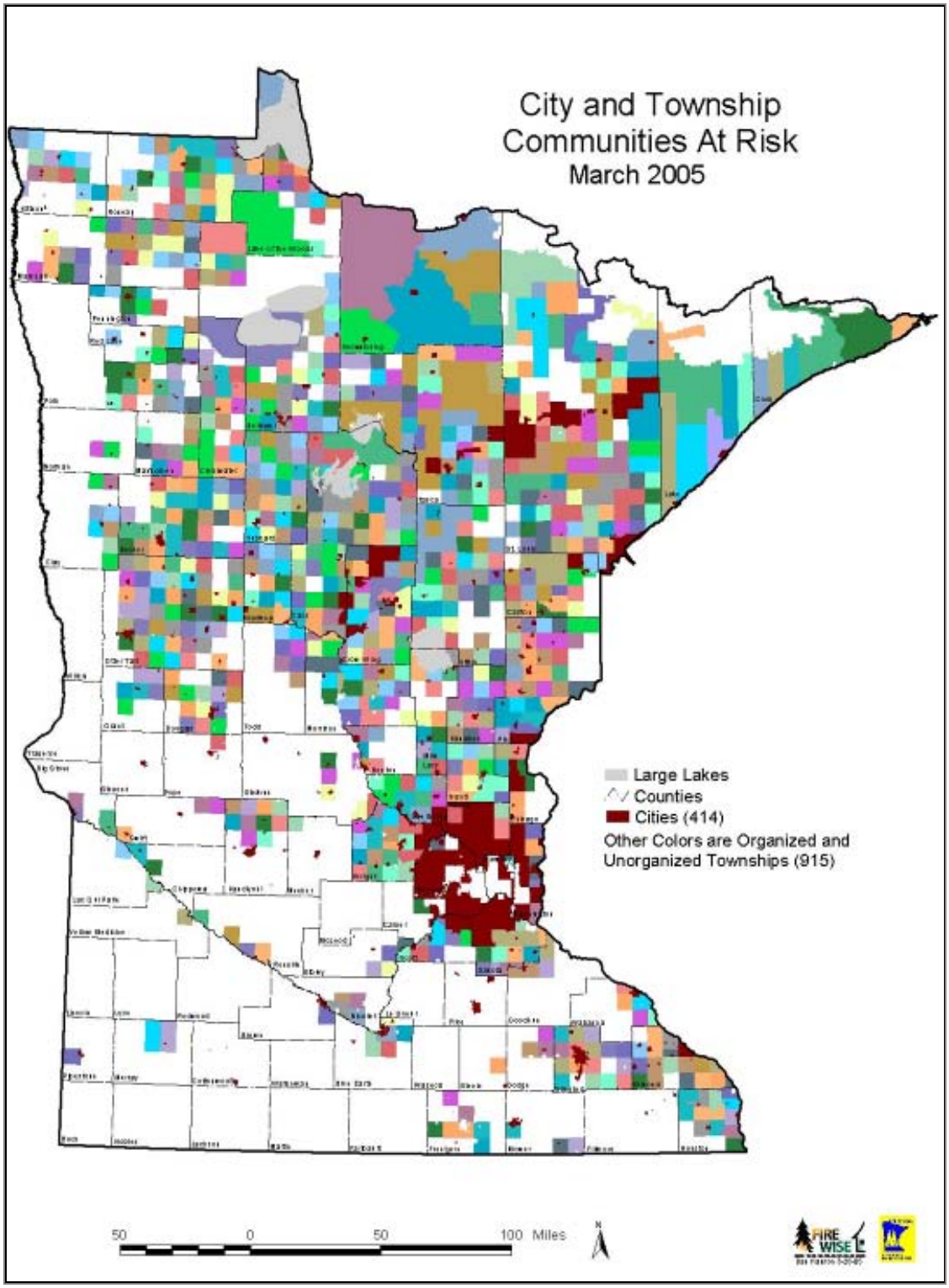
Refer to http://climate.umn.edu/doc/journal/drought_information_resources.htm

• Figure 29. State-wide Fire Risk



MN DNR

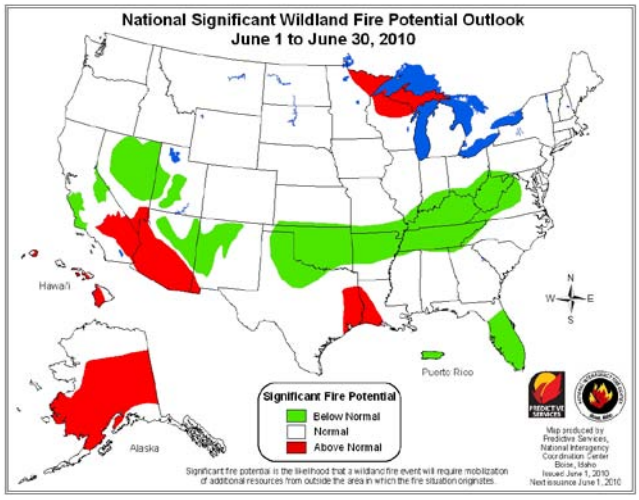
• Figure 30. Communities Across Minnesota at Risk



MN DNR

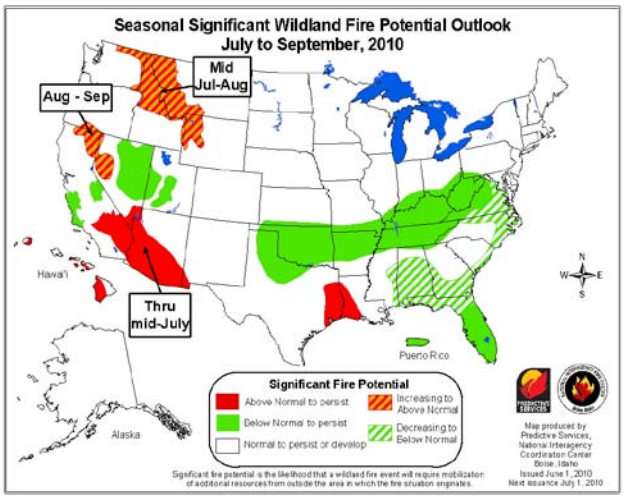
In 2010, the national predictions for wildland fire potential outlooks in the state suggest above normal fire potential based on abnormally dry conditions that still linger from 2009 over portions of northern and east central Minnesota.(Figures 31, 32). The National Weather Service, Climate Prediction Center (CPC) predicts an increased probability of below average precipitation over the Great Lakes Region including northeastern Minnesota. In addition, warmer than normal temperatures are predicted to accompany drier conditions over the Great Lakes.[46]

- Figure 31. National Wildfire Potential – June 2010



CPC

- Figure 32. National Wildfire Potential – July-Sept 2010



CPC

Smoke Management

DNR is signatory to the Memorandum of Understanding (MOU) of the Minnesota "*Smoke Management Plan"* along with other state and federal land management agencies in Minnesota. The "*Smoke Management Plan"* describes and recommends minimum practices to reduce air emissions from prescribed fire and from wildland fire use in order to mitigate the effects of those emissions on air quality and visibility. In addition, the plan defines the responsibilities of the land management parties in conducting prescribed burning in Minnesota, defines the responsibilities of the state regulatory agencies to issue permits for open burning and establishes a process to monitor the effects of burning on air quality and visibility.

Changes in wildfire risks are directly related to climate change. While the above figures lay out seasonal scenarios, there is no guarantee that condition will remain as predicted. Assessment and trends in wildfire risks are not static and can change dramatically over seasons. However, if current climate change patterns of a hotter and drier summer pattern continues, it can be expected that wildfire risks will rise, prompting increased needs for supplies, services and personnel.

Indicator 21: Wildfire Trends

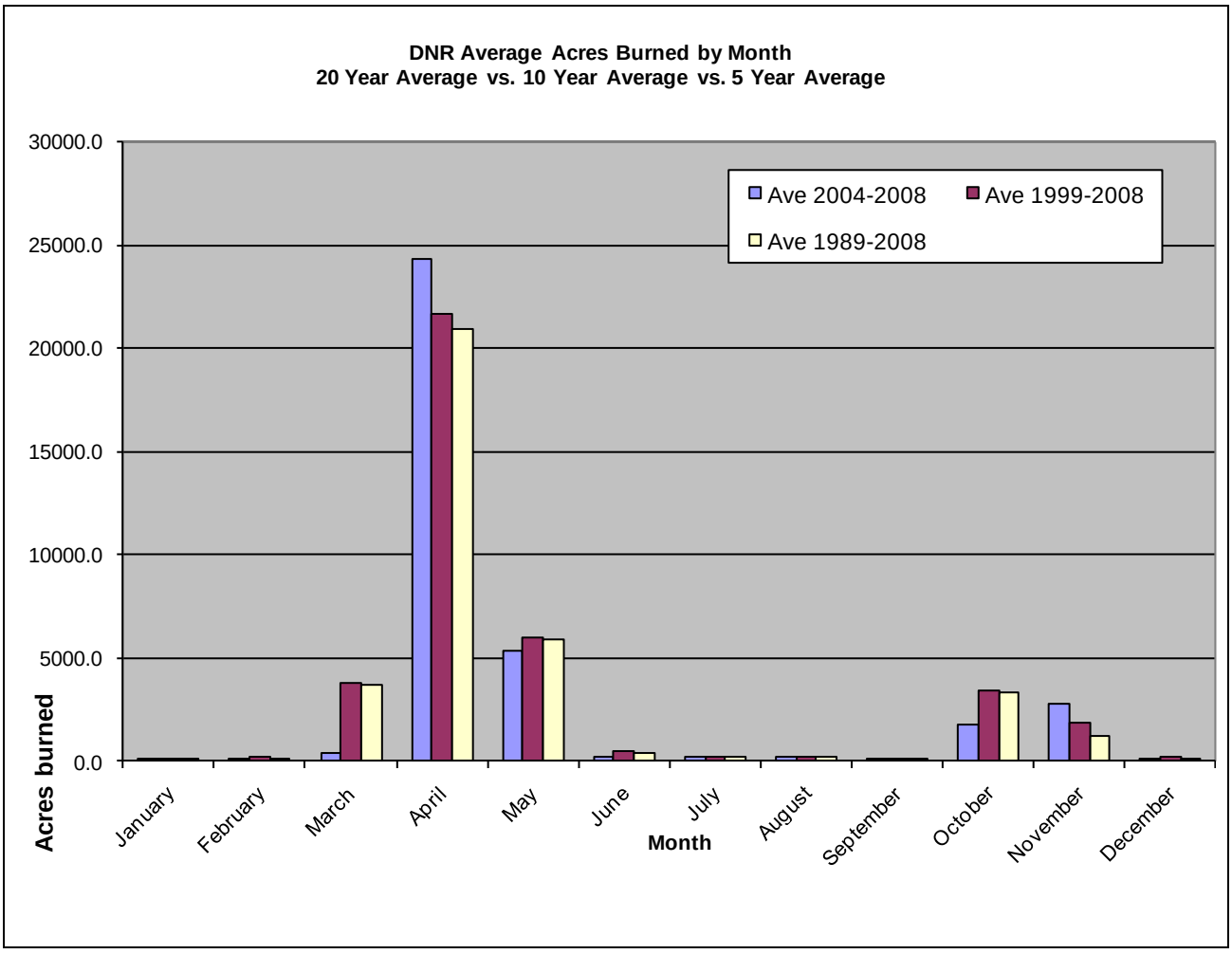
Expanding individual residential and seasonal housing and home developments in forested areas is increasing the amount of wildland/urban interface statewide. This, coupled with the state's history of human caused wildfires, is increasing the need to protect life, property, and natural resources from wildfires and making the state's response to suppress wildfires more complex and expensive in terms of dollars, time and personnel resources. The state is charged, by statute, with preventing and suppressing wildfires on 45.5 million acres of public and private lands within its boundaries. Wildfire control efforts under state authority originated in the late

[46] See: www.mnics.org/documents/fire_behavior.pdf

1800's and early 1900s, after a series of devastating wildfires destroyed Hinckley (1894), Chisholm (1908), Baudette (1910) and Cloquet (1918).

Forest fuel loads (and therefore wildfire risks) are influenced by the type, amount, and location of forest management practices such as timber harvesting, thinning, and prescribed burning. The number of wildfires each year is not easily predicable and varies widely from year to year, primarily due to weather. (Figure 33). Drought conditions also exacerbate wildfires numbers and severity. Because the state must respond to wildfires regardless of how they occur, wildfire suppression is not suited to targets based on wildfire numbers. Wildfire targets are based on response times and acres burned. Present overall targets are a response time of less than 20 minutes and an average acres burned of less than 10 acres. In addition, the number and severity of wildfires in any given year, can dramatically affect the state's ability to achieve forest targets, as funding and personnel resources must be diverted to suppress wildfires. The state is currently proposing to look into additional measures that would better relate the need to expend wildfire preparedness dollars. These may be based on such factors as the number of days at elevated fire indexes based on weather, fuel and drought conditions, rather than basing measures on the number of fires and acres burned.

- Figure 33. Average Acres Burned by Month



MN DNR

State Wildfire Program

The state (through the DNR) recognizes that without the aid of its local partners, the rural-volunteer fire departments (RFD/VFD), it would not be able to suppress the 6,000 to 7,000 wildfires annually. To that end, the state maintains a strong rural fire department program that serves over 600 of the 800+ fire departments in the state each year. The state DNR program ensures that these partners have access to the Federal Excess Property Program (FEPP) and the Fire Fighter Property Program (FPP). These federal programs provide much needed equipment to RFD/VFD partners at little or no cost. Approximately 50 trucks, 40 – 50 generators, 5 boats, and numerous small items have been acquired and distributed through the FEPP and FFP programs in the year 2008. The state also provides grants, the Volunteer Fire Assistance matching grant system, to 225 to 250 of these fire departments each year. These grant funds can be utilized by departments for the purchase of wildland firefighting equipment, such as personal protective equipment (PPE), communications equipment, dry hydrants, FEPP conversions, water handling equipment, and other equipment to meet their needs. The state also maintains a small cache of consumable/expendable equipment that is made available to fire departments statewide. As state fleet equipment is turned over, surplus equipment such as hundreds of radios (portable, mobile and base station), wildland engines (6) and tracked vehicles (7) are available for purchase by the RFD/VFDs in the state.

Prescribed Fire

Fire has historically played a role in most native ecosystems of Minnesota. Pine forests, savannas, grasslands, and many other plant communities benefit from fire as a management tool for the maintenance and health of these ecosystems. Land managers use prescribed fire to restore, alter or maintain plant communities and to protect life, property, and other values that could be degraded or destroyed by an unplanned wildfire. Most prescribed fires in Minnesota are designed with objectives related to ecosystem management such as restoration and maintenance of native plant communities, wildlife habitat improvement, control of undesirable vegetation or invasive species, and forest silviculture treatments. In addition, mitigating the threat of wildfire through fuel reduction is also an important objective, primarily in forested ecosystems. (Figure 34).

- Figure 34. State Prescribed Fire for Vegetation and Wildlife Habitat Management

MN DNR

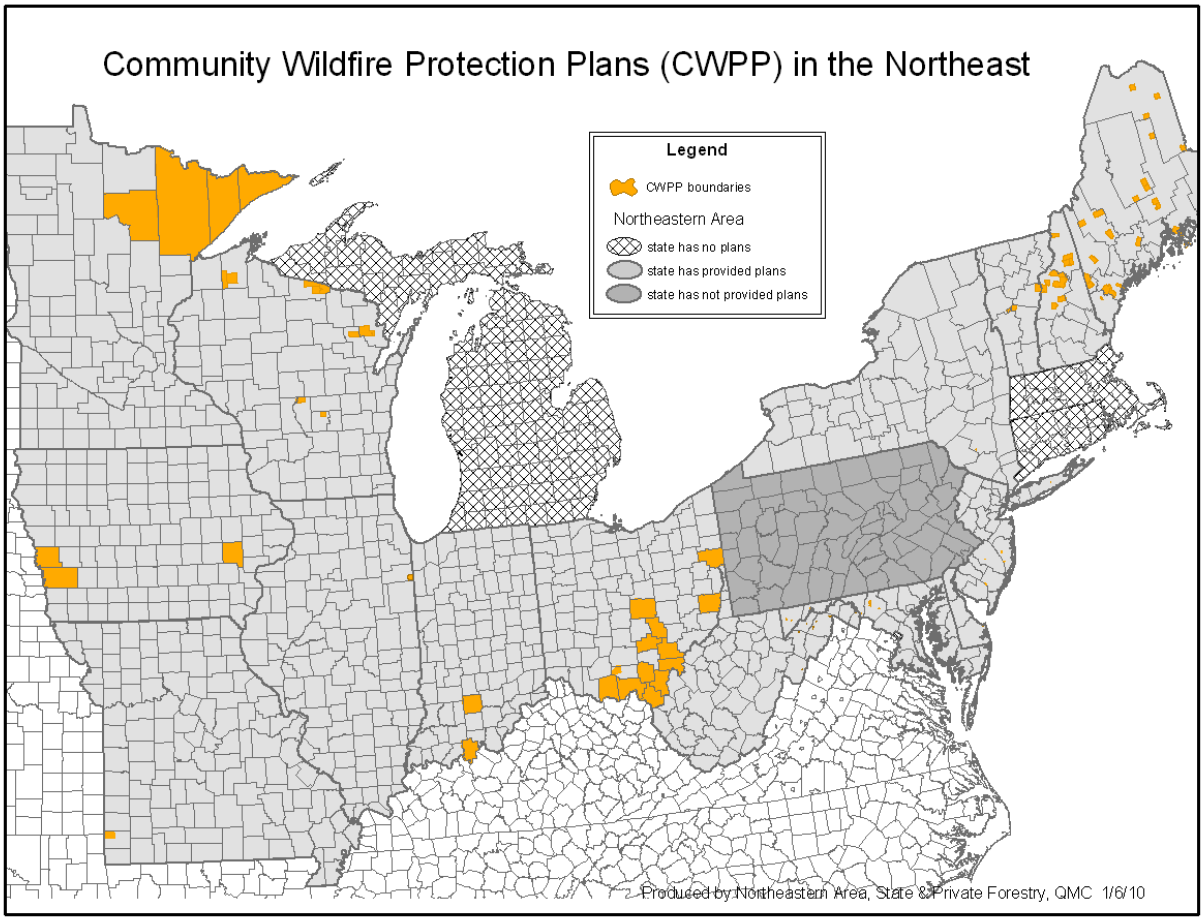
Community Wildfire Protection Plans

The state believes that a fire prevented, saves homes, resources, time and dollars. To aid in this effort the state maintains an active wildfire prevention program. This program utilizes national themes and concepts such as Firewise and Community Wildfire Protection Plans (CWPP) to deliver the wildfire prevention message to the public. (Figure 35). Prevention staff work with counties and individual communities through these programs to spotlight wildfire prevention in all communities and with individual homeowners. Currently there are four forested counties in the state that have completed Community Wildfire Protection Plans including:

- Cook County - available at http://www.co.cook.mn.us/index.php/wildfire-protection-plan
- Itasca County - available at http://www.co.itasca.mn.us/Land/CWPP.pdf
- Lake County - available at http://www.na.fs.fed.us/fire/cwpp/samples_cwpps/lake_county_mn.pdf
- St. Louis County - available at http://www.co.stlouis.mn.us/

Minnesota is mandated by state statute to control open burning statewide. This is accomplished through the open burning permit system which utilizes a network of Township Fire Wardens as well as a recently developed online computer application. This computer application allows individuals to obtain a DNR open burning permit through an internet connection. Open burning can then be regulated by each Area office daily commensurate with present local conditions for burning safely.

- Figure 35. 2010 Status of Community Wildfire Protection Plans



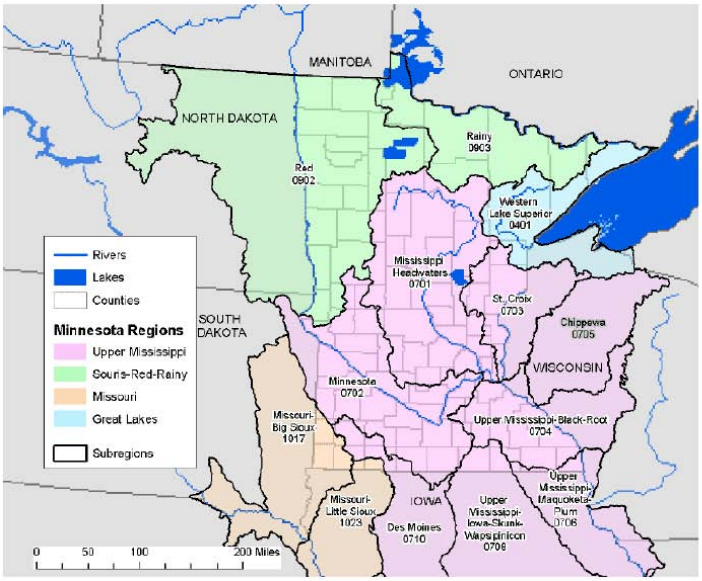
NAASF

Indicator 22: Catastrophic Events

Events such as flooding, drought, wild fires, tornadoes, ice-storm and straight line wind events have all been part of the Minnesota catastrophic climate regime. Ice-storm and straight line wind event response is coordinated through the Minnesota Interagency Fire Center (MIFC) and inter-agency emergency response teams.

Drought response is coordinated through the DNR Division of Waters. Flood response is coordinated through Homeland Security and Emergency Management (FEMA). While detrimental flooding (as opposed to natural systems flooding which can be beneficial to forest species and ecosystems), is catastrophic for agricultural and urban landscapes, drought is considered a higher threat for forest health. When forests are stressed, they become more attractive and vulnerable to insects and diseases which can cause considerable decline in healthy forest lands. Drought is neither stable nor predictable but does increase both soil and air temperatures. Drought can increase water temperatures which can affect aquatic species such as brook trout. Drought can also impact hydrology, which in turn may adversely affect forests. A prolonged drought can, over time, lead to changes in forest cover type. Monitoring of drought conditions is conducted through the State Climatology office and includes assessment of watersheds in their relation to droughts on a regional basis. All major watersheds are included regardless of political boundaries and include regional watersheds that cross into bordering states and Canada. (Figure 36, 37).

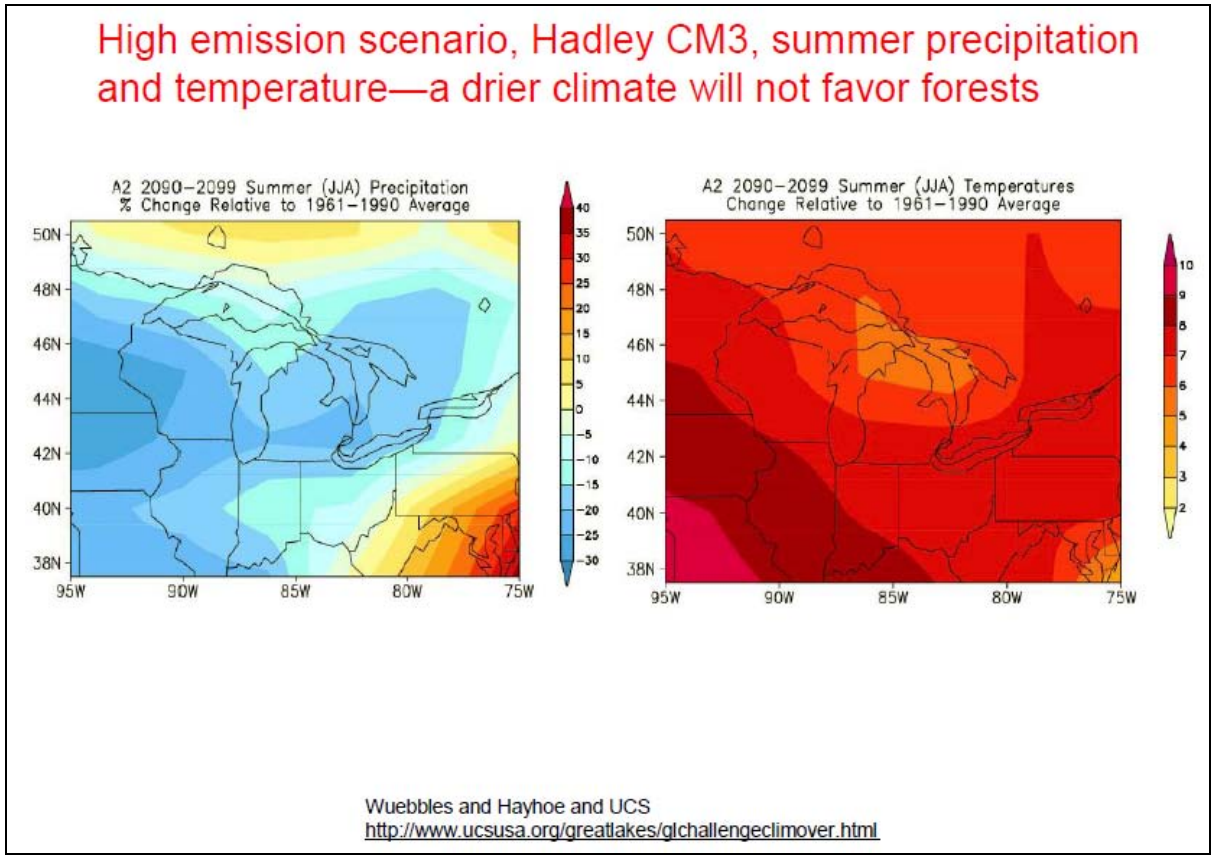
- Figure 36. Drought Plan by Watershed Source: MN DNR



Statewide Drought Plan watersheds:

- Red 0902
- Rainy 0903
- Western Lake Superior 0401
- Mississippi Headwaters 0701
- St. Croix 0703
- Minnesota 0702
- Upper Mississippi-Black-Root 0704
- Upper Mississippi-Maquoketa-Plum 0706
- Upper Mississippi-Iowa-Skunk-Wapsipinicon 0708
- Des Moines 0710
- Missouri-Little Sioux 1023
- Missouri-Big Sioux 1017

• Figure 37. Temperature Projections



Refer to: http://files.dnr.state.mn.us/natural_resources/climate/drought/drought_plan_matrix.pdf

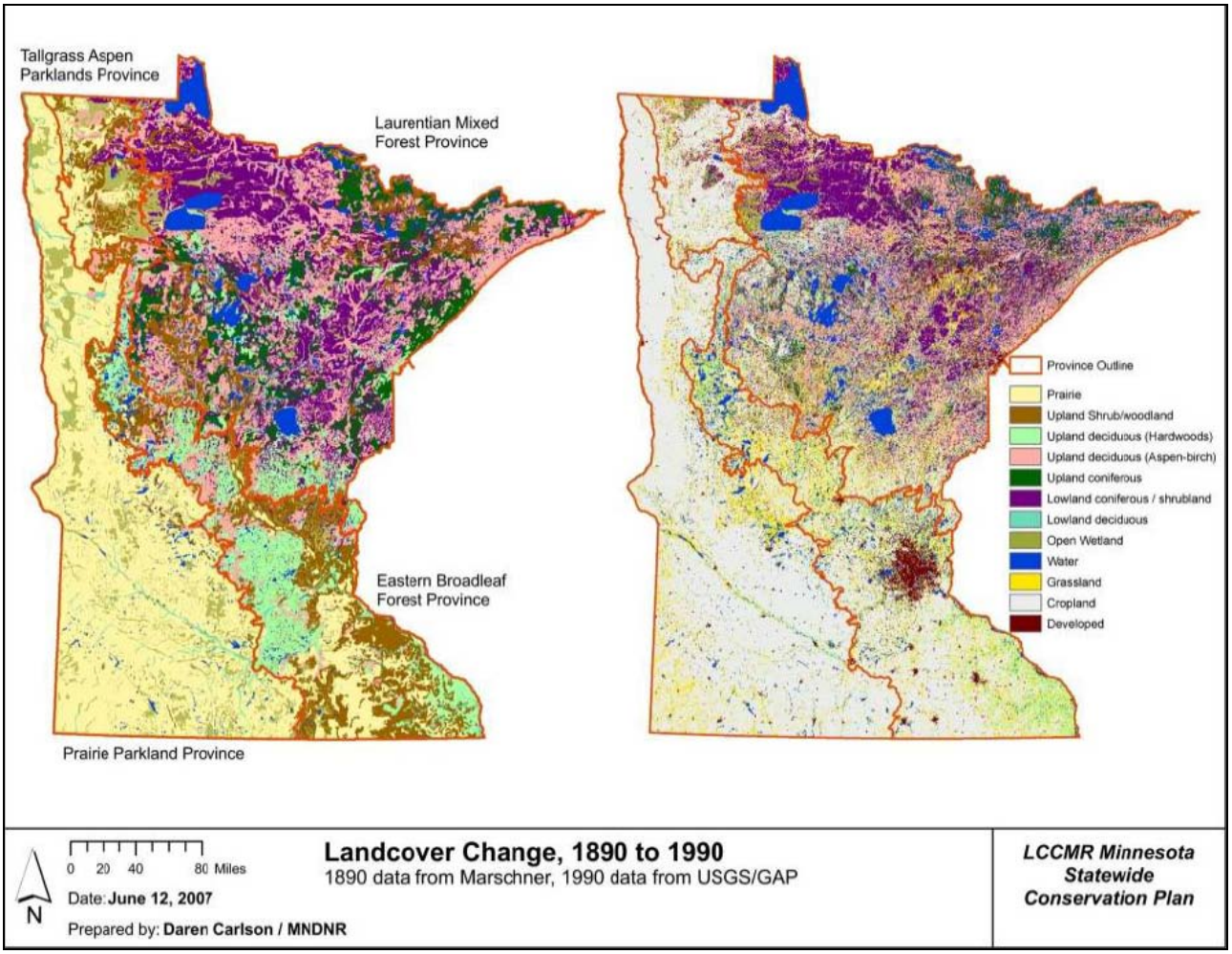
Indicator 23: Land Use Change

The estimated area of pre-settlement forest land in Minnesota was 31.6 million acres.[47] The largest decline in the area of forest land occurred before the first forest inventory was conducted in the mid-1930s, and was due to logging followed by homesteading and land clearing for agriculture.[48] This decline continued through the first four inventories in the state. Between 1977 and 1990, a small increase (0.7 percent) in the area of forest land was recorded. From 1990 to 2003, the area of forest land declined approximately 4% when adjusted for definitional changes between land surveys. However, by 2009, FIA data indicates that forest land acreage may have increased slightly due in part to some reversion of agricultural lands coming out of Natural Resources Conservation Service (NRCS) Conservation Reserve Program (CRP) to forest lands.

Changes in the area of forest land appear to vary regionally. Ninety percent of the state's forest land lies above the 46th parallel. Since 1977, there has been a 4 percent decline in the area of forest land above the 46th parallel from 15.1 million acres in 1977 to 14.6 million acres in 2003. Below this parallel, there has been an increase of approximately 10% of forest land from 1.5 million to 1.6 million acres. (Figure 38).

[47] Marschner 1930
[48] Zon 1935

• Figure 38. Changes in Land Cover Over 100 Years



The area and extent of Minnesota's forests have decreased since the first forest inventory in 1935. Forest land area has remained relatively stable over the past 30 years. While there has been some decline in the amount of forest land in some parts of the state, these losses have been offset by gains in other areas. Most of the gains in forest land have occurred as a result of marginal farmland and pastureland conversions to forest lands. In part this was due to the federal government's Conservation Reserve Program (CRP), which retired erosion-prone and marginal private croplands for specific timelines. However, this program has seen recent reversals as marginal lands are being cultivated for alternate fuels crop production (ethanol).

Indicator 24: Urban Land Use Changes

Minnesota is projected to grow by more than 1 million people in the next twenty years (2009 data), placing increasing burdens on natural systems within urban growth areas. The state loses approximately 1500 acres of forest and natural land cover to urban development each year, which represents a 1.2% change. These losses are concentrated around the Twin Cities metropolitan area and the corridor between Rochester and St. Cloud but also appear in forested landscapes that are being fragmented by increasing rural and lakeshore developments. (Figure 39). These developments are altering land use and impacting land and water conditions, which in turn harms fish and wildlife habitats as well as threatening clean water sources.

• Figure 39. Changes in County Population 1990-2000

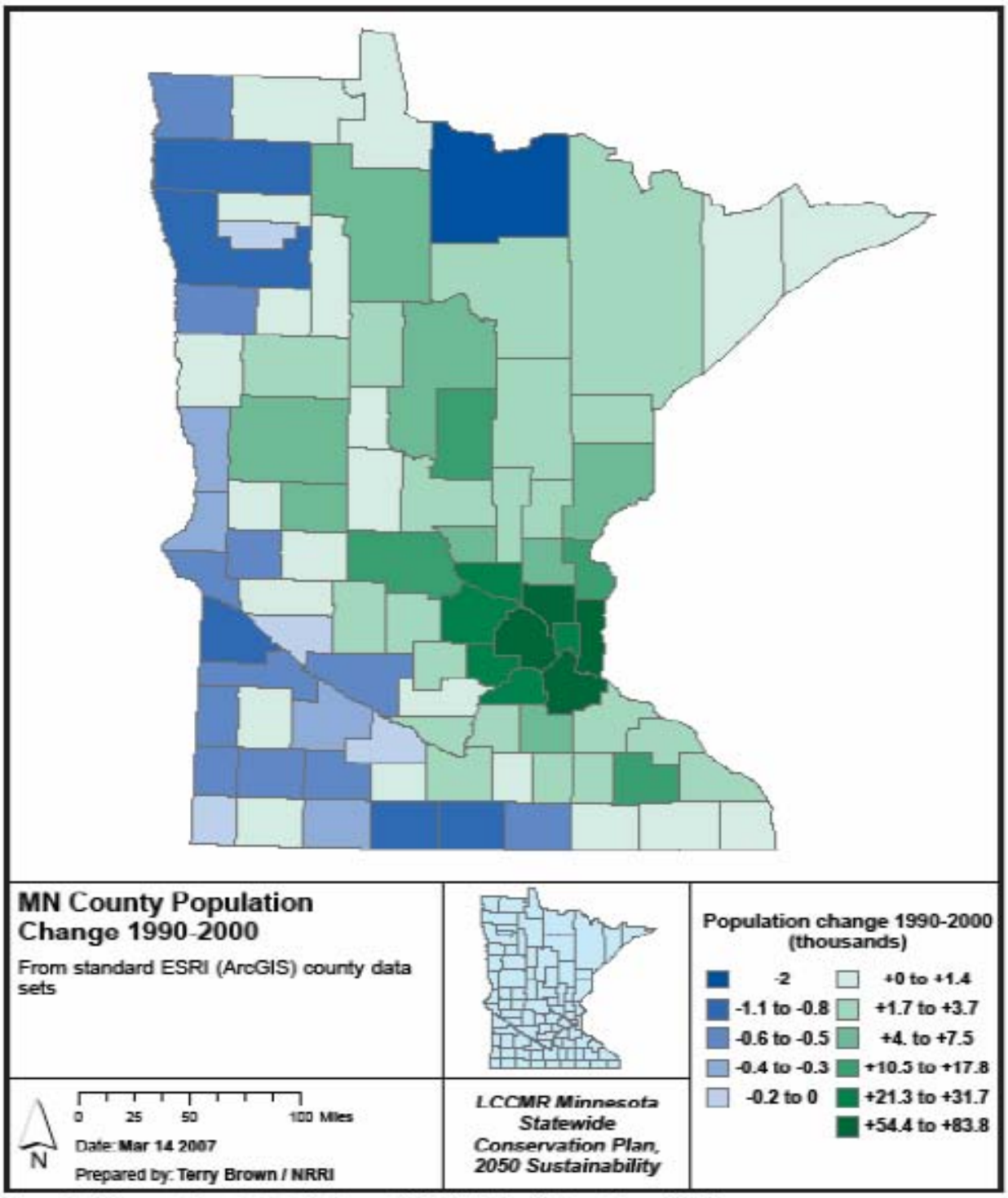
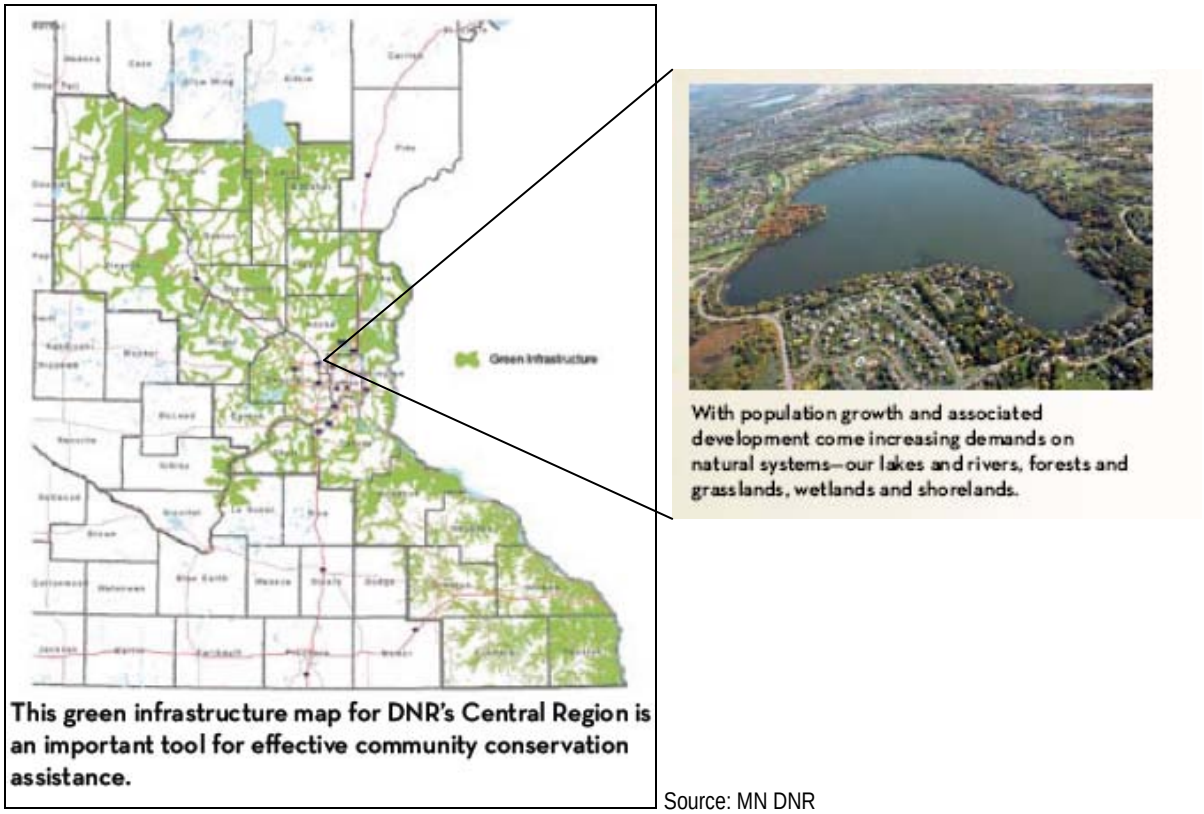


Figure L1. Minnesota County Population Change 1990-2000. Credit: Terry Brown, NRRI.

• Figure 40. Metro Urban Greenway Corridors



Source: MN DNR

In 2009, more than 46 % of Minnesota's forest land is under private ownership including industry. While industry has been divesting of their holdings, non-industrial private forest ownership is growing. Forest parcels are getting smaller and traditional uses of forest landscapes (timber harvest, tree-planting) are giving way to more non-traditional uses (destruction of natural habitats for urban lawns and shrubs) and large home development on smaller parcels. (Figure 40).

Criterion 4: Conservation and Maintenance of Soil and Water

Soil and water are the foundation for all other forest resources. **Soil,** which has both living and nonliving elements, retains water between rain events and stores nutrients for plants and animals. It is an anchor for vegetation and a seasonal or permanent home for a variety of burrowing animals, insects, and microscopic creatures. Soil conservation means maintaining site productivity and soil resource functions. Soils take thousands, even millions, of years to develop; therefore, it is not considered renewable even though it can be formulated and restructured to support plant growth.

Water resources include the physical features, habitat, and inhabitants of lakes, streams, and wetlands, as well as the water itself. Forests and trees, whether urban or rural, help reduce storm water runoff, filter pollutants, store water and nutrients, clean and cool water, protect municipal water supplies, reduce flooding, replenish groundwater, and provide fish and aquatic habitat. Water resources are a function (reflection) of watershed condition.[49]

This criterion ties to the national theme of *Enhancing Public Benefits From Trees and Forests.*

[49] NAASF-"*Suggested Framework for Statewide Forest Resource Assessments*." November 2008

Indicator 25: Forests, Water and People

Restoring and protecting the ecological integrity of the nation's waters is one of the primary goals of the federal Clean Water Act. Achieving this goal requires monitoring of the state's resources to assess their health. The "*Forests, Water and People*" assessment recently completed by the USFS, has identified private forests that are most important for drinking water supply and most in need of protection from development pressures. Through a four step GIS-based overlay analysis, four indices were developed for each watershed to gauge the importance for drinking water supplies and the need for private forest management to protect those supplies.

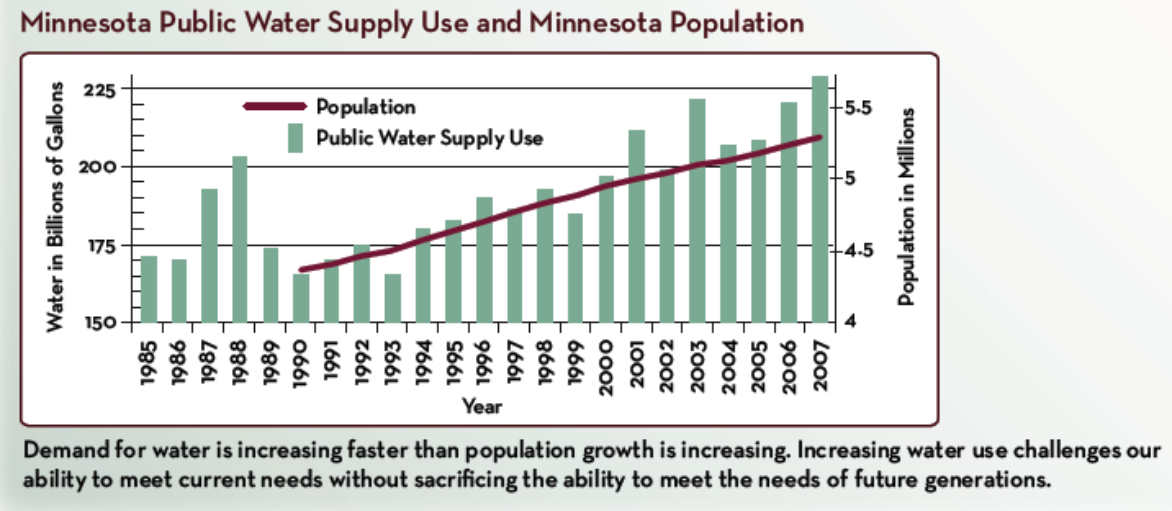
In essence, the report shows that the state of Minnesota contains large protected forest areas in the northeast, an even mix of private and publicly owned forests, and high development pressures around the Minneapolis-St. Paul metro area. Eleven watersheds in Minnesota (14 % of the state's total watersheds) tied for the highest score in their ability to produce clean water, based on a series of six indices that have been applied to all watersheds across the state. These watersheds are all north of the Twin Cities and include the Mississippi Headwaters, Leech Lake, Prairie-Willow and Pine watersheds.

In the ability of watersheds to provide drinking water on private lands, the same area to the north of the Twin Cities scored highest, again including the Mississippi Headwaters, Leech Lake, Prairie-Willow and Pine watersheds.

A detailed report on all indices with corresponding GIS composite scoring maps is available for the state under www.na.fs.fed.us/watershed

On a state level, the Minnesota Pollution Control Agency (MPCA) currently conducts a variety of surface water monitoring activities that support the overall mission of helping Minnesotans protect the environment.

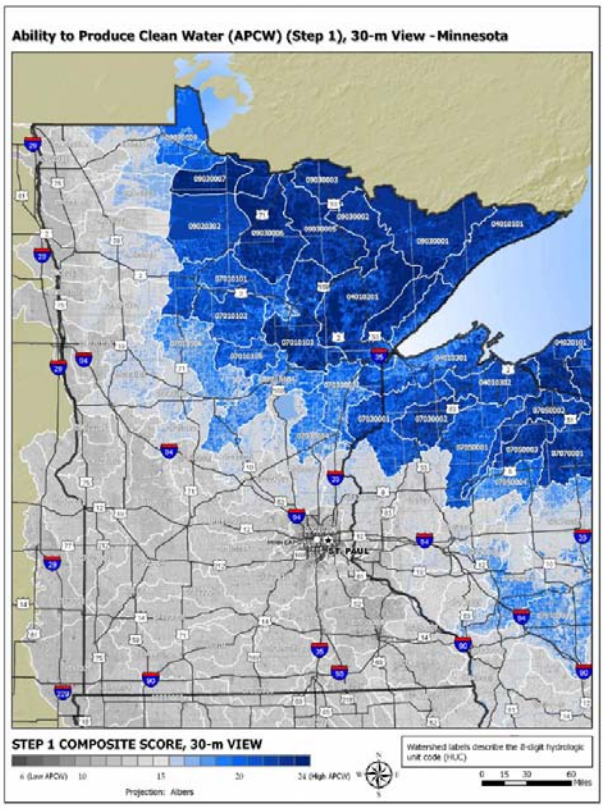
- Figure 41. Minnesota Public Water Supply Use and Population



Source: MN DNR

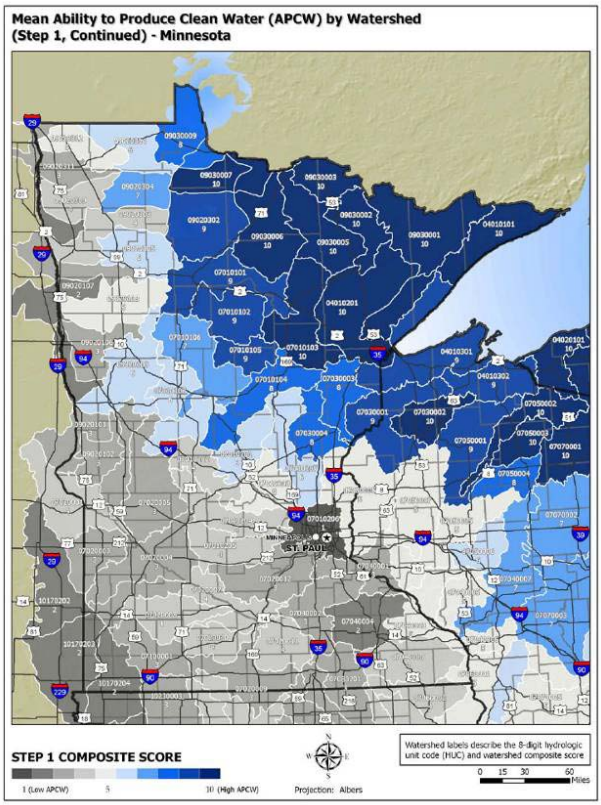
Indicators show population steadily increasing in the state, which will necessitate vigilant protection and monitoring of clean drinking water supplies. (Figure 41). While the state currently enjoys relatively high clean water supplies, fragmentation of large forest lands and their corresponding watersheds, will need constant monitoring to ensure these clean water supplies are protected into the future. (Figures 42, 43).

- Figure 42. Minnesota's Ability to Produce Clean Water



Source: USFS

- Figure 43. Minnesota's Ability to Produce Clean Water by Watershed



Source : USFS

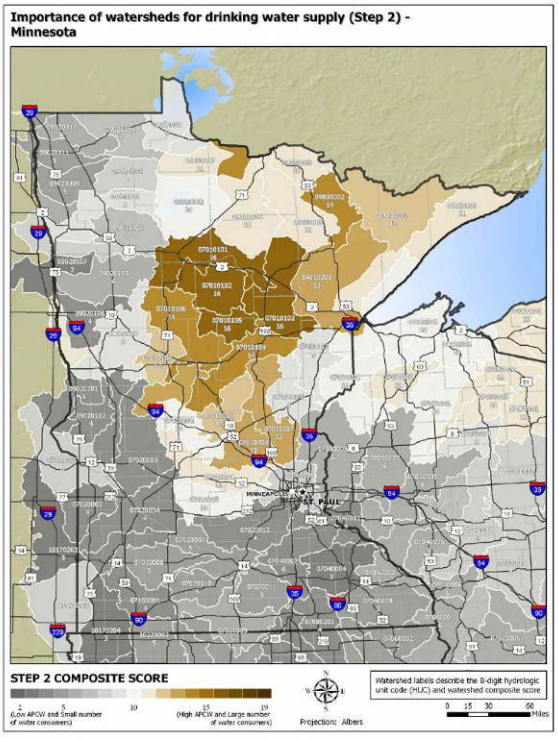
Indicator 26: Forested Watersheds

Minnesota has approximately 16.7 million acres of forested land in the state, down from 31.6 million acres in pre-settlement times. In the late 1800s and early 1900s, large tracts of wet lands were cleared and drained for agriculture, but proved to be uneconomical and were abandoned in great numbers by the 1940s. Over 2 million acres of these tax-forfeited lands are now in county or state ownership and some have since reverted back to their original landscape functions. However, many of these acres still function as agricultural lands through the use of drainage ditches and contribute to impaired waters. The potential to re-use these acreages for 'restored' watersheds, riparian functions and wetland bank credits are now being explored by both the state and local units of government. (Figures 44, 45).

The Minnesota legislature recently appropriated resources for water monitoring, assessment and total maximum daily load (TMDL) development for the state. The MPCA has developed an intensive watershed monitoring strategy intended to integrate water monitoring programs to provide a more complete assessment of water quality and to facilitate the collection of data necessary for the development of TMDLs on surface waters determined to be impaired. Initially, this monitoring effort will focus on streams and rivers within a watershed but could eventually include lakes and wetlands. The new monitoring strategy utilizes a progressive watershed approach allowing aggregation of watersheds from a coarse to a fine scale. The coarse level framework is the major watershed or 8-digit Hydrologic Unit Code (HUC). Within Minnesota there are 81 major watershed delineated. Intermediate (11-digit HUC) and minor (14-digit HUC) watersheds within the major watershed are also sampled to provide a complete assessment of water quality.

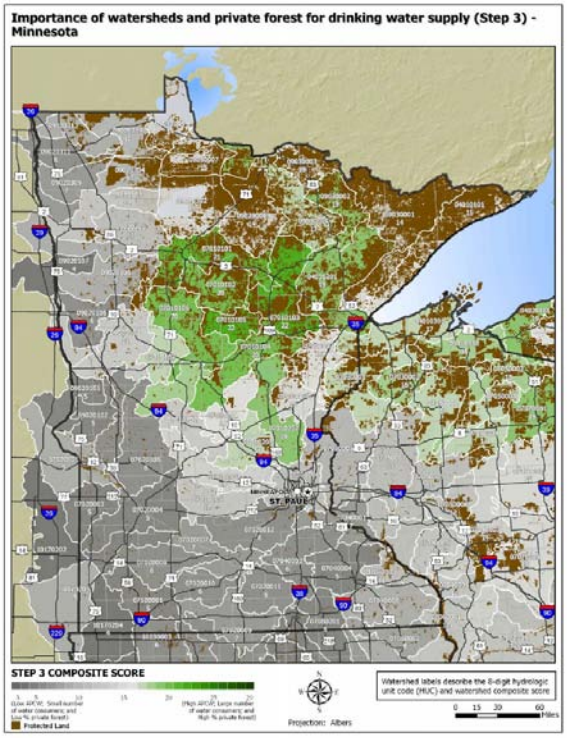
Site selection is determined by systematically sampling near the mouth or “pour point” at all watershed scales. The pour point of the major watershed is sampled for biology, water chemistry, and fish contaminants to provide data for the assessment of aquatic life, aquatic consumption, and aquatic recreation use support.

- Figure 44. Watersheds and Drinking Water



Source: USFS

- Figure 45. Private Forests and Drinking Water

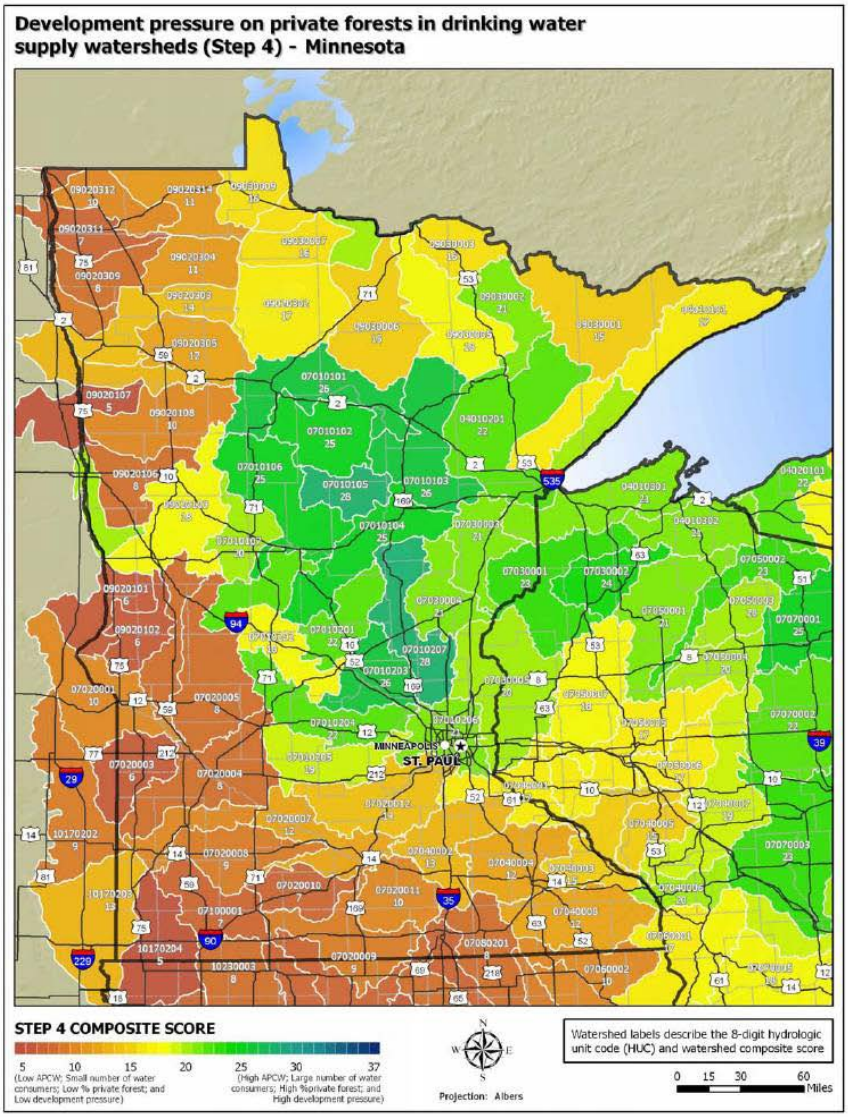


Source: USFS

MPCA inventory of impaired forested watersheds is in process but not yet complete for the state. A pilot project of this new monitoring strategy was conducted in the Snake River watershed in 2006. In 2007, the North Fork and Pomme de Terre watersheds were surveyed. In 2008, the Little Fork River basin, Upper and Lower Red River, and the Sauk River watersheds were surveyed.

The MPCA’s goal is to evaluate all 81 major watersheds in Minnesota utilizing the new monitoring approach. With adequate funding, every major watershed would be monitored on a ten-year rotational basis. In addition, the progressive watershed monitoring strategy has a Phase II component consisting of follow-up monitoring at all 11-digit HUCs determined to have impaired waters. In order to be successful, this phase will necessitate integration and coordination with other monitoring programs, particularly the impaired waters program. (Figure 46).

• Figure 46. Development Pressures on Private Forests and Drinking Water Supplies



Source: USFS

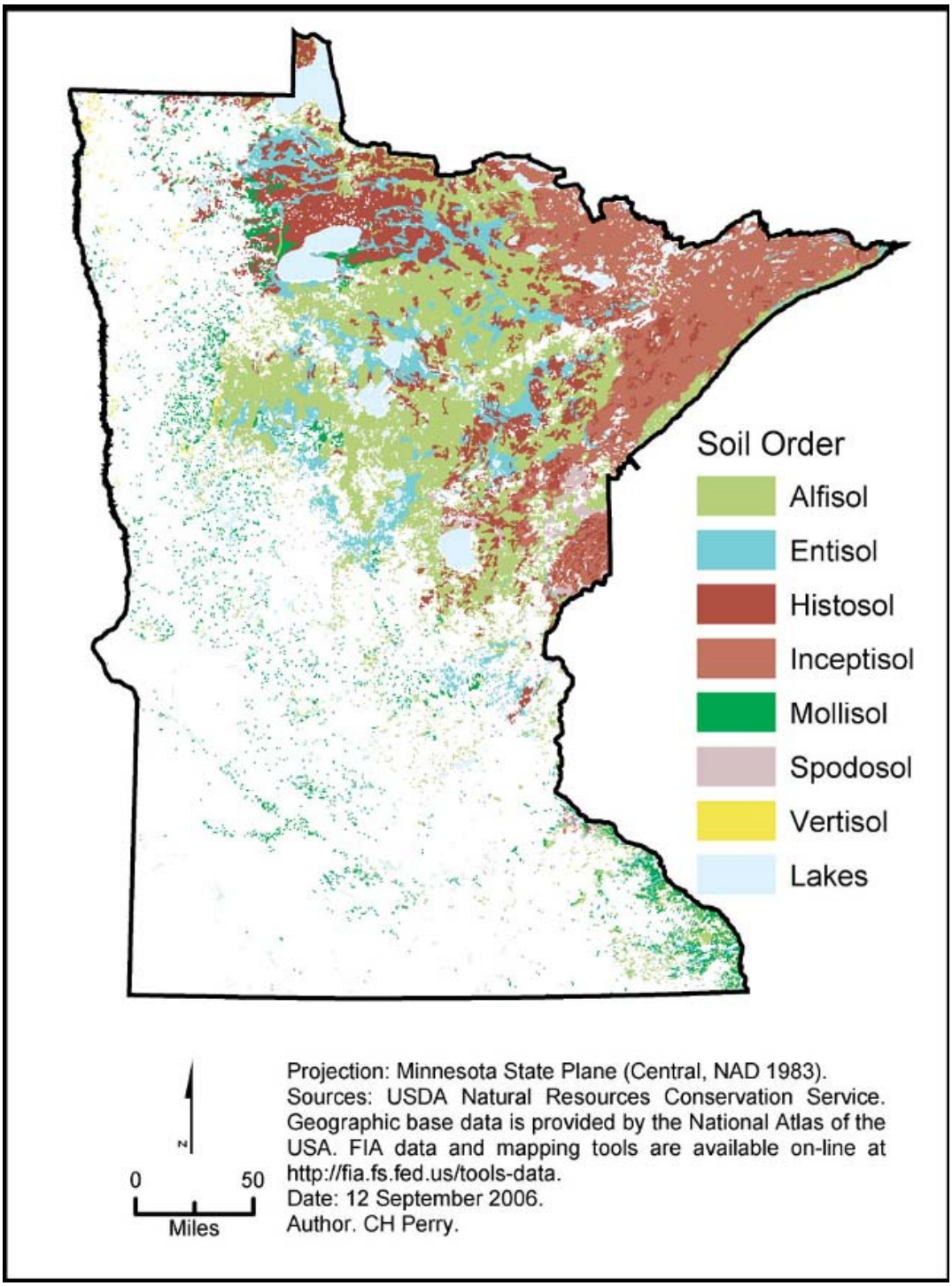
Indicator 27: Total Soil Carbon

The forests of Minnesota are largely underlain by alfisols, inceptisols, entisols, and histosols. Alfisols are fertile soils generally developed under deciduous forest. Inceptisols are diverse soils occurring across a range of climates and vegetative communities. Inceptisols are weakly developed soils. Entisols are young soils, common in river bottoms and outwash sand areas. Histosols are marsh and bog soils found in ancient glacial lakebeds across northern Minnesota. (Figure 47).

Forest floors under coniferous forests are deeper and thicker that those under deciduous forests. Spruce/fir forest-types have higher relative carbon content. Conversely, coniferous forest-types have lower soil pH than

deciduous forest-types. Higher quality soils are found in the forest/prairie transition zone and higher amounts of soil carbon are observed in the ancient glacial lakebeds of northwestern Minnesota.[50]

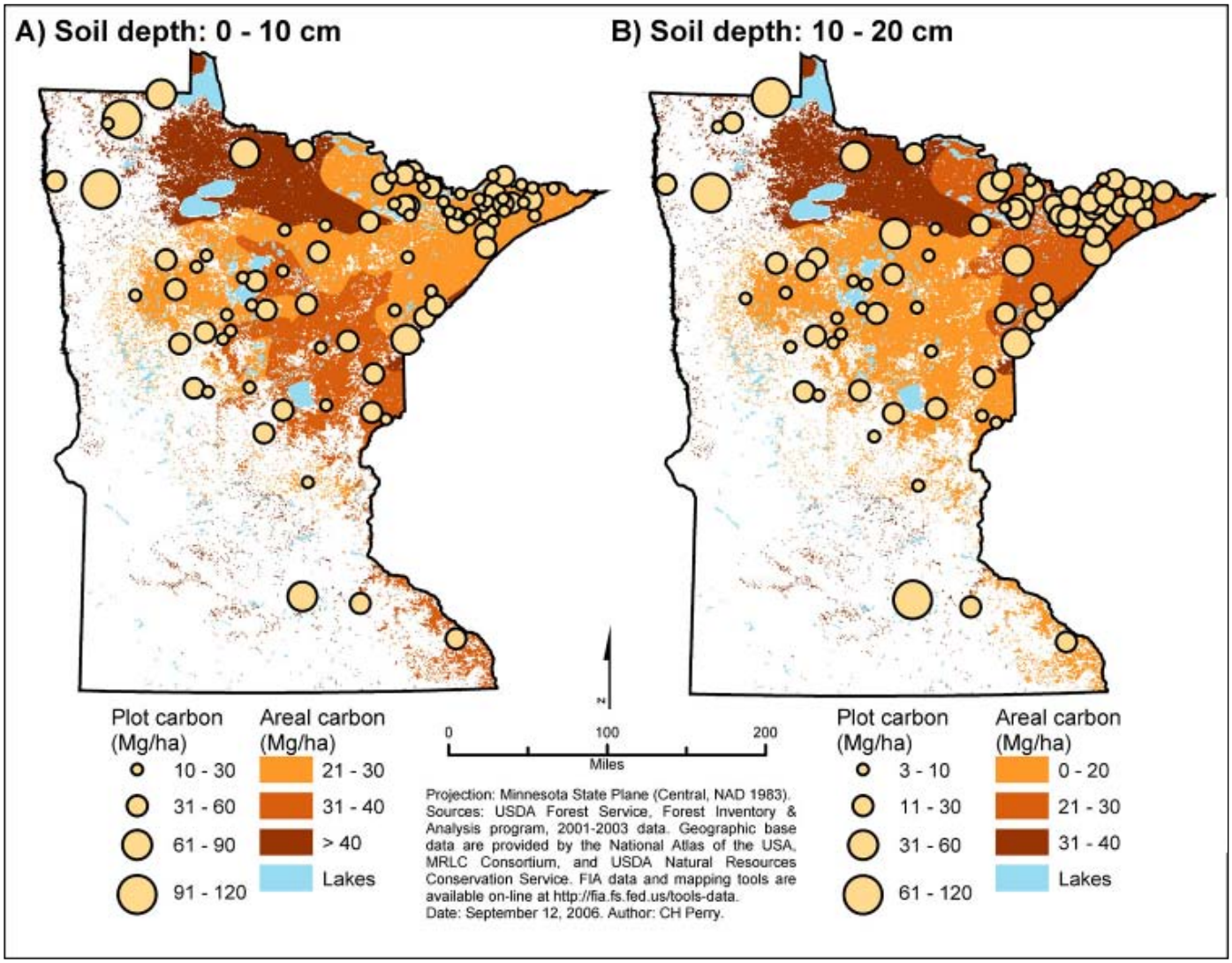
• Figure 47. State Soil Order



FIA

[50] FIA

• Figure 48. FIA Soil Carbon Sequestration



FIA

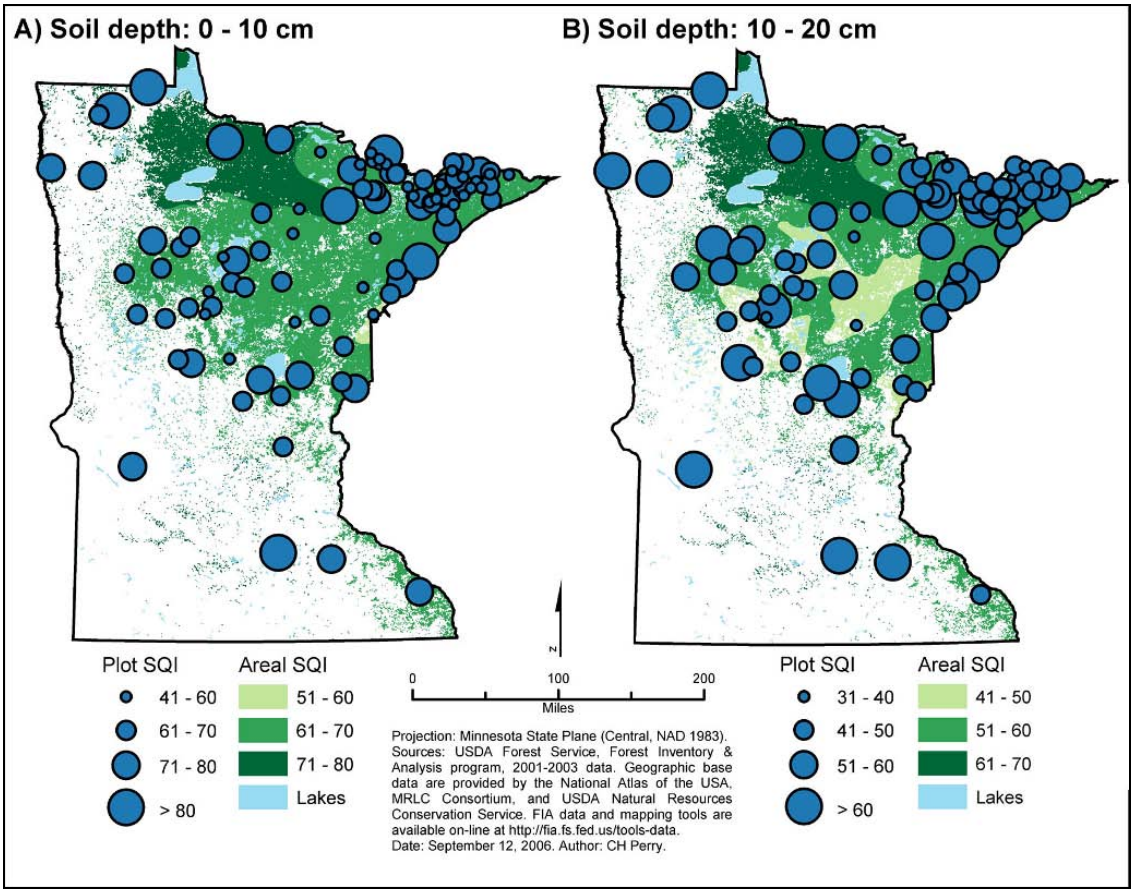
The above (Figure 48) shows soil carbon sequestration as observed on FIA plots in Minnesota and averaged across Major Land Resource Areas from 2001-2003

Indicator 28: Estimated Bare Soil

NRCS Soil Survey Geographic (SSURGO) data is being created through USDA but is not available for this assessment at this time. FIA field data are recorded on plots and reviewed in five year increments. As this is a new endeavor, there is not enough data to predict trends at this time. Figure 49 below represents soil quality index values for FIA plots in Minnesota and averaged across Major Land Resource Areas from 2001-2003. [51]

[51] FIA

• Figure 49. Soil Quality by FIA Plots



FIA

Indicator 29: Bulk Density

The state is concerned about the status of soil bulk density in forestlands especially related to timber harvesting practices and urban development. In the 1980's some individual projects were undertaken by the University of Minnesota to collect bulk density data on biomass harvest research sites. However, no concerted monitoring programs or data currently exists regarding this indicator. The state would like to pursue data monitoring but is unable to at this moment, due to a lack of funding.

Indicator 30: Calcium/Aluminum Ration

The state is aware of the need to monitor calcium/aluminum ratios to see if any climatic changes are precipitating more acidic soils in the state, which would affect forest cover types and have wide ranging consequences for the future of forestlands in the state. No trend data is available at this time, but the state would like to pursue data monitoring if funds become available.

Indicator 31: Riparian Buffers

Riparian buffers are vegetated areas next to water resources that protect these water resources from non-point source pollution, provide bank stabilization and stabilize habitat for aquatic and wildlife species. Riparian zones help to prevent sediment, nitrogen, phosphorous, pesticides and other pollutants from reaching a stream or other water body. They also slow floodwaters and runoff, which in turn capture sediments and prevent these from entering into stream or water bodies. Riparian vegetation such as cottonwoods, willows and sedges

provide a major source of energy and nutrients for stream communities through woody debris and leaf litter. Riparian habitat is important for several species including woodcocks, who require moist soils for food foraging. Early successional habitat can be regenerated in riparian areas using proper harvesting techniques at appropriate times of the year.[52]

Overhanging tree canopies help to cool water, which is especially important for some aquatic species such as brook trout and mollusks. These species benefit and depend on healthy upland forests and riparian zones to filter pollutants and provide energy inputs.[53] In addition to providing food and shelter for wildlife, riparian buffers act as important travel corridors for a variety of wildlife and migratory birds.

Minnesota boasts an extensive system of drainage patterns especially related to forested wetlands, peatlands (the state has the most amount of peatland acreage in the continental US), and the forested/agricultural interface of riparian buffer strips. In particular, rivers and waterways traversing grass or agriculture lands such as the Red River Valley Basin benefit tremendously by trapping soil erosion and improving water quality, when riparian buffers are protected or planted. These systems are projected to play a major role in water quality, flood damage reduction and biomass efforts in the future.[54]

The USDA, through a cooperative venture between the USFS and NRCS has recently published a technical manual entitled "*Conservation Buffers – Design Guidelines for Buffers, Corridors, and Greenways",* which provides a synthesis of diverse scientific knowledge on the planning and designing of conservation buffers into one easy-to-understand document to encourage increased protection, restoration and enhancement of riparian buffers along waterways. There is increasing awareness of the need to encourage riparian plantings especially within the forest – grasslands transitions zones, and providing a resource such as this guideline manual is one step towards increasing conservation values along riparian corridor systems.

For further details see www.bufferguidelines.net

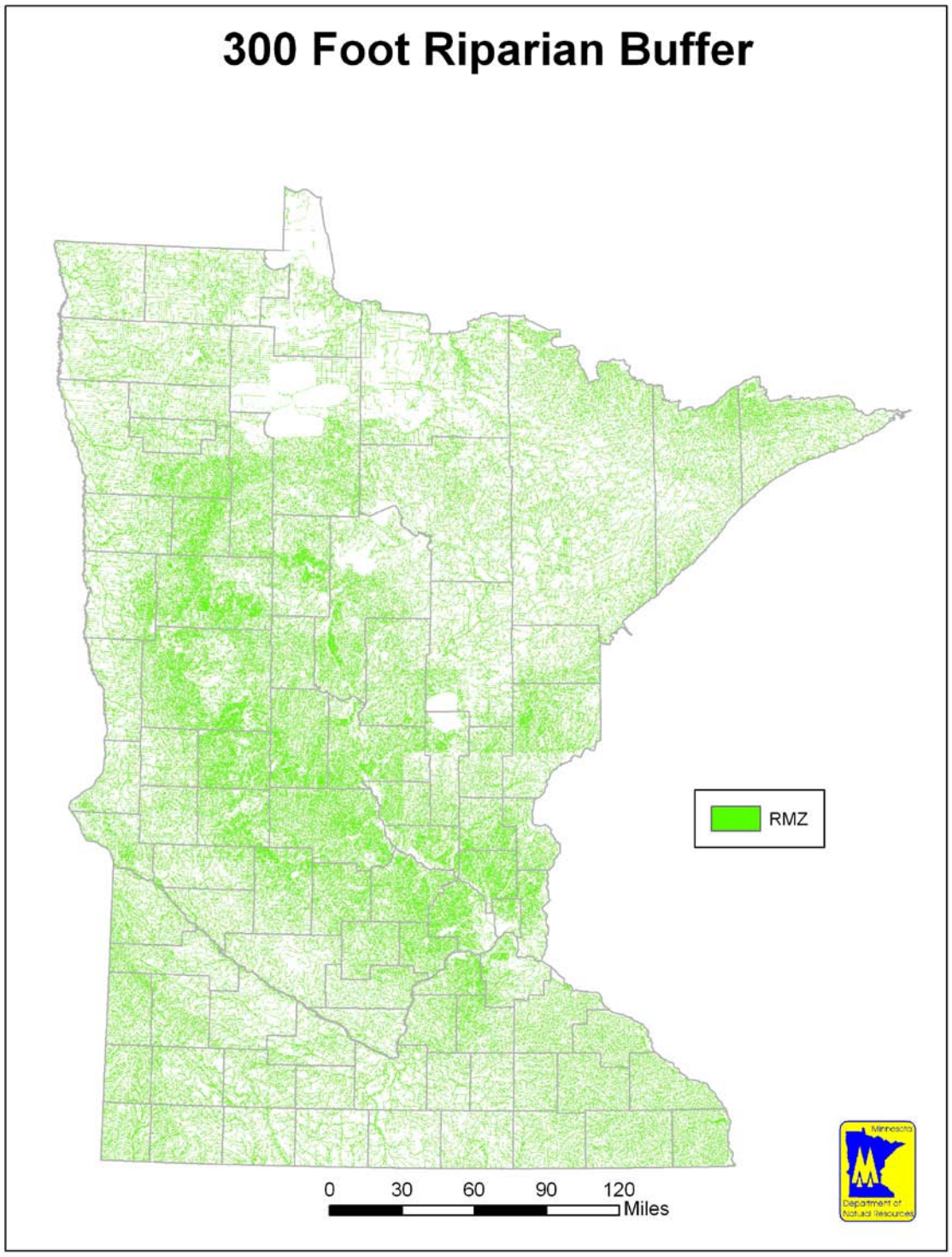
Riparian management zones (RZMs) are areas of special concern for the state of Minnesota in relation to water quality, timber harvest and wildlife habitat protection. The state is encouraging the protection of riparian functions and values, by minimizing the potential adverse impacts of forest management through the encouragement of riparian management zones. The "*Sustaining Minnesota Forest Resources Voluntary Site-Level Forest Management Guidelines"*[55] was developed for the public and private landowners who own or manage riparian corridors on their property. Guidelines lay out specifics in both text and diagram forms protection examples of riparian zones in relation to timber harvest and other management objectives. A variable buffer width of 50 - 200 feet is recommended with an emphasis on protection and restoration of native vegetation. (Figure 50). Updated guidelines for riparian management zones will be revised in the near future based on recommendations from the MFRC Riparian Science Technical Committee report.

For further details see www.frc.state.mn.us/Fmgdline/Guidelines.html).

As this is a new venture and there is not enough long-term information to predict trends, the following map represents a baseline for this indicator.

[52] USFWS
[53] USFWS
[54] Michael Carroll - DNR Regional Director. December 2009
[55] MFRC

•Figure 50. State and Private Forestry Project



MNDNR

Criterion 5: Maintenance of Forest Contributions to Global Carbon Cycles

Carbon-containing gases in the atmosphere along with water vapor, nitrous oxide, and ozone are strongly implicated as potential sources of climate change. Carbon dioxide, methane, and nitrous oxide increases have changed the composition of our atmosphere. Carbon dioxide concentration alone has increased since the 18th century and other 'greenhouse' gases are expected to warm the earth by allowing sunlight to reach the earth's surface while blocking heat from escaping. Some of these gases also thin the ozone layer that shields the earth from harmful solar radiation.[56]

Growing forests store carbon naturally in both the wood and soil in a process called carbon sequestration. Trees are about 50 percent carbon; wood products from harvested trees continue to store carbon throughout the life of the product. In general, forest activities such as tree planting, increase carbon sequestration, while activities such as prescribed burning release carbon into the atmosphere. Increasing carbon stored in urban and rural trees and forests is usually an inexpensive way to mitigate increasing atmospheric greenhouse gases but should not be viewed as the primary solution to ecosystem-wide impacts of climate change.[57]

In addition to sequestration, planting and maintaining trees in communities and especially around buildings to provide shade or block prevailing winds, can moderate temperatures and substantially reduce energy demands and related greenhouse gas emissions.[58]

This criterion ties to the national theme of *Enhancing Public Benefits From Trees and Forests.*

Indicator 32: Acres of Forest Land

As concerns about climate change grow, and as Minnesota develops policies to reduce greenhouse gas emissions, the potential of forests and the forest products industry to contribute to these reductions has attracted increased attention. Forests sequester and release vast amounts of carbon through both natural processes and human activities. Land use policies, forest management strategies, wildfire control, and the use of wood in long-lived forest products (such as houses and furniture) can preserve and enhance the carbon storage capacity of forests while also strengthening the role of the forest products industry in mitigating the effects of climate change.

Minnesota is fortunate to have approximately one-third of its land cover be forested. The state also has the most extensive acreage in peat lands in the lower 48 states. Many of these peat lands are forested and are excellent carbon sinks. In 2008, the Governor's Minnesota Climate Change Advisory Group (MCCAG) recognized the importance of forests in greenhouse gas reduction by suggesting that 30% of the state's 2025 greenhouse gas emission reduction goals could be achieved through forest management. This prompted the University of Minnesota Terrestrial Carbon Sequestration Initiative, to publish a paper on the *"Potential for Terrestrial Carbon Sequestration in Minnesota"*[59]*,* which lays out scenarios for capturing carbon both in forests and peat lands.

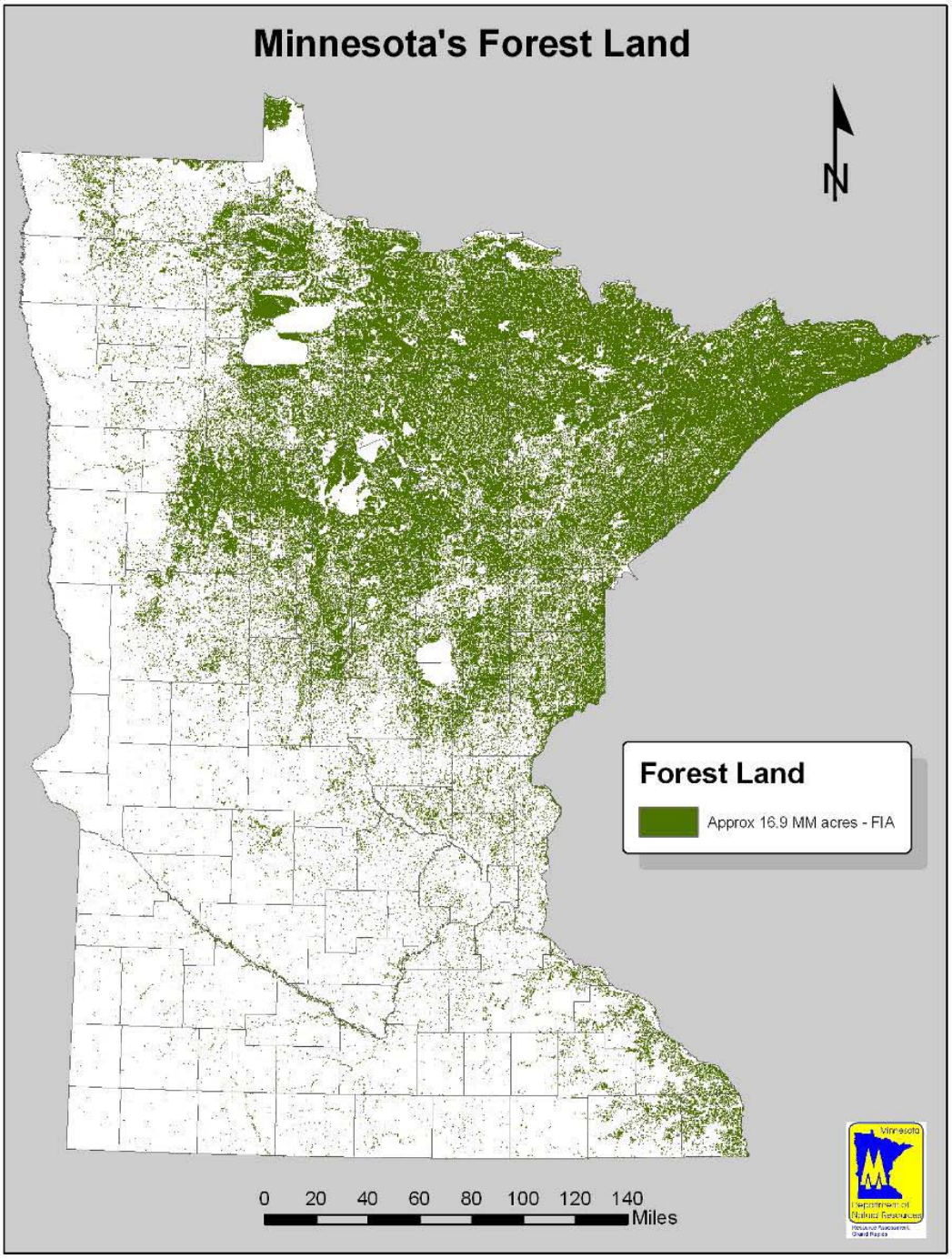
The University of Minnesota's Center for Integrated Natural Resources and Agricultural Management has also produced a Landowners Guide to Carbon Sequestration Credits which is available through www.cinram.umn.edu/index.html

Carbon sequestration is garnering considerable attention in Minnesota and the state has joined eight other mid-west states and Manitoba, Canada in signing the Midwest Greenhouse Gas Reduction Accord.

Further information can be seen at www.bwsr.state.mn.us/publications/Carbon-seq.pdf

[56] NAASF – Suggested Framework for Statewide Forest Resource Assessments. November 2008
[57] USFWS
[58] NAASF – Suggested Framework for Statewide Forest Resource Assessments. November 2008
[59] Details at: wrc.umn.edu/outreach/carbon/pdfs/andersonetal2008.pdf

• Figure 51. Current Forest Lands



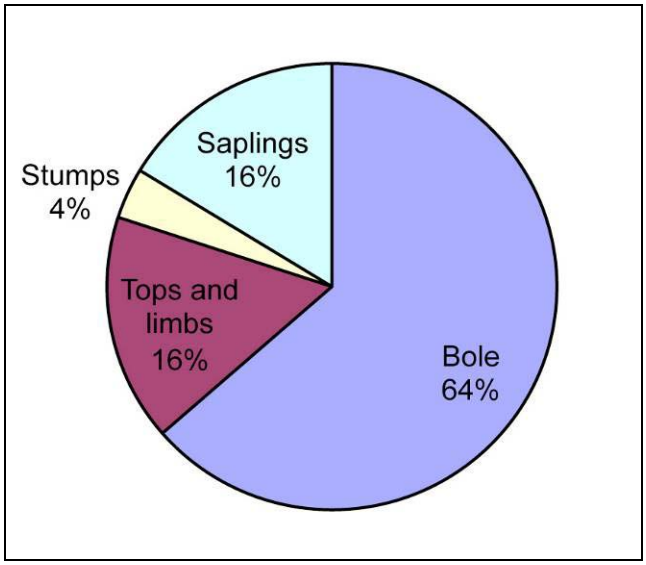
MN DNR

At this time it is too early to predict carbon sequestration trends as research and information related to climate change is on-going. The map above (Figure 51), serves as a baseline for future potential carbon sequestration sites.

Indicator 33: Forest Ecosystem Biomass

Biomass from the live aboveground portions of trees was estimated at 421 million dry tons in 2007 (an average of 27 dry tons per acre) on all Minnesota timberlands. (Figure 52). Biomass estimates are increasing in importance for analyses on carbon sequestration, wood fiber availability for fuel, and other issues. In 2007, 71% of the total biomass was in growing-stock trees 5 inches and larger, an additional 16% was in trees less than 5 inches DBH and the remaining 12% was in non growing-stock trees. Three-quarters of the total biomass was composed of hardwood species. Although total biomass was almost evenly split on private (216 million dry tons) and public (204 million dry tons) timberland, softwoods made up 34% of the total biomass on public lands, but only 14% on private lands.

- Figure 52. Percentage of Above Ground Biomass by Tree Component- 2008



FIA

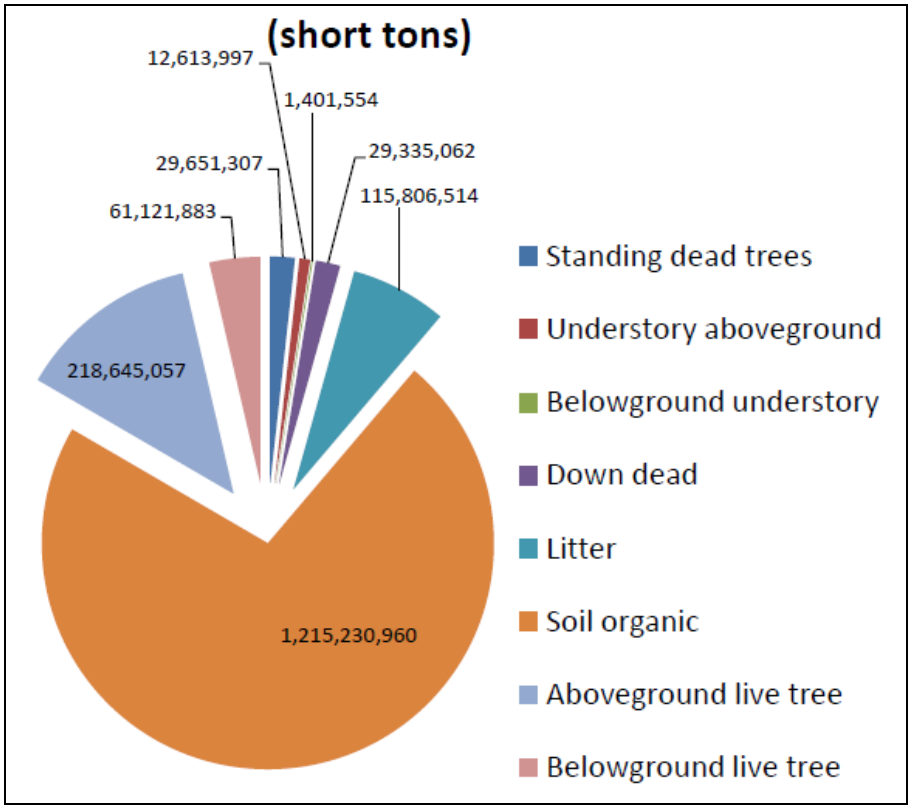
Indicator 34: Forest Carbon Pools

Minnesota has approximately 16.7 million acres of forest land and nearly 6 million acres of peat lands (including bogs, marshes, fens and other wetlands). These lands contain very large carbon stocks in standing plant biomass (1.7 billion metric tons) and peat (4.25 billion metric tons) respectively. Forest land averages about 105 metric tons of carbon per acre, while a single acre of peat land contains 750 metric tons of carbon. Total emission of the carbon contained in 1,000 acres of peat land would increase Minnesota's $C0^2$ emissions by almost 2%.

Forest land carbon is more susceptible to loss by fire, invasive pests or disease, or land use conversion than is peat land carbon. Reasonable changes in land use or cover and forest management could increase carbon capture 2- 4 % or 3-6 million metric tons of $C0^2$ per year. Much of this reduction is achievable on public lands.

Soils are by far the largest reservoir of carbon in forests, accounting for 72% of forest carbon. Live vegetation (above and belowground vegetation) accounts for about 17% of forest carbon while dead materials (standing and down dead, litter) account for about 10%. (Figure 53).

• Figure 53. Carbon in Forest Pools in Minnesota



FIA

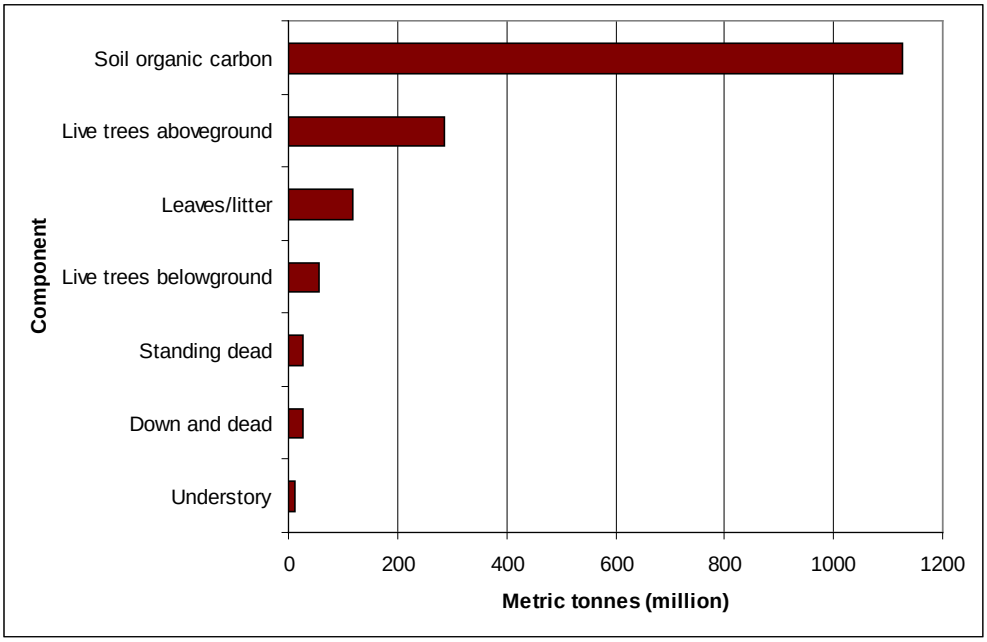
Concern over global climate change has focused attention on the capacity of forests to act as carbon sinks. The introduction of markets for trading in carbon credits will result in a different mix of forest management practices and additional requests for information on forest carbon stocks.

The FIA program does not directly measure forest carbon stock. Instead, a combination of empirically derived carbon estimates (for stocks that are directly measured, such as standing live tree carbon) and models (based on forest attributes, such as forest type and stand age in the case of the leaf/litter carbon) are used in combination to estimate Minnesota's total forest carbon stock. The standard units for carbon stock reporting are metric. Estimation procedures are detailed by Smith et al. 2006.[60]

There are 1.7 billion metric tonnes of forest carbon in Minnesota. This is equivalent to all the carbon emitted in the form of CO^2 in the United States in the year 2006. Soil organic carbon and live tree aboveground carbon were the largest components of the total forest carbon stock in Minnesota (Figure 54). On a per-acre basis, soil organic carbon was highest on the least productive sites (many of the least productive sites in Minnesota are on peat lands) while live tree above ground carbon was highest on the most productive sites (Figure 55). Carbon sequestration tended to increase with increasing stand age (Figure 56).

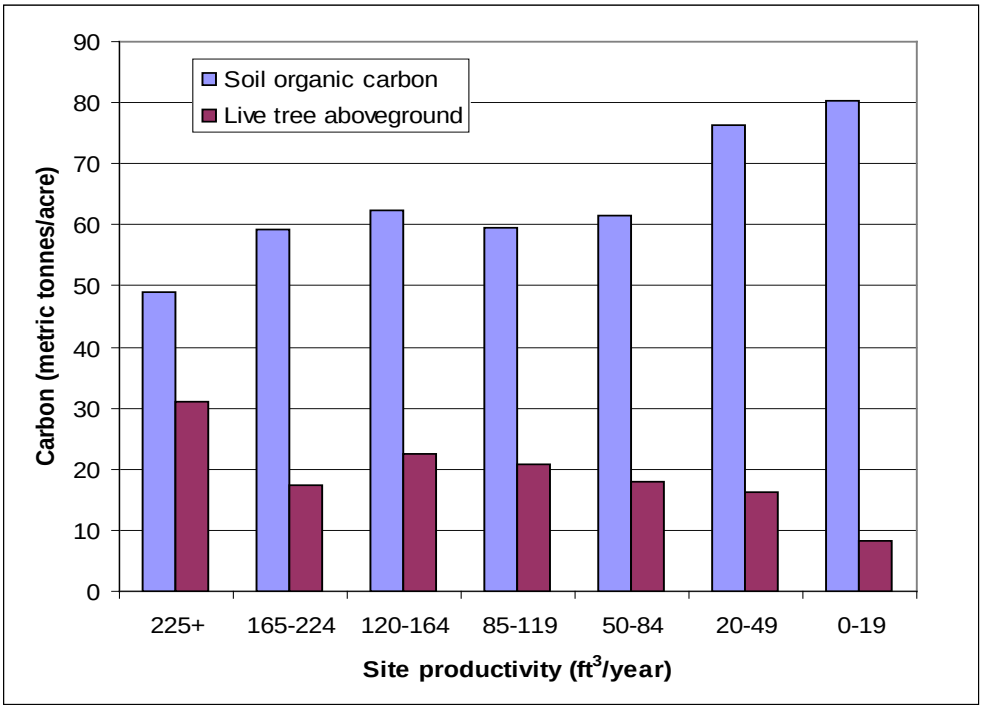
[60] FIA

• Figure 54. Carbon Stocks on Forest Land by Component in Minnesota, 2002-2006.



FIA

• Figure 55. Soil Organic Carbon and Above Ground Live Tree Carbon on Forest Land by Forest Productivity Class in Minnesota, 2002-2006.



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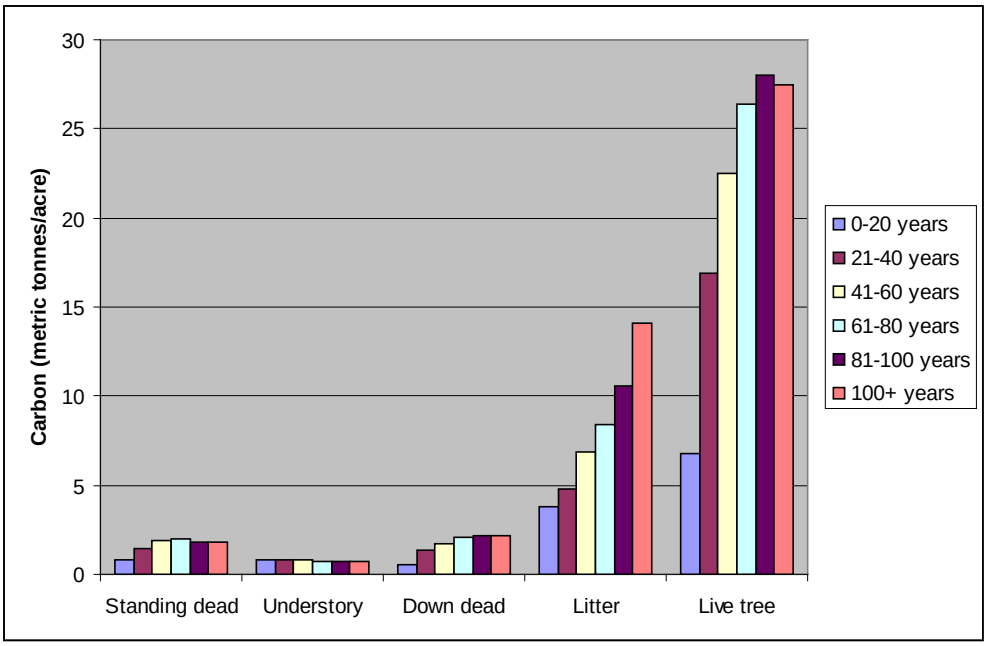
The soil organic carbon is mostly concentrated in peat lands and black spruce bogs. This data is based on forest type but as there is no continuous data being measured at this time, no trends can be predicted at this time.

• Figure 56. Carbon Stocks Per Acre of Forest Land by Selected Component and Stand-age Class, Minnesota, 2002-2006

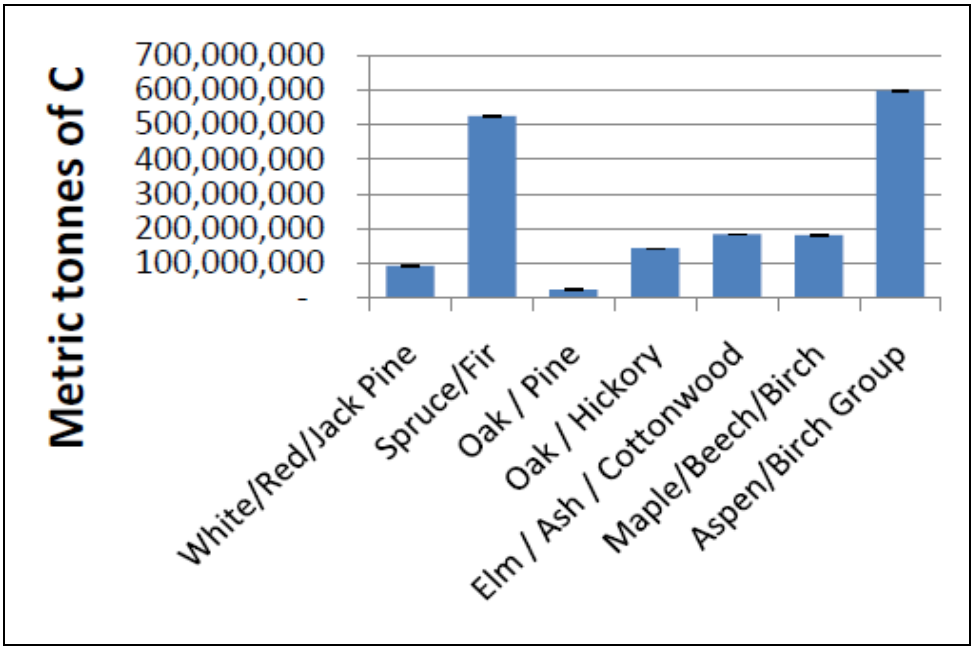


Source: Smith, J.E.; Heath, L.S.; Skog, K.E.; Birdsey, R.A. 2006. *Methods for calculating forest ecosystem and harvested carbon with standard estimates for forest types of the United States.* Gen. Tech. Rep. NE-343. Newtown Square, PA: USDA- Forest Service, Northeastern Research Station. 216 p.

Indicator 35: Forest Carbon by Forest Type

The carbon content of Minnesota forests reflects both the amount of each type of forest land and variation in carbon density among forest types. Spruce-fir forests contain more carbon per acre than do aspen-birch forests. Spruce-fir forests contain about 30% of all forest carbon but comprise only 23% of the forest land in the state. In contrast, aspen-birch forests, the most abundant forest type in Minnesota at 38% of the forest land, account for only 34% of all forest carbon. Elm-ash-cottonwood and maple-beech-birch forests are the most carbon dense forests in Minnesota but together account for only 21% of all forest carbon.

- Figure 57. Total Forest Carbon



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Criterion 6: Maintenance and Enhancement of Long-Term Multiple Socio-economic Benefits to Meet the Needs of Societies

This criterion addresses economic values people place on trees and forests for meeting their forest products, recreational, cultural, social, psychological, and spiritual needs. Many people depend on forests for their livelihood and/or for their personal physical and mental well-being. Forests in urban and rural areas contribute significantly to many communities economic bases. In addition, urban and community trees and forests provide cooling, storm water reduction, and other benefits. Tracking these values, as well as monitoring shifts in demands for products and services, provides useful insights for the future. Changes can indicate potential drains on the forest resource or highlight management opportunities.

Forests produce a multitude of goods and services-everything from timber and mushrooms to recreation and water. Sustainable forestry requires diverse, strong markets for a wide variety of products. Market forces are often the dominant influence on resource-based goods and services, but nonmarket forces-such as the desire to sustain biological diversity or the opportunity to dwell in or visit a natural place-are also important factors influencing investments in goods and services. Most forests can provide multiple goods and services simultaneously. However, there will always be situations where multiple activities and desired uses are incompatible.[61]

This criterion ties to the national theme of *Enhancing Public Benefits From Trees and Forests.*

[61] NAASF – Suggested Framework for Statewide Forest Resource Assessments. November 2008

Indicator 36: Production of Roundwood

In Minnesota, trees and forests are critical to the state's economy and environmental protection. The forest industry produced over $6 billion in forest products sales in 2008 and still remains the fourth largest manufacturing sector in the state.

Recent roundwood timber production peaked in 2005 at 3.7 million cords. (Table 8). Harvest levels in 2006 were down over 500,000 cords. Recent figures for 2008 indicate 2.8 million cords which show more downward movement. It is also clear from mill shutdown announcements that the downward trend has continued.

- Table 8. Roundwood Production

Year	Pulpwood	Sawlogs & Others	Fuel/Residential*	Fuel/Commercial	TOTAL
2001	2,754.9	605.4	186.1	12.9	3,563.2
2002	2,906.8	605.4	150.2	12.9	3,675.3
2003	2,829.7	605.4	150.2	12.9	3,598.2
2004	2,875.6	544.3	150.2	12.9	3,583.0
2005	3,019.8	544.3	150.2	12.9	3,727.2
2006	2,441.9	544.3	150.2	12.9	3,149.3

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Indicator 37: Production and Consumption of Roundwood Equivalent

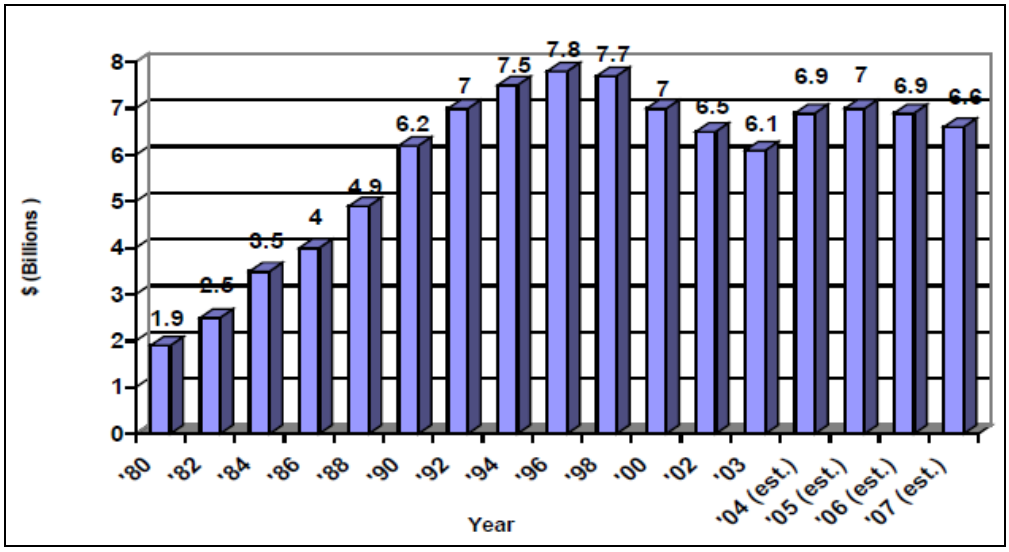
The main tool for accomplishing sustainable forest management in Minnesota is commercial timber harvest. (Figure 58). For this reason, it is important to carefully track production and consumption of roundwood and to maintain strong and diverse markets for forest products. A recent study of all-ownership sustainable timber yields across all ownerships indicates that there is a significant surplus in available roundwood compared to current harvest levels.

The annual volume of timber harvested in Minnesota has declined in recent years due to factors such as reduced demand for housing construction and other forest wood products in a down-turned economy. Recent mill curtailments and shutdowns have also resulted in significant reductions in production and consumption of roundwood. It is likely that this trend will continue for the near future.

Minnesota is still a net importer of raw wood but this has also declined since 2006. The most current annual volume of timber harvested is indicated below.

- pulpwood = 2.44 million cords (2006)
- sawlogs & specialty = 272 million board feet (2004). Included in this total are specialty items:
  -veneer = 8.0 million board feet (domestic) = .9 million board feet (exported)
  -chips = 8,000 cords (fuel & mulch)
  -shavings = 11,000 cords (animal bedding)
  -posts & poles = 12,000 cords
- fuelwood = 149,000 cords live trees from timberland. (2002-03)

- Figure 58. Value of Forest Products Manufactured in Minnesota



USFS and DNR mill surveys & residential fuelwood survey

Indicator 38: Trends in Forest Products Manufacturing Sector

The annual economic impact of the forest products manufacturing sector in 2008 was as follows:

- value of forest products manufacturing shipments 2007: $6.02-7.2 billion (estimated)[62]
- 4th largest manufacturing industry in Minnesota based on employment (#1 computer & electronic equipment, # 2 fabricated metal products, #3 food manufacturing)[63]
- generates 11% of dollars of all manufacturing shipments[64]
- value-added impact attributable to Minnesota timber = $41.60 per dollar of timber sold, and $4.3 billion dollars total that stays in Minnesota[65]

In 2008, employment figures can be described as follows. (This also includes non-traditional forest products).

- 37,850 employees (primary processing [including logging] = approximately 17,440; secondary manufacturing = approximately 20,410).[66]Indicators suggest a 9% decrease in 2008 employment.
- $1.6 billion in wages paid[67] - indicators suggest an estimated 16% decrease in 2008.[68]
- important industries include: pulp & paper, oriented strand board (OSB), cabinets and cabinet parts, window & door components (MN # 2 in U.S.), store fixtures, office & residential furniture, pallets, crating & pallet parts, millwork, wood shavings (for poultry industry).
- non-traditional industries dependent on forestry: balsam boughs for wreath industry (annual sales of $23 million+), wood "flour" energy for taconite industry, 6 co-generation facilities utilizing wood for energy production.

Industry statistics for 2008 can be described as follows:

- 5 pulp and paper mills
- 3 recycled pulp & paper
- 3 hardboard & specialty

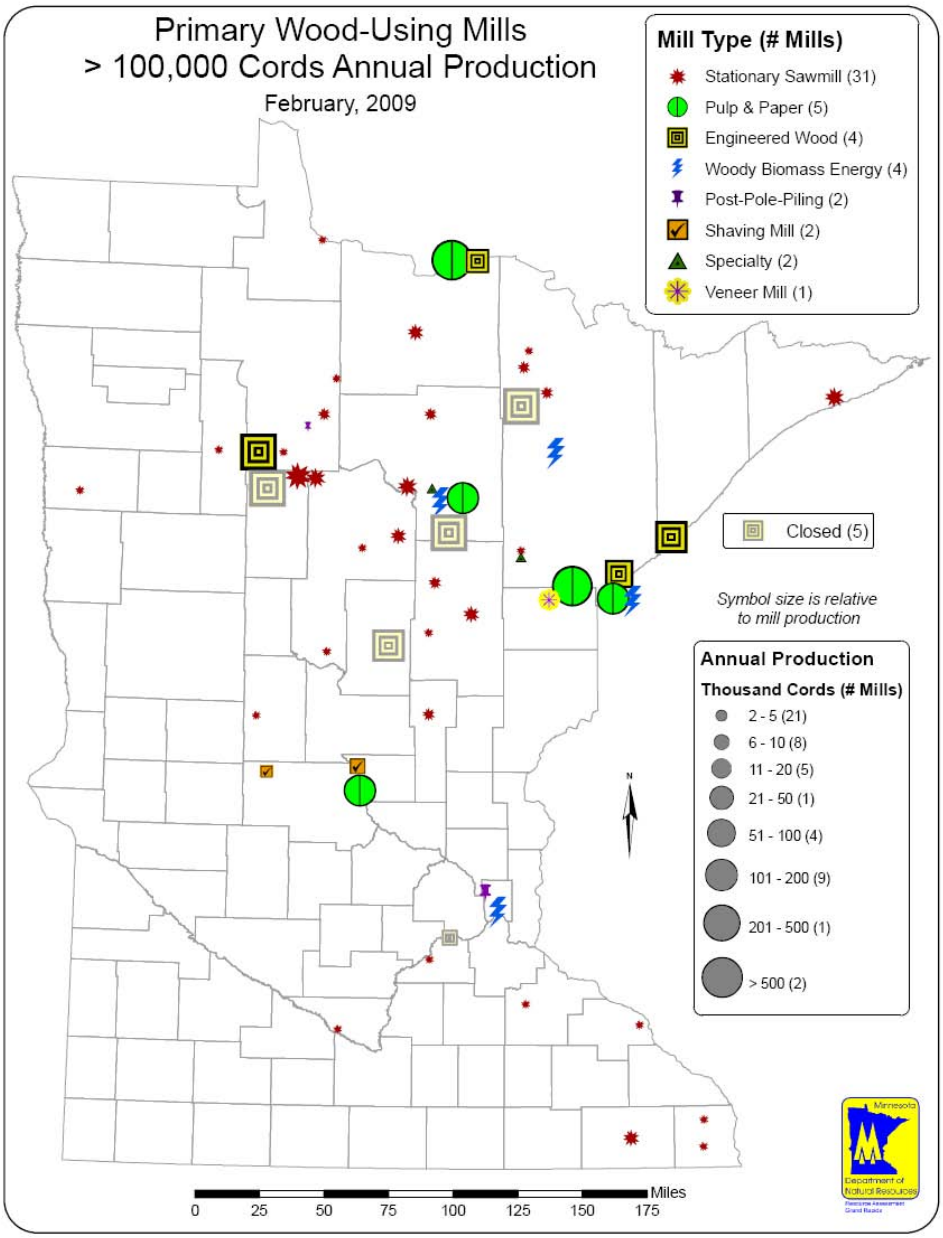
[62] MN Forest Industries estimates based on 2007 data
[63] MN Department of Employment & Economic Development analysis
[64] MN Department of Employment & Economic Development analysis
[65] MN Department of Employment & Economic Development analysis
[66] MN Forest Industries estimates based on 2007 data
[67] MN Forest Industries estimates based on 2007 data
[68] MN Department of Employment & Economic Development analysis

- 2 oriented strand/structural board
- 500+ sawmills
- 150 associated specialty businesses
- over 800 secondary manufacturers

Mill Locations

Location of mills is an important factor in determining markets for wood. Figure 59 below, shows the pulp & paper, OSB, recycled fiber, hardboard, sheathing and large sawmills in Minnesota in 2008. These mills utilize various species of wood material, with aspen pulpwood being by far the largest component.

- Figure 59 Mill Locations



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Mill Closures and Shutdowns

In September 2008, Ainsworth's Grand Rapids Oriented Strand Board (OSB) mill announced a permanent closure. The mill has not been operational since September 2006. In January 2009, Ainsworth announced two other major mill closures in Bemidji and Cook. Harvest levels in 2006 were down over 500,000 cords from 2005 harvest levels. These and other slowdowns and curtailments continue to have a large impact on timber markets in Minnesota. It is likely that this trend will continue for the near future, thus requiring a need for additional utilization and management of Minnesota's forest resources. (Table 9).

• Table 9. Recently Closed Mills

Mill	Location	Primary Product	Status	Date of Shutdown
Trus Joist	Deerwood	Oriented Strand Lumber	Indefinite Shutdown	2007
Ainsworth	Grand Rapids	Oriented Strand Board	Closed	2008
Certaindeed	Shakopee	Roofing Felt	Indefinite Shutdown	2008
Ainsworth	Bemidji	Oriented Strand Board	Closed	2009
Ainsworth	Cook	Oriented Strand Board	Closed	2009

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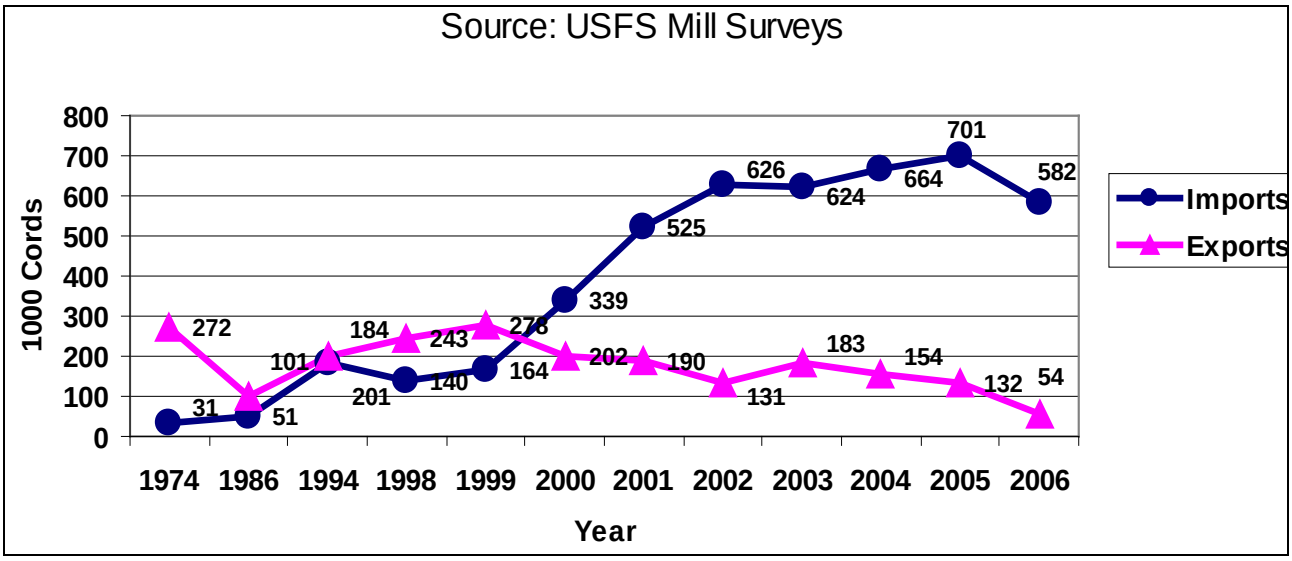
Indicator 39: Timber Imports/Exports

Timber imports of pulpwood into Minnesota as well as exports out of the state saw declines in 2006-08. This change has been due to several factors, most notably reduced demand from mill closures and slowdowns. Minnesota is still a net importer of raw wood as of December 2008, but by a greatly reduced margin. It is likely that this downward trend will continue in the near future. However, it is not currently possible to predict future imports and exports, as these are a function of supply and demand, which could change radically due to closure or re-opening of a number of mills. (Figure 60).

• Figure 60. Imports and Exports of Pulpwood Roundwood



Indicator 40: Forest Conservation Easements

Minnesota has an urgent window of opportunity to conserve healthy working forests and the ecological, social, and economic benefits that they provide. Traditionally, timber companies owned and managed lands for a century or more and were committed to stewardship. Now, the shifting economics of the forest products industry and escalating real estate prices have forced unprecedented changes in forest land ownership.

- From 1980 to 2000, housing density in the state increased 605 % for seasonal homes.
- Forest land prices increased an average of 13 % per year between 1989 and 2003. This increases the likelihood of parcelization and decreases the purchasing power of land protection efforts.
- Since 1999, more than 400,000 acres or 30% of Minnesota's industrial forest land have been sold. Much of this land is being subdivided and developed. These losses are permanent.
- Forest land is now far more valuable as a short-term source of timber to industrial owners. The new owners of many large forest tracts, REITs and TIMOs value forest lands not only for their ability to supply forest products, but also for their investment potential through real estate development and other options.[69]
- As of 2008, another 120,000 acres have been identified as potentially up for sale.
- One million acres of Minnesota industrial forest land are at risk.

In 2006, the Minnesota state legislature appropriated $7 million for forest conservation easements that protected over 51,000 acres from development. This initial funding is significant but only the beginning of a long-term effort to conserve roughly half of the 1 million acres of industrial forest land at risk.

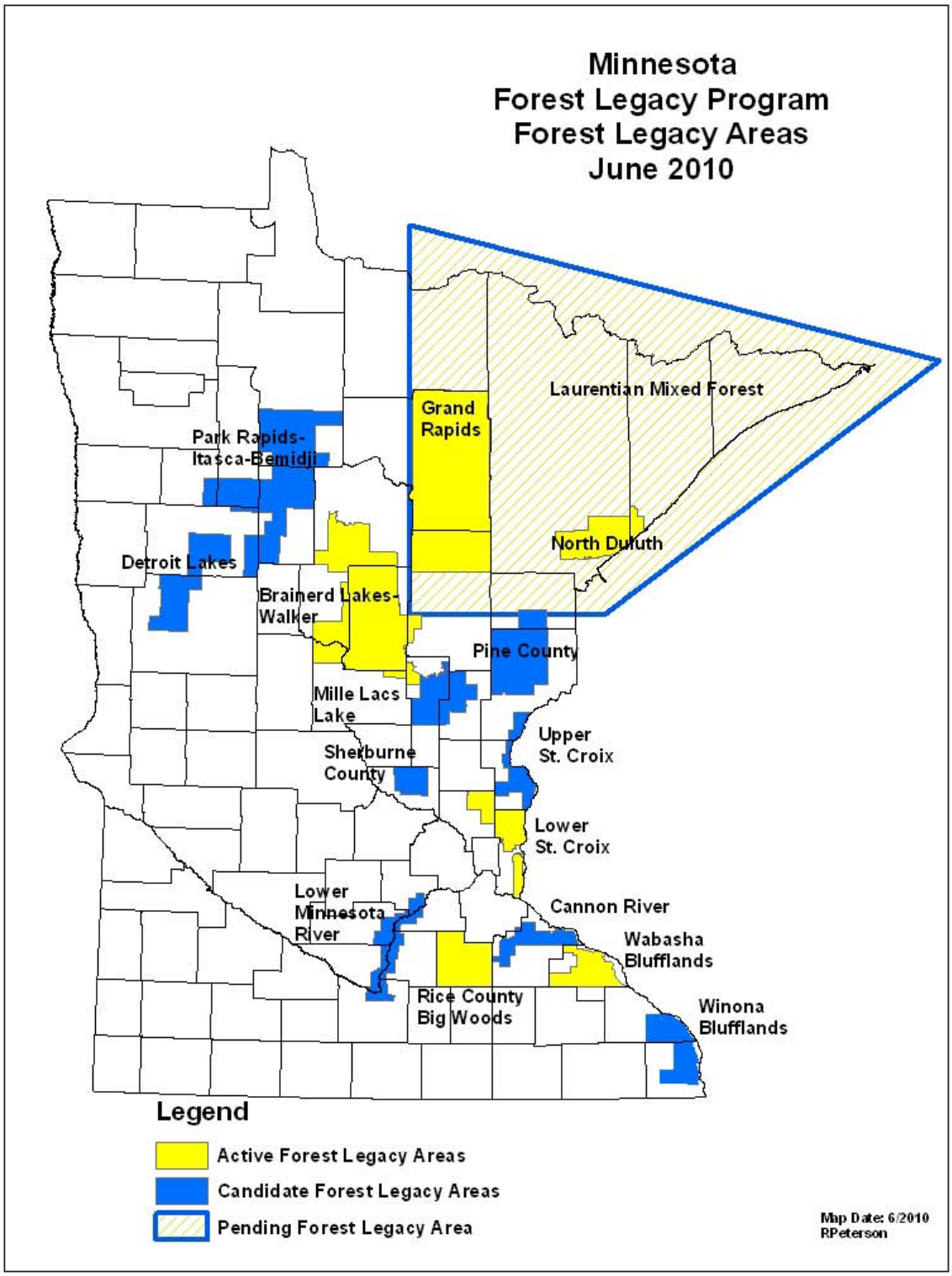
Opportunity exists in the state to explore using conservation easements on approximately 1 million acres. (Figure 61). The long-term 25-year target for DNR is to protect up to 530,000 acres (500,000 acres in the Laurentian Mixed Forest; 30,000 acres in the Eastern Broadleaf Forest). The passage of the 2008 Clean Water, Land, and Legacy Amendment by Minnesota voters provides a significant new funding source to help realize this goal.

Several other projects are pending and would protect an additional 264,000 acres with conservation easements to provide public access, prevent development, and allow sustainable timber management. Funding for these projects is from a combination of private, federal and state money.

Note: For discussion on the Forests for the Future Assessment of Need (AON), please see Strategies (Part 2) of these documents.

[69] *"Minnesota Forest For the Future Strategy Report "* available on-line at: http://www.dnr.state.mn.us/forestlegacy/index.html

- Figure 61. State Opportunity Areas for Large-scale Conservation Easements



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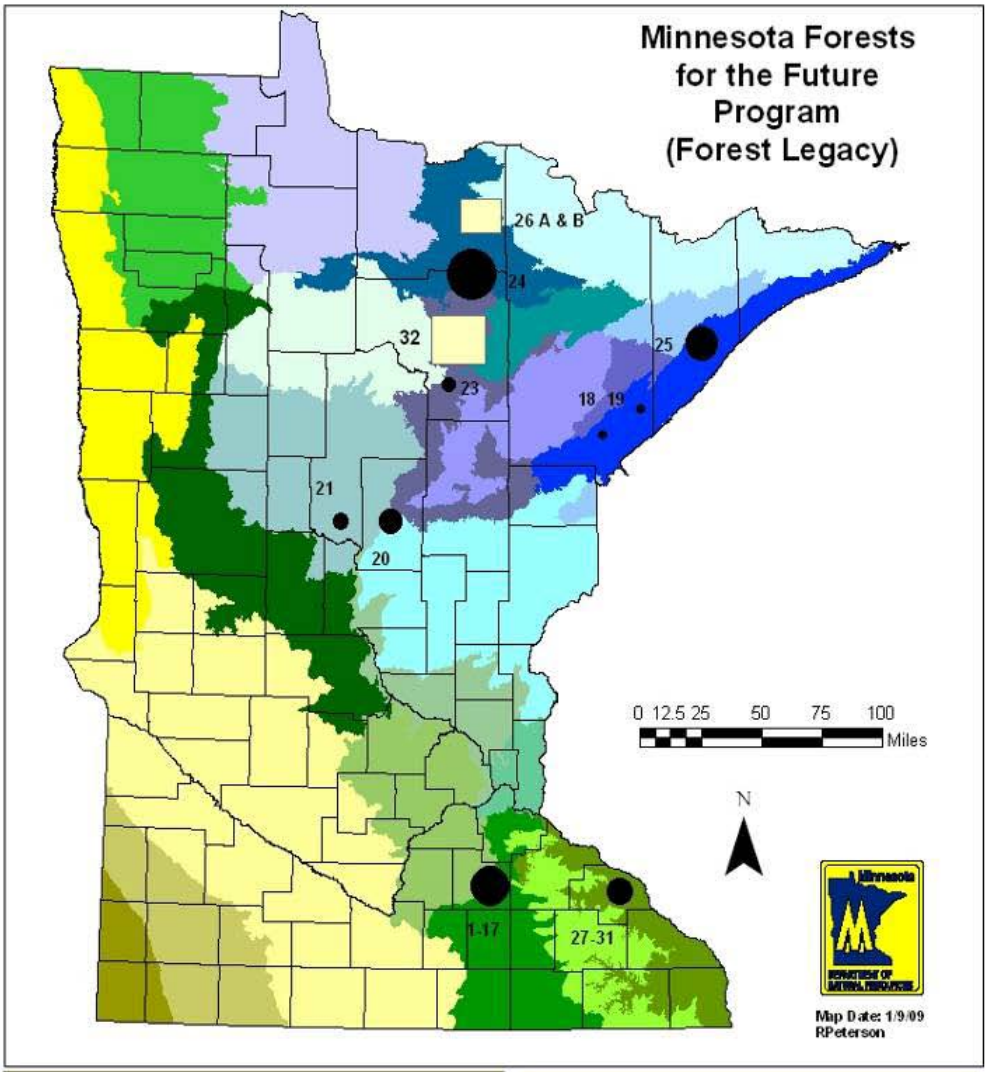
• Figure 62. Forest Legacy Program



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Note: More than $50 million in potential projects covering more than 200,000 acres are likely to develop in the next two to three years. (Figure 62).

For further information refer to the 2008 Minnesota Forests for the Future report at http://www.dnr.state.mn.us/forestlegacy/index.html

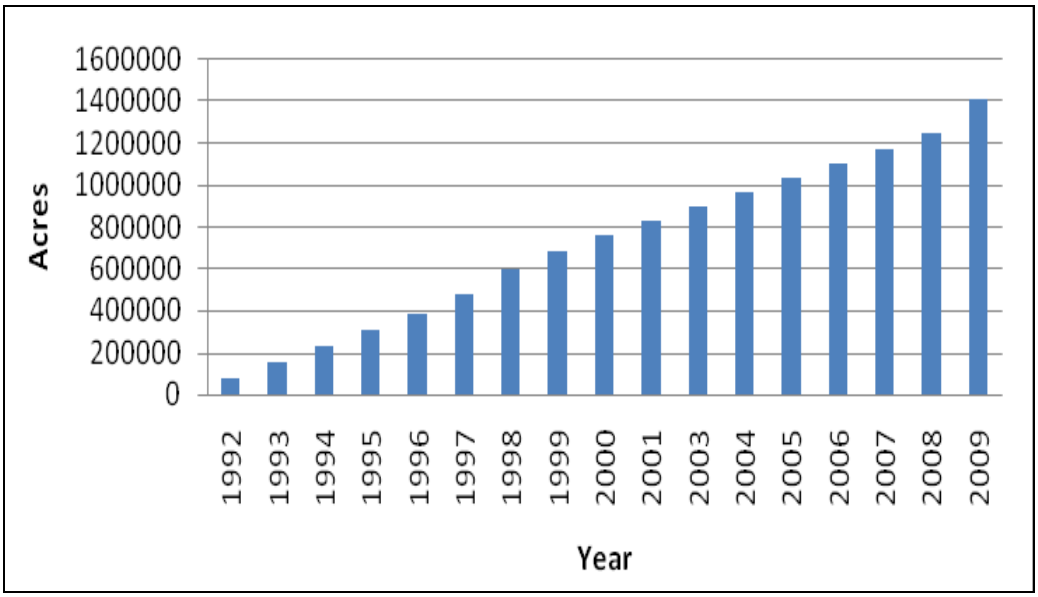
Indicator 41: Private Forest Land Management and Management Plans

Forest stewardship is the voluntary application of economic and ecological principles to the management of Non-industrial Private Forests (NIPF). The Forest Stewardship Program's (FSP), initiated in the 1990 Farm Bill purpose is to enable individual landowners to achieve personal land ownership objectives, while maintaining forest ecosystems, biological resources, and the supply of forest products for future owners and society as a whole. This program is critical in Minnesota because NIPF landowners own and manage 5.7 million acres of the state's 16.7 million acres of the state's forest lands.

The FSP is the structure to provide state, local, private and continuing federal forest management initiatives. Some initiative examples include state funded cost-share programs, Tree Farm program, America the Beautiful and local watershed initiatives.

A primary goal for the Forest Stewardship Program (FSP) is to write or revise another million acres of stewardship plans by 2015, thus raising the total acres with a stewardship plan to 2.3 million acres. In fiscal year 2008, 77,000 acres of plans were written by DNR and Private Forest Management (PFM) partner foresters and 157,889 acres were written in 2009. To date the state DNR and its FSP partners including consulting, industry and Soil and Water Conservation District (SWCD) foresters have written 1.4 million acres of stewardship plans. (Figure 63).

- Figure 63. Cumulative Acres of Stewardship Plans Written in Minnesota



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Private Lands with Stewardship Plans

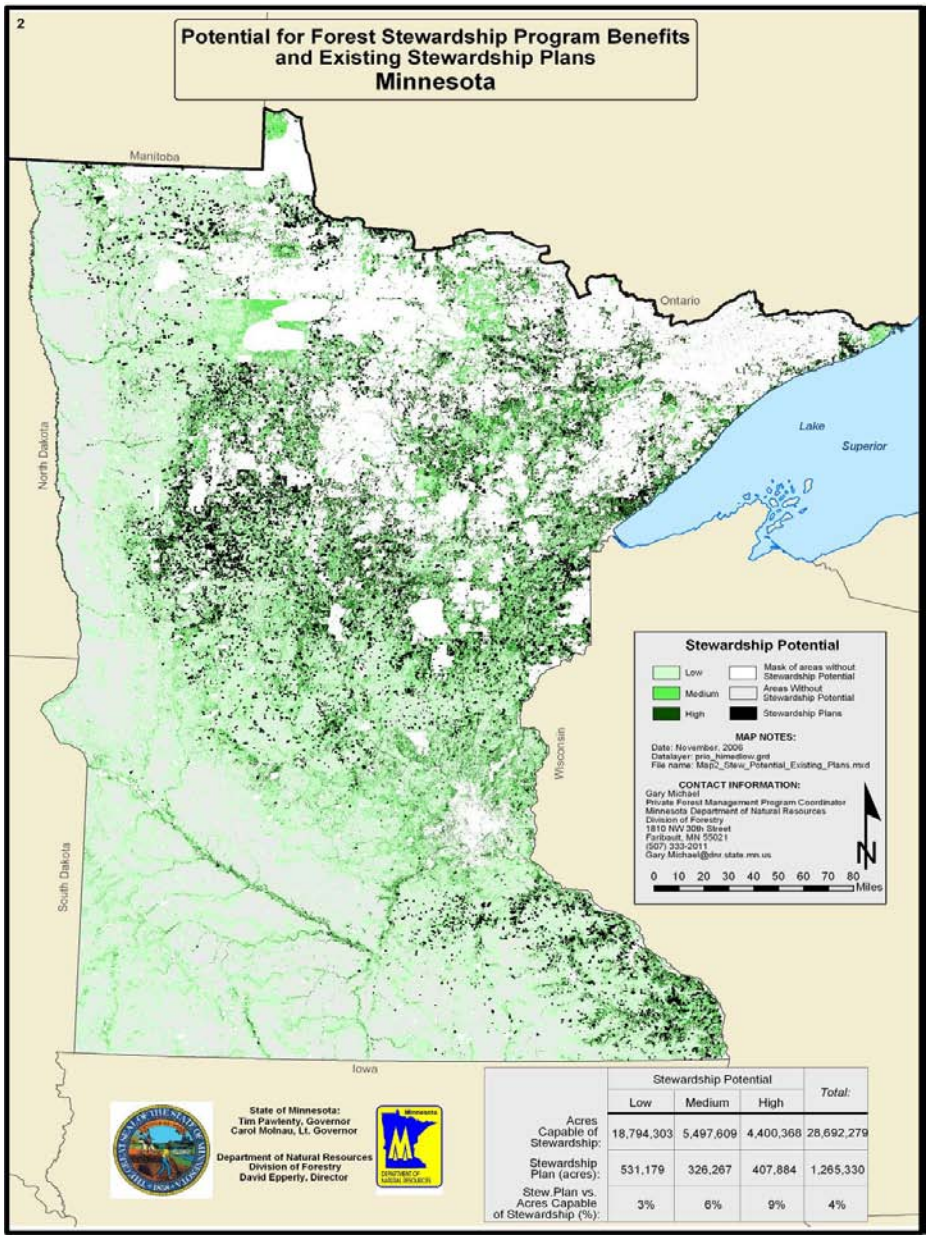
Private, non-industrial landowners including farmers, rural residents, absentee owners, and lake property owners hold some of the most valuable forest land in Minnesota and represent almost half of the state's land interest. Unlike government or industrial landowners, many lack the professional forestry expertise needed to keep their forests healthy and productive in terms of timber harvest, habitat retention, recreation or other benefits. To help keep these forests healthy, diverse and able to meet multiple goals, DNR Forestry works in conjunction with the USFS, county foresters, non-profit groups, consulting and industrial foresters, SWCD forest resource professionals and others to provide education and technical assistance to private landowners for best forest management practices.

NIPF landowners are classified as having between 20 and 5,000 acres of land, of which at least 20 acres must have the potential to grow trees or be forested in order to qualify for assistance. There are approximately 173,000 NIPF landowners in Minnesota. Of these, around 20% regularly consult professional foresters.

22% of the 173,000 NIPF landowners have a forest stewardship plan and the goal is to reach another 28% by 2015. Forest planning assistance is also beginning to encourage private forest owners to pursue third-party forest certification of their lands. Certification provides independent verification that a forest is being managed sustainably and lets consumers know that wood they purchase was produced in an environmentally sound manner. This is a new endeavor and will be monitored for future trends. (Figure 64).

In 2009, the state of Minnesota revised the FSP strategic plan for 2010-2015. The final plan can be viewed at: http://www.dnr.state.mn.us/grants/forestmgmt/stewardship.html

- Figure 64. Forest Stewardship Program Potential



	Stewardship Potential			Total:
	Low	Medium	High	
Acres Capable of Stewardship:	18,794,303	5,497,609	4,400,368	28,692,279
Stewardship Plan (acres):	531,179	326,267	407,884	1,265,330
Stew Plan vs. Acres Capable of Stewardship (%):	3%	6%	9%	4%

Indicator 42: Roads and Access

Forest roads and access routes are for the most part, originally constructed by public agencies and forest industry to access lands for forest management including timber harvesting, fire control and wildlife habitat improvement. In Minnesota, they are part of a broader network that connects remote parts of forest lands to existing township, county, state and federal roads and highways. They also serve as an important role in providing access to and through forests for recreational users such as hunters, hikers, horse riders, birders, berry pickers, etc. They are also an important component of the state's 'Off-Highway-Vehicle' (OHV) trail systems.

- **System Forest Roads** (state owned and managed) are usually well-maintained, with a gravel surface and generally capable of accommodating two-way traffic. Most of these roads are connected to state, county, or township public highways and are open to highway licensed vehicles, off-road vehicles, all-terrain vehicles, and off-highway motorcycles. System roads are maintained to accommodate low-clearance highway licensed vehicles.
- **Minimum Maintenance Roads** (state owned and managed) are forest roads that are used for forest management access on an intermittent, as needed basis. These roads are open to all motorized vehicles but not maintained to the level that low-clearance highway licensed vehicles can use them routinely. Minimum maintenance roads are generally narrow, with a surface of native material and seldom graded. A minimum maintenance road sign states, "Road may be impassable. Travel at your own risk".

There are 1,230 miles of state owned and managed system roads and 1,095 miles of minimum maintenance roads administered by the state. Many of the minimum maintenance roads are relatively primitive routes which became part of the road inventory as a result of the recently completed (Dec. 2008) OHV planning process, in order to continue to allow established patterns of motorized vehicle use on forest lands with a "limited" classification for OHV use. All other 'routes' that provide forest access are open or closed to motorized vehicle use depending upon classification in state OHV plans. This classification system was also used by select counties in conjunction with joint state and county planning efforts. However, there is no state-wide classification system or mapping completed at the county or township level at this time. This remains a need as a result of the fluid nature of OHV planning and is currently being addressed on an individual county basis.

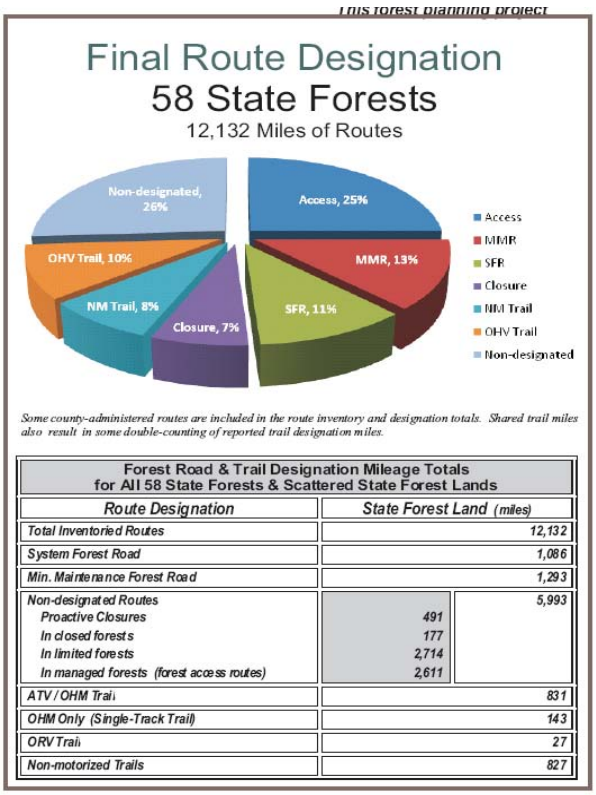
Sustainable forest roads and accesses are monitored at both the state and federal level. There has been recent cooperation between the two national forests (Chippewa NF and Superior NF) and the state on OHV planning. Trends at the federal level are not yet available. At the state level, increased use by OHVs on forest roads and damage to minimum maintenance roads has resulted in some closures because of environmental degradation and/or public safety hazards.

State Forests Motorized and Non-Motorized Roads and Access

In 2003, the Minnesota Legislature required DNR to review all 58 state forests to evaluate recreational motor vehicle access needs. (Figure 65). The primary goal was to provide more consistent, understandable, and enforceable recreational motor vehicle use management on public forest lands.

After five years of intensive work, DNR and its partners have completed the classification of state forest land for recreational motor vehicle use and designate which forest roads and trails will be open and closed to motorized use. (Figure 66). Over 12,132 miles of routes on 5.7 million acres of public land were inventoried and classified, including DNR-administered lands (within and outside state forest boundaries) and intermingled county and national forest lands. DNR resource teams worked with counties, American tribal councils, and the USFS to develop forest classification and route designations for each forest or group of forests in Minnesota. Implementation was scheduled to be completed by December 31, 2009.

- Figure 65. Final State Motorized and Non-Motorized Trails



Some county-administered routes are included in the route inventory and designation totals. Shared trail miles also result in some double-counting of reported trail designation miles.

Forest Road & Trail Designation Mileage Totals for All 58 State Forests & Scattered State Forest Lands		
Route Designation	*State Forest Land (miles)*	
Total Inventoried Routes		*12,132*
System Forest Road		*1,086*
Min. Maintenance Forest Road		*1,293*
Non-designated Routes		*5,993*
Proactive Closures	*491*	
In closed forests	*177*	
In limited forests	*2,714*	
In managed forests (forest access routes)	*2,611*	
ATV / OHM Trail		*831*
OHM Only (Single-Track Trail)		*143*
ORV Trail		*27*
Non-motorized Trails		*827*

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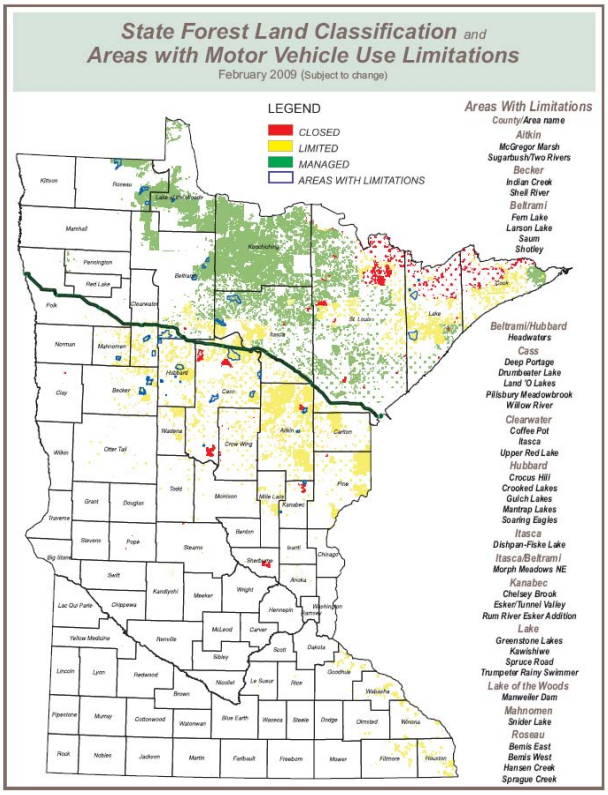
- Figure 66. State Forest Land Classification and Areas of Limitations



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As this is a new endeavor, all spatial analysis is currently baseline only. Refer also to Indicator #43 below for further discussion.

Indicator 43: Recreation Use Trends

Outdoor recreation in Minnesota is important for both societal and personal reasons.[70] Tourism in Minnesota is an $11 Billion industry which is about the same as agriculture.[71] Tourism is a major economic generator in forested areas, both in urban and rural settings. The state has a strong tradition of nature-based outdoor recreation and tourism, with participation well above the national average for activities such as fishing, hunting, boating, hiking, picnicking, horse-back riding, motorized and non-motorized trail riding. Camping, day-use facilities, and water-based activities are abundant and provided by federal, state, county and city agencies, as well as private entities and resort owners. But Minnesota is not escaping the dramatic national trend of declining per-capita participation in nature-based outdoor recreation. The decline includes many of the core outdoor activities the state encourages, such as forests and parks visitation and hunting and fishing activities.[72] Recent park figures show increases in park visitation that may be attributed to the economic downturn and residents choosing to stay close to home.

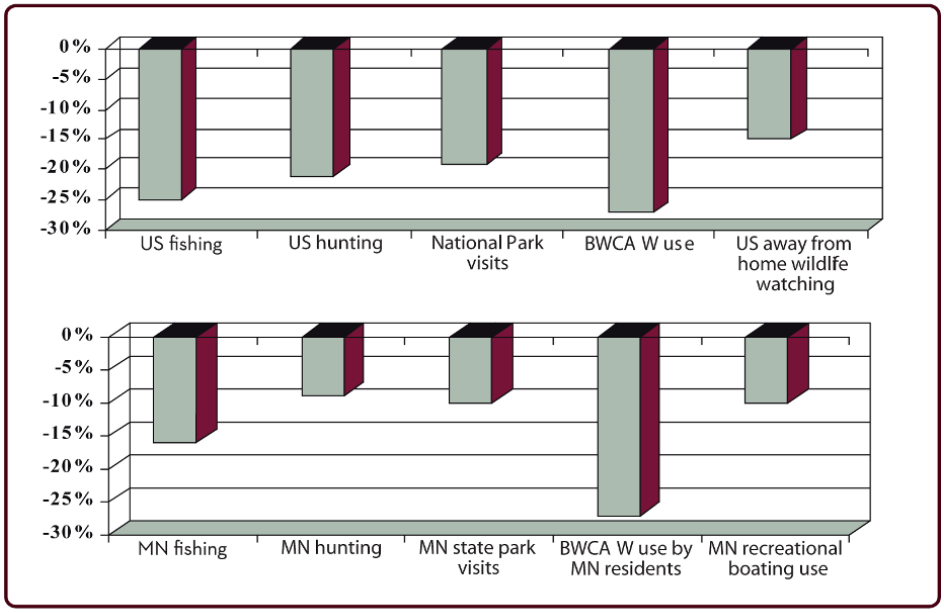
The primary driving factor behind these trends is a decline in nature-based outdoor recreation among young adults (20-40) and their children. Today's young adults are not as engaged in nature-based activities as were the baby boomers. The world of electronics including TV, computers and electronic gaming have supplanted

[70] "*Adapting to Change: Minnesota's 2008 - 2012 State Comprehensive Outdoor Recreation Plan*". (SCORP)
[71] Explore Minnesota Tourism Department
[72] "*Strategic Conservation Agenda 2009 – 2013*"

patterns of participating in outdoor activities and resulted in an increasingly sedentary lifestyle.[73] A 2006 survey by the United Health Foundation found that while Minnesotans are generally healthier than the national average, there has been a 132% increase in the obesity rate since 1990. Estimates in 2006 pegged 20-24 % of Minnesota adults as obese. This news does not bode well for the future of outdoor recreation because parents and other family members are often the ones who introduce youth to the outdoors.[74]

In addition to the above primary factor, a number of secondary factors contribute to the declines in outdoor recreation participation. As the population ages, participation in recreation activities generally declines. Similarly, as the state of Minnesota becomes increasingly urban, as well as increasingly racially/ethnically diverse, participation in traditional outdoor recreation activities generally declines.[75] (Figure 67).

- Figure 67. Indicators of Trends in Nature-Based Recreation [76]



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Changing demographics, economics, land use, environment and culture will require changes in how outdoor recreation areas are planned, designed, funded, developed, managed and promoted. As the state's population increases, it will need increased investment in land, resources and infrastructure as outdoor recreation competes for the public's time and money with many other societal needs and priorities. Yet outdoor recreation is an essential component of the state's critical tourism industry and it can play an important role in improving health and wellness of both individuals and communities as a whole.[77]

[73] This discussion is detailed in Richard Louv's book "*Last Child in the Woods – Saving our Children from Nature-Deficit Disorder*-" 2008
[74] "*Strategic Conservation Agenda* 2009 – 2013"
[75] "*Strategic Conservation Agenda* 2009 – 2013"
[76] USFWS and U.S. Census Bureau, "*National Survey of Fishing, Hunting and Wild-life Associated Recreation*," National Park Service visitation records, MNDNR data on certified hunters and anglers, state park visitation records and regional boating studies. BWCAW use data compiled from USFS records of May-September quota group permits.
[77] "*Adapting to Change: Minnesota's 2008-2012 State Comprehensive Outdoor Recreation Plan.* "(SCORP)

Project Get Outdoors

In 2009, Minnesota DNR is aggressively marketing the state's high-quality outdoor opportunities as great destinations for residents and visitors alike. This effort also includes the promotion of physical activities in the natural outdoors and their benefits for good and long-lasting health.

- DNR is providing new and expanded opportunities to experience the outdoors through a partnership with schools to build fishing and hunting skills, as well as wildlife and nature education experiences.
- Research is being conducted to evaluate the effectiveness of existing outdoor outreach efforts in order to adapt programs and make full use of park and forest facilities. Some of the efforts include assessing the following:
    - School forest assistance, MinnAqua fishing education, Becoming an Outdoors Woman, geocaching, Project WET water education, forestry education, Master Naturalist, hunter safety education, Fishing in the Neighborhood.

Trail Trends

The Minnesota Legislature has been very supportive of recreational trails in recent years. The 2003 Legislature required the DNR to prepare a report of present motorized and non-motorized recreational opportunities. The report included the following:

- detailed discussion of the source of revenue for trails
- analysis of recent and projected expenditures from the OHV accounts
- information regarding all other sources of revenue used for OHV purposes
- inventory of all the state forest roads and access routes, including designated OHV routes and all motorized and non-motorized trails

The report concluded that there is a demand for more trails, but it is not possible to predict how many miles will be built due to the unknown future funds for trail development and acquisition. The 81 page report is available through http://files.dnr.state.mn.us/aboutdnr/reports/trails/ohvstudy.pdf

The 2003 Legislature also required the DNR to review the motorized access classification of each of the 58 state forests. The Legislature mandated a deadline of December 31, 2008 to complete the classification review and to also designate state and county forest roads and trails for use by OHVs. The review was completed according to schedule. A graphic which summarizes the results of the classification and designation project is available through http://files.dnr.state.mn.us/input/mgmtplans/ohv/designation/completed_forests_graphic.pdf

More trails, both motorized and non-motorized, are being constructed by DNR as well as city, county and federal agencies. Progress will be updated at a later date.

Fish & Wildlife

Wildlife and fishing resources are very important to Minnesota. 29% of Minnesotans fish, 15% hunt or trap and 54% of residents watch wildlife, the highest participation rate in the country. Fishing contributes $4.7 billion to the state's economy (including boats & equipment) while hunting and wildlife watching contribute over $1 billion more. The sale of hunting and fishing licenses remain high revenue generators for the DNR but have been in a downward trend recently due both to less participation and related drops in some species breeding populations. For example, duck breeding populations have seen a decrease of 31% since 2008 and are well below the target of 1 million birds in the state. Habitat loss accounts for much of these changes. The only waterfowl that remains at a constant breeding population is the Canada goose, with numbers approximately 285,000, which is similar to the past few years.[78]

Minnesota forests provide important habitat for both consumptive wildlife species (eg. white-tail deer, black bear, small game species) and non-consumptive wildlife species (eg. Canada lynx, gray wolf, bald eagle, non-game song birds). Both mature forests and young forest habitats are needed to fulfill habitat requirements and are key

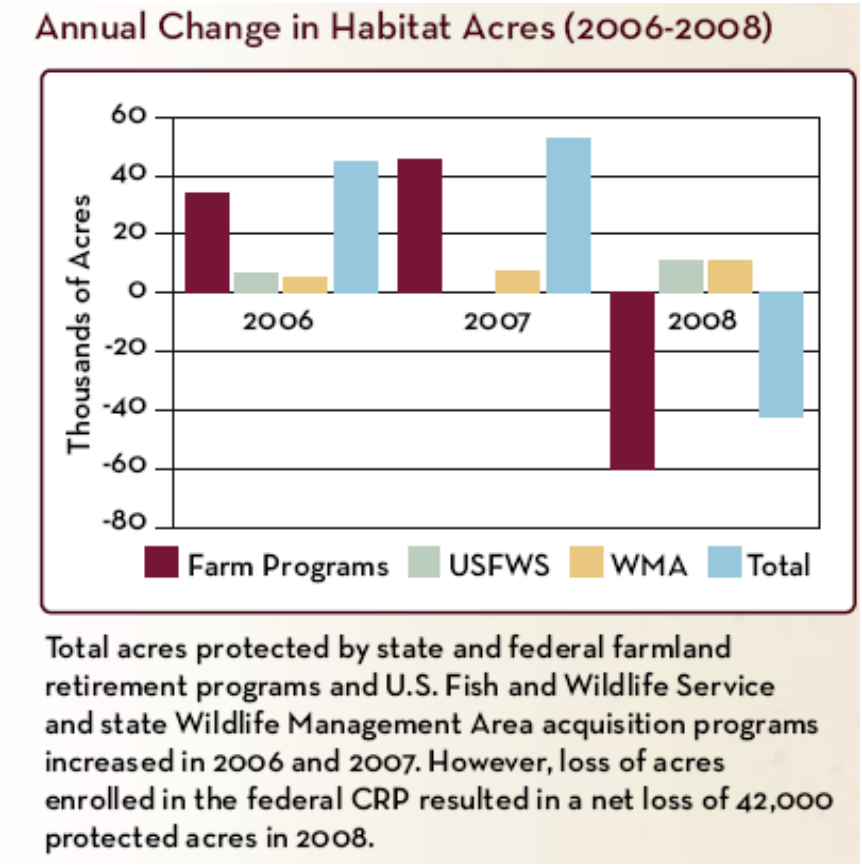
[78] "*Strategic Conservation Agenda*. 2009 – 2013"

to sustaining sensitive species such as brook trout and American woodcock. While woodcock populations have declined throughout much of their range, they have remained relatively stable in Minnesota due to the abundance of young forest habitat. In addition, song bird species such as the golden-winged warbler, have experienced steep declines throughout their range, but have remained stable in the state, where an estimated 40% of the global population breeds.[79]

Since 1955 the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation has published state-specific surveys (most recently every five years), that quantify the economic impacts of wildlife-based recreation and provide detailed information to manage wildlife, market products and study trends. This partnership effort between USFWS states and national conservation organizations, also provides reports which identify priority information needed to address state-wide trends in fishing and hunting recruitment/retention, economic impacts of expenditures on wildlife watching, and the extent of private and public land use by hunters and anglers. (Figure 68).

For further information go to http://wsfrprograms.fws.gov/Subpages/NationalSurvey/National_Survey.htm

- Figure 68. Annual Changes in Habitat Acres



Source: MN DNR

Ruffed Grouse Trends

Minnesota is frequently the nation's top ruffed grouse producer. On average, 115,000 hunters harvest 545,000 ruffed grouse in the state each year. During the peak years of 1971 and 1989, hunters harvested more than 1 million ruffed grouse. One reason for Minnesota's status as a top ruffed grouse producer is that timber

[79] USFWS

harvesting has produced an abundance of young forest and other grouse habitat on county, state and national forest lands. An estimated 11.5 million of the state's 16.3 million acres of forest land are grouse habitat.

Minnesota's ruffed grouse spring drumming counts are up significantly in 2009 from 2008 and have been steadily increasing since 2005. Ruffed grouse populations, which tend to rise and fall on 10-year cycles, are surveyed by counting the number of male ruffed grouse heard drumming on established routes throughout the state's forested regions. In 2009 observers recorded 2.0 drums per stop statewide. In 2008 the average was 1.4 drums per stop. Grouse counts increased most in the northwest region, from 0.9 to 1.9 drums per stop. 2009 counts of 1.1 drums per stop in the central hardwoods and 0.5 drums per stop in the southeast were similar to 2008 counts.[80]

American Woodcock

Due to the concern over declines of the woodcock, an American Woodcock Conservation Plan was recently developed through the Association of Fish and Wildlife Agencies. To begin implementing the plan in the Great Lakes states, partners from Minnesota, Wisconsin, and Michigan have formed the Upper Great Lakes Woodcock and Young Forest Initiative. Through this initiative, the association will target young forest management to landscapes that will be sustainable for woodcock habitat. Work is underway with partners including USFWS, USFS and DNR to select priority areas. Included in this effort are the Upper Mississippi River and Great Lakes Region joint venture, which is in the process of developing and modeling priority areas that could be selected for implementation of the project.[81]

For further information refer to www.timberdoodle.org

Waterfowl Trends

In 2007, waterfowl trends indicated that while pond numbers increased 24% compared to 2006 and were 7% above the long-term average, the estimated numbers of temporary (Type 1) wetlands decreased 43% from 2006 and remained below (-55%) the long-term averages. Breeding waterfowl numbers remain below the 10-year averages with the exception of Canada goose numbers, which increased 30% from 2006 to 2007.(Figure 69).

[80] University of Minnesota Extension-Woodland Advisor; Summer 2009 v.5 I.3
[81] USFWS

• Figure 69. Location of Waterfowl Breeding Population

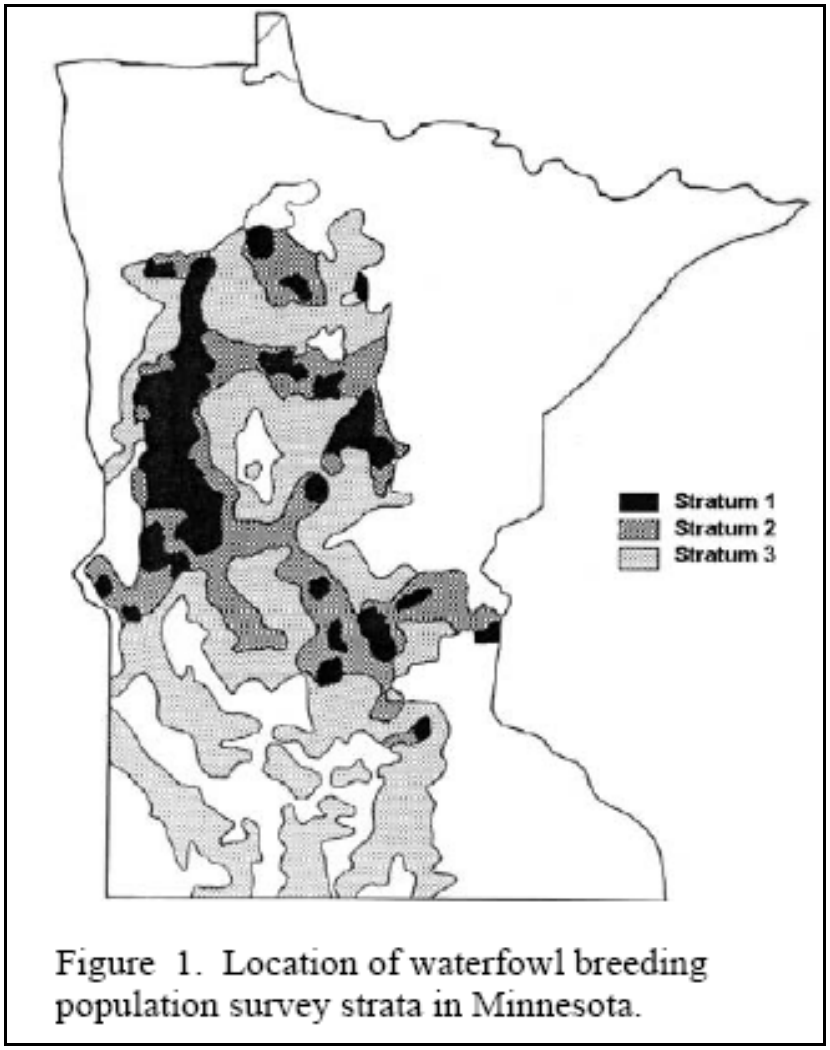


Figure 1. Location of waterfowl breeding population survey strata in Minnesota.

Source: MN DNR

For further information and species lists refer to Natural Resources Research Institute at www.nrri.umn.edu/mnbirds/speciestrends.htm

Minnesota is taking an aggressive approach to bolster participation in the outdoors and retain wildlife habitat. In 2009, the new "*Conservation Agenda* "report under the direction of the governor, identified the need to participate in outdoor recreation as one of three key driving forces for the DNR to concentrate on. This is a new initiative and can be tracked through www.dnr.state.mn.us/conservationagenda/index.html

Fish Habitat

In the face of many pressures on natural resources, sustaining Minnesota's excellent fishing is not guaranteed and cannot be taken for granted. Changing land use and population growth threaten aquatic habitats in the state. Maintaining high quality aquatic habitat and healthy ecosystems are essential for sustaining the fisheries that provide fish that are safe to eat, support a multi-billion dollar angling economy, and contribute to the quality of life all Minnesotans enjoy. Just as wildlife managers focus on managing terrestrial habitat, fisheries managers must focus on managing aquatic habitat.

The DNR is in the process of creating a *Fish Habitat Vision and Guidelines* document for maintaining the high quality aquatic habitats and healthy ecosystems that are essential for sustaining the fisheries that provide fish that are safe to eat, support a multi-billion dollar angling economy, and contribute to the quality of life that all Minnesotans enjoy. This new 2010 vision is in the planning stages and is expected to provide a template for future fish management and aquatic habitat protection in the state.

For further information refer to
http://files.dnr.state.mn.us/fish_wildlife/roundtable/2010/fisheries/fish_habitat_vision.pdf

Indicator 44: Existing Biomass Facilities and Harvest Development

Rising energy costs in recent years and growing interest in renewable alternatives to fossil fuels have focused increasing attention on woody biomass as an energy source in the USA. Woody biomass as an energy-producing feedstock is becoming a popular renewable fuel solution that has the potential to provide multiple benefits to communities and forests, including reduced greenhouse gas emissions, increased energy independence, reduced wood waste in landfills, support for local wood fuel economies and strengthened local economies. Additionally, the use of woody biomass as an energy source can provide new markets for forest landowners; and in doing so, can improve forest health through the removal of hazardous wildfire fuels, improve a forest's recovery from natural disasters, alleviate vegetative competition that contributes to infestations from pests and pathogens, and deter conversion of forestland to other uses.

Woody biomass as forest harvest residues leftover from timber harvesting are an important and growing part of the raw material supply for renewable energy in Minnesota. In 2007, MFRC and DNR developed biomass harvesting guidelines (BHG) that, when used properly, encourage forest ecological values and help to mitigate any adverse environmental effects associated with biomass harvesting. Although the BHG are voluntary recommendations made in Minnesota's site-level forest management guidelines, the BHG are upheld on state and third-party certified lands. The guidelines do not generally provide recommendations on how to manage specific sites or which management activities need to be applied to specific harvest sites. Instead, the guidelines seek to "…provide a menu of site-level management practices that provide for the harvesting of woody biomass while ensuring the sustainability of forest resources in Minnesota." [82]

Current Use

There are over 50 wood energy facilities in the state (excluding landscape/mulch industry). Of these, 50 plus facilities, seven use over 200,000 green tons (gt) annually. Current statewide demand for open-market non-mill residue is 900,000 gt of which only a portion is forest-derived. Virtually all available mill residue in the state is utilized.

Available Supply

The estimated annual statewide supply of logging residue is 1,700,000gt, which assumes a 3.7 million cord harvest level and 50% recoverability. Current estimates are that less than 25% of the available logging residue biomass is being used. The estimated annual statewide brushland material is 1,000,000gt, which assumes a 15- year rotation and does not account for recoverability. The state will need procurement equipment and commitments to periodic offering of brushlands for this resource to become available. There are now proposals to explore both stimulus money and the Legislative Citizen Commission on Minnesota Resources (LCCMR) for equipment development work. The estimated annual statewide timber stand improvement (TSI) pre-commercial material is 400,000gt which is a high-range estimate that does not account for recoverability. Biomass harvesting in the state will not make TSI on most sites profitable, but will offset the costs and provide for more healthy and productive forests through sustainable management of these resources.

Indicator 45: Proposed Biomass Facilities and Harvest Development

While there has been growing interest in utilization of woody biomass for energy in recent years, the development of bio-energy systems is still evolving and is dependent on the maintenance and productivity of

[82] MRFC, 2007

agricultural and forest operations. With the current increase in fuel prices coupled with national security concern on dependence of foreign fuel, it is highly likely that the demand for renewable energy will increase. In particular, the development of new energy sources will result in economic growth in forested and agricultural areas where renewable resources are available. New jobs and economic growth will be created in the field of biomass production, collection, conversion and distribution.

The DNR is exploring new sources of biomass on Wildlife Management Areas (WMAs). Pilot projects on WMAs in Stevens, Chippewa, and Kandiyohi County are exploring the feasibility and habitat management benefits of using perennial native grasses for bio-fuels. These projects are intended to show that conservation lands can provide renewable sources of energy without creating land-use conflicts or compromising conservation values. The projects also provide experience that can be transferred to growing energy crops on private lands while enhancing wildlife and water quality.

Proposed Facilities

More than 20 biomass facilities are in the feasibility exploration stage in the state, with more announced regularly. Of these four proposals have made public announcements or begun the environmental permitting process.

- Renewafuels (Cleveland Cliffs Subsidiary, location to be determined) 200,000gt
- Central Minnesota Ethanol Cooperative (Little Falls) 400,000gt
- Mountain Timber (Mountain Iron) 200,000gt
- US Steel Keetac Expansion (Keewatin, MN) 200,000gt

Indicator 46: Non-Traditional Forest Products

Minnesota forests provide a large range of nontraditional forest products including: forest boughs, tree-tops, berry picking, herbs, maple syrup, mushroom picking, fungi, pinecones, hunting, fishing and game and fur-bearing animal collection. The largest-volume products are balsam boughs and spruce tops for the seasonal wreath and decorative industry. Bough harvest has been steady. Spruce top harvest has risen over the past 10 years.

Fishing, game and furbearing animal harvest is closely regulated by the DNR, in cooperation with the USFWS, in order to assure sustainability of harvest. Most other nontimber products tend to be harvested in very small volumes, shown by the number of harvest permits for these items sold on public lands, which indicates harvest well within sustainable levels. Two of the larger volume products for which more formal sustainability analyses have been done are balsam boughs and spruce tops for the seasonal wreath and decorative industry.

Balsam Fir Boughs

Minnesota is a leader in the production of holiday wreaths and greenery due to the state's large resource of balsam fir. Balsam boughs used in the wreath industry account for over $23 million in sales annually. Current harvesting is estimated to be 4,320 tons per year, which is less than 1% of the total resource allowed (675,000 tons) within harvesting guidelines.[83]

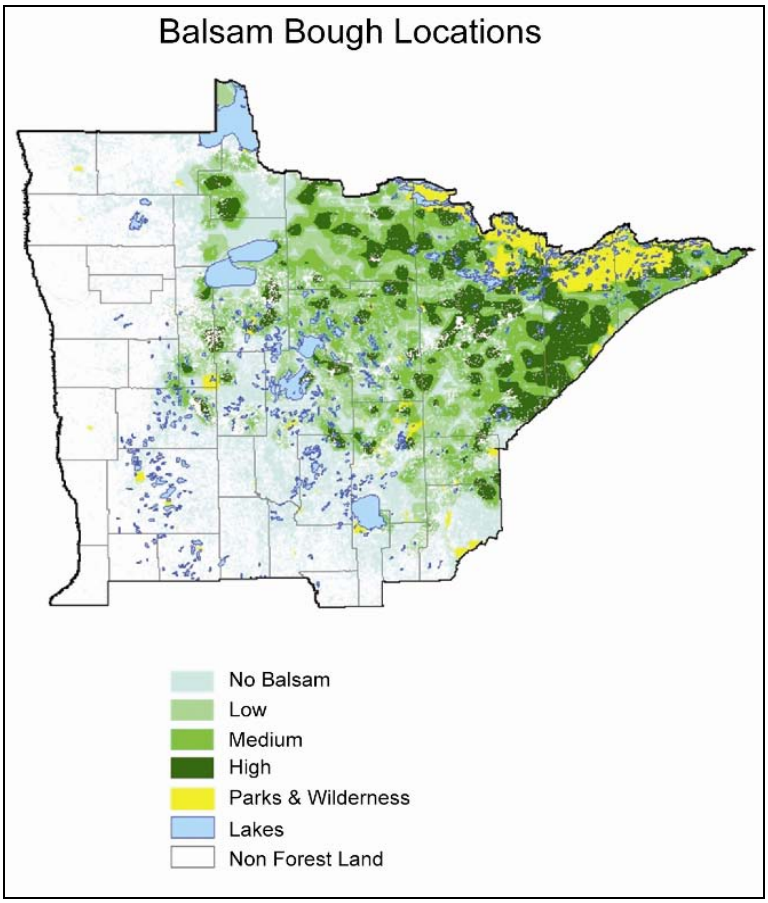
Most balsam bough harvesting occurs in St. Louis, Aitkin, Itasca and Cass counties. However, they are not necessarily the top counties in terms of the available resource. Eight other counties including Lake, Koochiching, Cook, Beltrami, Lake of the Woods, Clearwater, Carlton and Pine, also contribute significantly to the resource. These 12 counties contain over 97% of the balsam bough resource in the state. (Figure 70).

While balsam boughs can be harvested throughout a large portion of the forested areas of the state, harvesting is not permitted in either parks or wilderness areas, (yellow area in Figure #70). State law requires a permit, written consent, or bill of sale to be carried whenever cutting, removing, or transporting boughs whether the land is publicly or privately owned. Major landowners that do permit harvesting include private lands (37% of the

[83] FIA

balsam resource), DNR (27%), the Superior NF (16%), St. Louis County (6%), Koochiching County (2%) and all other combined landowners of county and public lands (5%).

- Figure 70. State Locations of Balsam Boughs for Harvest



MN DNR

Decorative Spruce Top Production

In Minnesota, the spruce top decorative industry is driven by demand for seasonal product demands around Christmas. This activity is seen as a value-added revenue generator for spruce forest stands that might not otherwise be economically viable. Public land, especially state-owned DNR land, contains the majority of the potential spruce top resource.

The market for spruce tops has been highly cyclical over the past 80 years. There was a strong market in the 1930s and again in the early 1960s. The market has been almost dormant since the 1960s until the mid 1990s, when activity again saw an increase.

Harvest typically takes place during the late fall on wet sites that may be unfrozen. Annual spruce top market demand has been estimated at around 650,000 tops, well within the sustainable annual level.[84] While the majority of the harvested supply stays within the state, there is not enough trend data or tracking of the resource at this time, to provide meaningful economic information. The cyclical nature of the industry has resulted in a situation where forestry field managers have limited experience in setting up and administering spruce top sales. The DNR is in the process of reviewing harvesting and hauling equipment options for spruce top production and to minimize environmental impacts in a constantly changing market.

[84] Minnesota Spruce Top Production and Market Survey. DNR

Criterion 7: Legal, Institutional, and Economic Framework for Forest Conservation and Sustainable Management

Social, legal, economic, and environmental conditions reflect society's values and have a profound effect on forest conservation and sustainable management. These factors create a complex web of influences that can sometimes interact in unexpected ways. For example, some communities, in an effort to slow growth, have enacted zoning ordinances to require larger lot sizes. This has the unintended effect of fragmenting more forest land than if lots were clustered closer together.[85]

This criterion ties to all three of the national themes.

Indicator 47: Site-Level Guidelines and Monitoring

Recognizing the importance of managing forest resources sustainably for future generations, the Minnesota Legislature in the mid -1990s, tasked the MFRC to develop guidelines recommending forest management practices that help protect cultural resources, soils, riparian areas, visual quality, and water and wetland quality. The resulting *Voluntary Site-Level Forest Management Guidelines- Sustaining Minnesota Forest Resources* were finalized in 1998 and revised in 2005. In 2008, guidelines sections for biomass were added to the text. These guidelines have been widely distributed and extensive training provided to landowners, resource managers and loggers. They are now being used to direct timber harvest and other practices on all state land and on lands under other ownership throughout the state. The guidelines can be found at www.frc.state.mn.us/Fmgdline/Guidelines.html

Guideline implementation has been monitored annually since 2000. (see: "*Timber Harvesting and Forest Management Guidelines on Public and Private Forest Land in Minnesota – Monitoring for Implementation 2004, 2005, 2006"* at www.dnr.state.mn.us/Forestry/Index.html). Landowners, managers and loggers have generally followed the guidelines well. It is expected that higher implementation rates are attainable through additional training, better planning, and improved communications between landowners and loggers.

A breakdown of monitoring observations reveal that implementation is very good for:

- endangered, threatened, and special concern species
- cultural resources
- filter strips
- snags
- visual quality

Implementation was fair to good for:

- landings
- rutting (except on crossings)
- coarse woody debris
- roads and skid trails (except for the use of water diversion and erosion control practices

Improvement needs were identified for the following:

- amount of infrastructure
- RMZs along streams and lakes
- water diversion and erosion control practices
- wetland crossings
- leave tree retention

[85] NAASF – *"Suggested Framework for Statewide Forest Resource Assessments."* November 2008

The state and its partners are beginning to see improvements in sustainable forest management through voluntary guidelines and will continue to monitor progress regularly for future trends.

Indicator 48: Forest Certification

Forest certification is an independent, third-party verified system that evaluates and recognizes sustainable and responsible forest management and procurement practices. Primarily a market-driven initiative, consumers began to demand "green" certified products in response to increased concerns over illegal logging and the degradation of tropical rainforests. Consumers can be confident that products displaying a certified logo were grown, harvested and produced in a sustainable manner, consistent with the principles of forest certification.

In the United States, forest certification is a voluntary program that involves increased stakeholder input, internal process improvement, and increased partner and interdisciplinary coordination. 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 recertification assessments every five years, with mandatory annual surveillance audits during each nonassessment year. Audits must be performed by approved auditing firms. After each assessment or audit, corrective action requests (CARs) are assigned for compliance gaps. The organization seeking forest certification or striving to maintain their certificate must respond to, and correct, each compliance gap within the time-frame allowed, generally three months to one year.

DNR's Forest Certification Program

MN DNR's History of Forest Certification

Minnesota has been actively involved with third-party, independent forest certification since 1997, when DNR first pursued forest certification for about 150,000 acres of state-administered forest lands located in Aitkin County. This first effort served as a pilot project and was planned in conjunction with the Aitkin County Land Department's effort to certify 220,000 acres of county-administered forest lands. Aitkin County Land Department became the first county in the United States to certify their forest land through FSC. Together, DNR and Aitkin County were successful in certifying about 378,000 acres of forest land in MN. Since 1997, interest, recognition and support for forest certification has continued to grow among natural resource managers, forest product manufacturers, builders, policy makers, consumers of green or sustainable products, and informed members of the general public.

DNR's Current Forest Certification Program

DNR successfully expanded certification to all DNR Division of Forestry- and most Division of Fisheries and Wildlife -administered forest lands in December of 2005. Currently DNR manages 4.9 million acres of certified forest lands, 4.84 million acres of which are dual-certified through FSC and SFI. Forest certification helps ensure strong markets for state-owned timber, thereby maintaining the ability to effectively manage state forests and also maintain the economic vitality of many of Minnesota's forest dependent rural communities. Forest certification has led to improved forest management practices, improved interdisciplinary coordination and communication, and a sustainable supply of forest products and services from healthy, diverse and productive ecosystems. In tough economic times, certification has also reportedly helped to improve the market competitiveness of Minnesota's certified forest products. Maintaining forest certification also demonstrates DNR's dedication to sustainable and responsible natural resource and forest management.

DNR is working to maintain its forest management certificates and assist local partners in pursuing or maintaining their certification. Past surveillance audit reports, CAR responses, and other certification data can be found on MN DNR's forest certification website at http://www.dnr.state.mn.us/forestry/certification/index.html

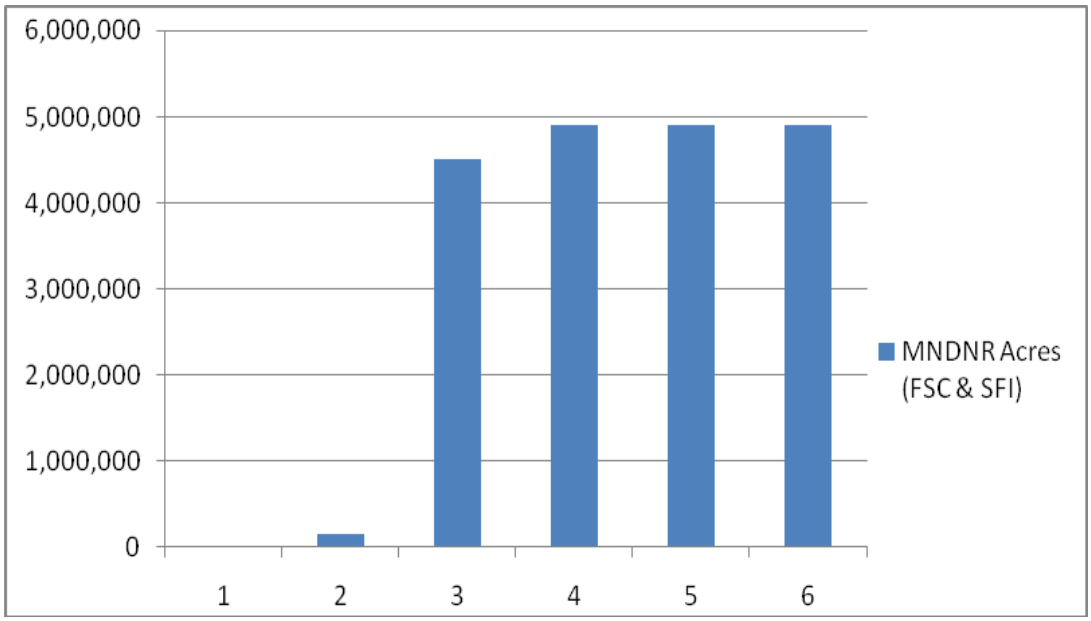
Status of Forest Certification in Minnesota

DNR's Forest Certification Status (State land):

Since 2005, DNR has worked to maintain dual-certification (FSC & SFI) on 4.84 million acres of state-administered forest lands. However, it would be inaccurate to define that as a trend or target, due to the inherent nature and status of forest certification, as explained above.(Figure 71).

Baseline (pre-1997) = 0 acres (statewide)
Baseline 1 (1997) = 150,000 acres (located in Aitkin County)
Baseline 2 (2005) = 4.5 million acres (statewide)
Baseline 3 (2006) = 4.9 million acres (statewide)
Baseline 4 (2009) = 4.9 million acres (statewide)

- Figure 71. MN DNR's Forest Certification Status on State Lands



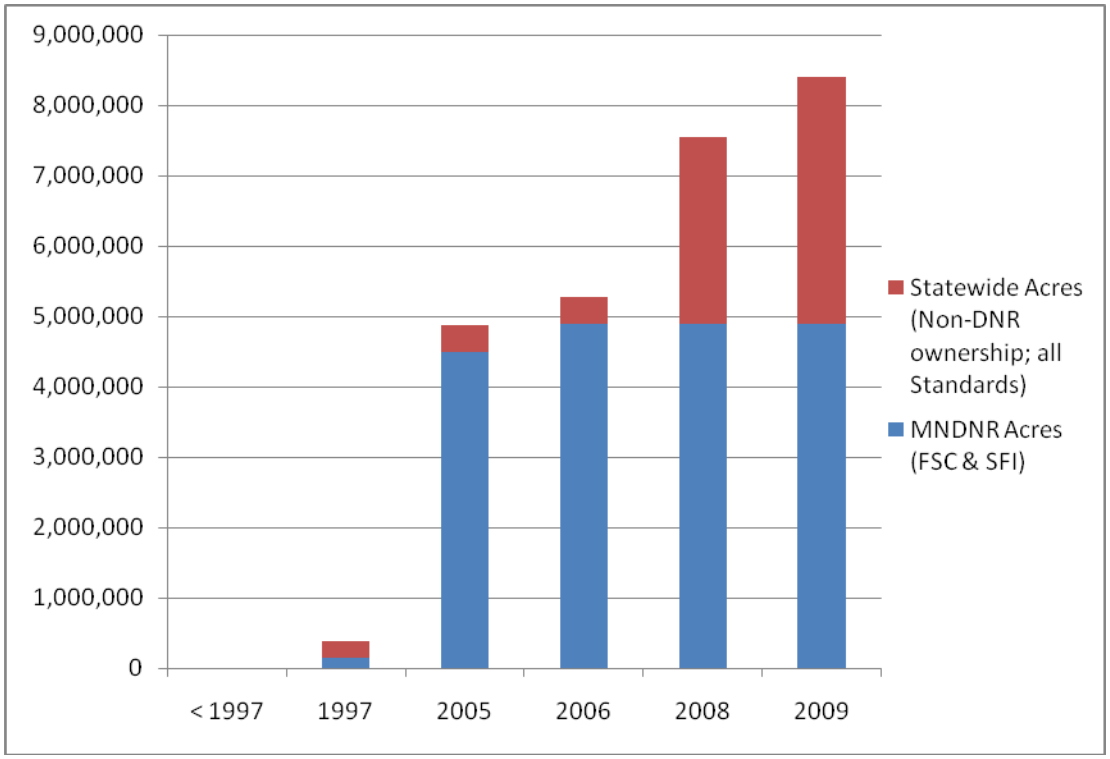
MN DNR

Statewide Forest Certification Acres in MN:

Third party certified forest lands have grown from zero acres in 1996, to over 8 million acres in 2009. Most recently, during the summer of 2008, five counties underwent an initial assessment to become dual certified. These counties include Carlton, Crow Wing, Clearwater, Beltrami and Koochiching. Together these county land departments total about 700,000 acres. This five-county group was awarded their SFI certificate in 2008 and their FSC certification in 2009. As of January 2010, this brought the total of certified forest land statewide to 8.4 million acres, up from 7.5 million acres in 2008. (Figure 72).

Baseline (pre-1997) = 0 acres statewide
Status 1 (1997) = 378,000 acres statewide *(all ownerships; both FSC & SFI)*
Status 2 (2005) = 4,878,000 acres statewide *(all ownerships; both FSC & SFI)*
Status 3 (2006) = 5,278,000 acres statewide *(all ownerships; both FSC & SFI)*
Status 4 (2007) = 7,553,654 acres statewide *(all ownerships; both FSC & SFI)*
Status 5 (2008) = 7,553,654 acres statewide *(all ownerships; FSC, SFI & ATFS)*
Status 6 (2009) = 8,394,807 acres statewide *(all ownerships; FSC, SFI & ATFS)*

• Figure 72. Statewide Forest Certification Acres (Combined blue and red region)

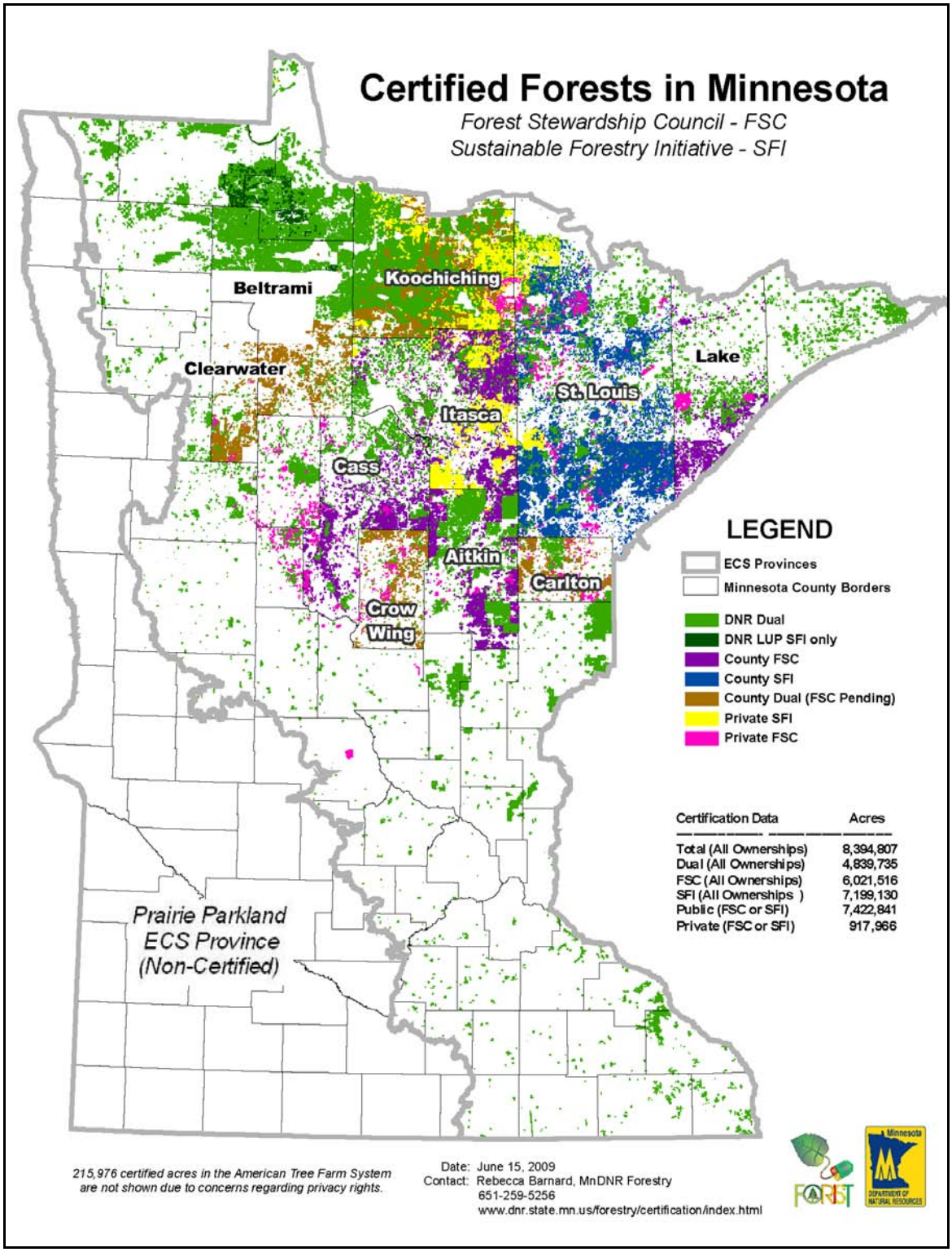


MN DNR

Trends and Growth in Forest Certification within Minnesota

It is very hard to assess or measure the trends in regards to forest certification. First, forest certification is still relatively new and awareness of certified products has just begun to measurably grow. Second, it is difficult to find accurate historic or current forest certification data for two reasons: 1) there are wide gaps in previously collected data due to the slow initial growth in forest certification, and 2) presently, there are many discrepancies in current data from one website to another. Lastly, because forest certification is a voluntary, market-driven process, much of forest certification's future relies on strong markets; consumer and public awareness and support; and financial assistance and support from policy makers. (Figure 73).

• Figure 73 2009 Forest Certification



MN DNR

Indicator 49: Chain of Custody Certified Forest Product Businesses

The chain of custody (CoC) process allows an end product to be marketed and labeled as certified only if it originated and was grown, harvested and manufactured in accordance with the certification standard(s). Printers and other producers of forest products must adhere to the CoC standard in order for the end product to be marked and labeled as certified. Both FSC and SFI have separate forest management and CoC standards. The CoC process requires documentation that enables forests based products to be tracked back through the manufacturing process, thereby verifying that the product was grown, harvested and manufactured in a responsible manner.

As mentioned in response to Indicator 48, forest certification is continuing to grow, in spite of the current economic times. Furthermore, because certification is voluntary, government agencies have no direct control over the number of certified businesses within a particular state. DNR works hard to assist statewide partners, customers, stakeholders, etc. That said, each certificate holder is responsible for continuing to assess the costs and benefits of certification and each certificate holder is free to make their own choice of whether to obtain, maintain or drop certification. The data here is a snapshot of current figures (as of June 19, 2009) and is not meant to be used to identify a baseline or trend. These numbers have grown significantly since 2008.

FSC CoC Certificates in MN: 88 companies (June 19, 2009)
SFI CoC Certificates in MN: 42 companies (June 19, 2009)

Indicator 50: Planning and Coordination Efforts

Minnesota has a long history of various forest land owners, managers and interest groups working together to advance forest policy and sustainable forestry in the state. A fair amount of this coordination has been driven by the intermingled forest ownership pattern in the state. Forest planning and coordination takes place through a number of levels and forums within the state. On the state-wide level there is the MFRC and the Minnesota Forest Resources Partnership (MFRP). On the large landscape level there is coordination through the MFRC Landscape Program which encompasses all ownerships, and the DNR Subsection Forest Resource Management Plans (SFRMP) which is targeted to DNR state lands only. Other coordination for specific ownerships include national forest plans which are updated every 10 years, and county and tribal forest plans which are updated periodically depending on each county and tribe.

Minnesota Forest Resources Council (MFRC)

The 1995 Sustainable Forest Resources Act (SFRA - Minnesota Statutes chapter 89 A) establishes a number of innovative policies, programs, and administrative mechanisms that focus both on site and landscape-level forest resource management. The creation of the MFRC, a 17-member organization working to promote long-term sustainable management of Minnesota's forests, represents both private and public interests. As a principal administrative mechanism, MFRC facilitates the development of many initiatives and serves as a forum to discuss and advise the governor, federal, state, county and local governments on sustainable forest resource policies and practices. The council provides an annual report to the governor and Legislature on the implementation of SFRA and an overview of yearly activities in the state.

One of the primary roles of MFRC is to identify and address key policy issues related to the sustainable management of Minnesota's forests. In 2008, the council updated and refined their focus in the policy arena. A strategic policy focus was developed for 2009-2010 which identified the following four priority areas:

- **Forest Land Base:** Economic, ecological, and social impacts of forest land ownership changes, parcelization and development on private and public lands that may result in fragmentation or loss of forested land.
- **Forest biomass and biofuels harvest:** Economic and ecological impacts and benefits of forest biomass harvesting.
- **Forest carbon sequestration:** The role of forests and forest products in carbon sequestration.

- **Threats to forest health:** Economic, ecological, and social impacts of declining forest health, especially related to invasive terrestrial plants, insects and diseases across the landscape.

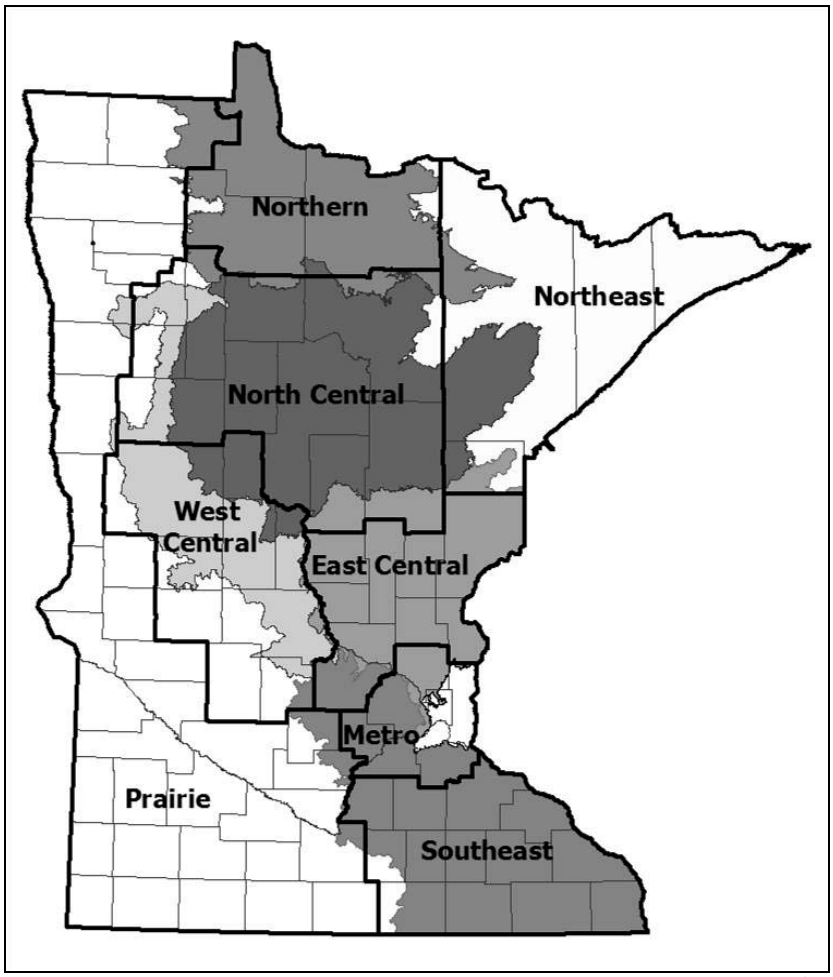
Additional roles include identifying and tracking important forest policy issues with a special emphasis on water quality and its relationship to forest cover; professional recruitment; education and training; public education and information; and issues surrounding wildfire. For further information refer to www.frc.state.mn.us/initiatives_policy.html

MFRC Landscape Program

The SFRA directed MFRC to establish regional forest resource committees to foster landscape-based forest resource management. Through these regional committees, it develops and implements landscape level management plans for Minnesota's six major forested regions.

Since 1997, regional forest resource plans have been prepared for the six forested region in the state (Figure 74). The plans describe desired future conditions for the region's forests over a long-term horizon (up to 100 years). The plans also include shorter-term goals and strategies to guide efforts by landowners, forestry professionals, and industry, tribal, and agency managers in the sustainable management of each region's forest resources.

- Figure 74 Minnesota Forest Resources Council Forest Landscapes



MFRC

Volunteer, citizen-based regional landscape committees are central to carrying out landscape management processes. Regional landscape committees provide an open public forum for diverse interests to cooperatively promote forest sustainability. By bringing together representative interests from landscape regions, the committees serve as springboards for effective forest management activities that address specific needs and challenges in each region.

With the planning process in all six of the major forested landscapes completed, the landscape program is now focused on plan implementation. Regional committees meet on a regular basis to guide implementation of landscape plans and coordination of land management activities. The six committees are actively working to:

- encourage consideration of the landscape-level context by all agencies, organizations, industry, and private landowners when developing their resource management plans and implementation projects
- coordinate and support projects by partnering organizations that promote sustainable forest management practices in the landscape region
- develop and implement committee projects that proactively address the goals and strategies outlined in the regional forest resource plans
- monitor activities and outcomes of projects implemented by the committees, as well as those by partnering organizations and landowners across the landscape region

Organizations and stakeholder groups participating on the regional committees include the following:

- landowners
- loggers/sawyers/foresters
- industry/wood products manufacturing
- business and development community
- education community
- environmental/conservation/sporting organizations
- local units of government
- regional, tribal, state and federal agencies

Minnesota Forest Resources Partnership (MFRP)

MFRC was organized in 1995 and is recognized in Minnesota Statutes, chapter 89A.04. It is a voluntary, self-funded partnership of forest landowners, managers and professional loggers dedicated to improving the health and productivity of Minnesota's forest resources and economically viable forest dependent communities. The organization represents 12 county land or natural resources departments, two national forests, one state natural resources agency, three forest industry partners, and two forestry associations.

It is the mission of the MFRC to implement and coordinate scientifically based, technically and economically feasible forest management practices to provide sustainable forest resources and promote economic viability.

The guiding principles of the organization include:

- Forest management is part of the solution to improving the health and productivity of forests, while creating value for maintenance of intact forested ecosystems.
- Forest management should be viewed as long-term investments to enhance many forest values and improve forest health and productivity.
- Realizing the productive potential of Minnesota's forests will require additional investments in tree planting, seeding, and thinning. These investments will return large dividends for Minnesota's environment, habitats, and forest enterprises over time.
- Active forest management contributes to community vitality.
- Minnesota's forest products industries face a changing competitive environment. The partnership supports these industries by producing better quality fiber, healthier trees, increased yields, and investments in forest management practices.

- Landscapes should be viewed as a combination of social, economic, and natural resource elements – none of which are mutually exclusive. Landscape-level goals should be voluntary, broad-based, and balance objectives for social, economic, and natural resource elements within the landscape.
- Flexibility in the application of site-level harvesting guidelines will provide for the exercise of professional site-specific judgments in the field.

For further information refer to www.mnforestpartnership.com/about.php

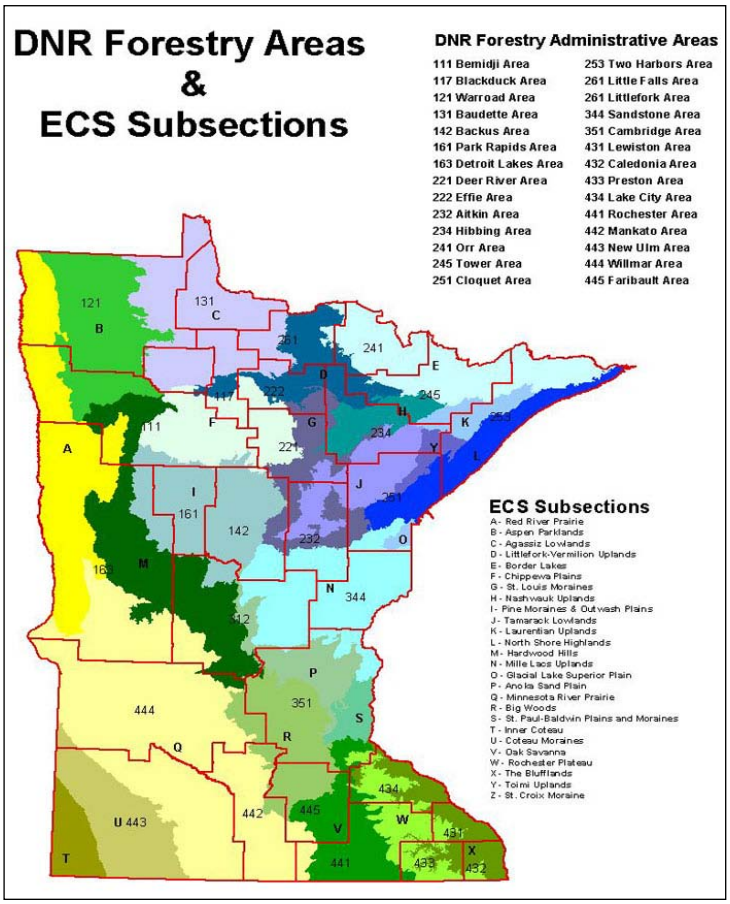
DNR Subsection Forest Resource Management Plans (SFRMP)

Since 2000, DNR has been developing its forest resource management plans using the subsection level of its ecological classification system (ECS) rather than its administrative areas. (Figure 75).

SFRMPs are DNR plans for vegetation management on forest lands administered by the Division of Forestry and Section of Wildlife. ECS subsections, not administrative boundaries, are the basis units for delineation. The key products from these plans include:

- key issues, strategies, and long-term desired future forest composition goals for DNR lands within a subsection.
- identifying DNR forest stands to be treated over the 10-year planning horizon consistent with the long-term goals.

- Figure 75. SFRMP Areas by ECS Classification



For further information refer to http://www.dnr.state.mn.us/forestry/subsection/index.html

Chippewa National Forest Plan

The Chippewa National Forest is situated in Beltrami, Cass and Itasca counties. It amended its forest management plan in 2004, which establishing natural resource management direction for the next 10-15 years. The plan is organized into four chapters including: Introduction; Forest-wide Management Direction; Management Area Direction; and Monitoring and Evaluation. An environmental impact statement (EIS) accompanied the plan and describes the analysis used in developing the plan. For further information refer to http://www.fs.fed.us/r9/forests/chippewa/projects/forest_plan/documents/cnf/Chippewa_FP_Preface.pdf

Superior National Forest Plan

The Superior National Forest is situated in four counties in Cook, Koochiching, Lake and St. Louis counties. Its plan amended in 2004, establishes natural resource management direction for the next 10-15 years. The plan is organized into four chapters including: Introduction; Forest-wide Management Direction; Management Area Direction (including the management direction that is unique to the Boundary Waters Canoe Area Wilderness); and Monitoring and Evaluation. An EIS accompanied the plan and describes the analysis used in developing the plan. For further information refer to http://www.fs.fed.us/r9/forests/superior/projects/forest_plan/2004Plan/snf/documents/Superior_FP_Preface.pdf

County Forest Plans

In Minnesota, 15 northern and central counties (Aitkin, Becker, Beltrami, Carlton, Cass, Clearwater, Cook, Crow Wing, Hubbard, Itasca, Koochiching, Lake, Lake of the Woods, Pine and St. Louis) manage 2.8 million acres of forest land that were often the result of tax-forfeited lands in the 1930s. Several of these counties have plans to manage their natural resources and forest lands. These plans guide land management including timber harvest on most of the acres and are required to be completed in order to qualify for forest certification. The following counties have recent forest plans that can be reviewed via Web sites.

Aitkin County http://www.co.aitkin.mn.us/Departments/Land/forestmgmt.html
Becker County http://www.co.becker.mn.us/dept/natural_resource/forest_management.aspx
Beltrami County http://www.co.beltrami.mn.us/
Carleton County http://forestmanagement.co.beltrami.mn.us_Carlton County's Plan
Cass County http://www.co.cass.mn.us/land/frm_plan.html
Clearwater County www.co.clearwater.mn.us
Cook County http://www.co.cook.mn.us
Crow Wing County http://www.co.cook.mn.us/land/forest_management_plan.html
Hubbard County http://iic.gis.umn.edu/finfo/plans/county/hubbard.htm
Itasca County www.co.itasca.mn.us
Koochiching County http://iic.gis.umn.edu/finfo/plans/county/kooch.htm
Lake County http://iic.gis.umn.edu/finfo/plans/county/lake.htm

Tribal Forestry Plans

There are 11 tribes in Minnesota and all are involved with natural resource planning efforts including forest management on over one million acres. As sovereign nations, these 11 tribes are responsible for their own forests, but scattered ownership patterns create opportunities to work cooperatively with all levels of government (federal, state, county, local) and private forest landowners on forest issues that cross all ownerships. Tribal forests are vital to their communities as they are an important source of employment and income plus settings for artistic expression, worship and religious ceremonies. Forests provide habitats for basic needs of hunting, fishing and gathering (forest products such as berries, mushrooms, wild rice), plus materials for shelter, fuel, canoes, clothing, house wares, plant medicines, and forest product enterprises. While each tribe plans and manages their own forests, there are collaborative efforts between tribes and other governing entities related to fire and smoke management, invasive species management, timber harvesting, biomass development, water quality management, recreation and trail management, fishing and hunting management and recognition and management of significant cultural and historic outdoor spaces including traditional burial grounds.

Minnesota tribal forestry plans are sometimes incorporated under wider natural resource initiatives such as the Great Lakes Indian Fish and Wildlife Commission (GLIFWC), an agency consisting of 11 Ojibwe nations in Minnesota, Wisconsin and Michigan committed to implementing off reservation treaty rights of hunting, fishing and gathering and to the protection of treaty rights and natural resources.

Below are links to some of the larger tribal forestry initiatives, land departments and information regarding important natural resources.

Red Lake http://www.fs.fed.us/rm/pubs/rmrs_p024/rmrs_p024_350_353.pdf
White Earth http://www.whiteearth.com/naturalresources.htm
Grand Portage http://www.epa.gov/osp/tribes/NatForum06/4_18.pdf
Bois Forte http://www.boisfortednr.com/wildrice/report.pdf
http://transition.blandinfoundation.org/html/VFVC_Biomass_Forum_08/PROCEEDINGS_biomass_harvesting.pdf
Leech Lake http://www.lldrm.org/forest.html
Fond du Lac http://www.fdlrez.com/newnr/forestry.htm
Mille Lacs http://www.lacdesmillelacsfirstnation.ca/default.aspx?l=,1,497

State Advisory Committees

The following represent advisory committees that work directly with forestry issues in the state and region.

- **Minnesota Forest Resources Council (MRFC)** is a state council established by the Sustainable Forest Resources Act of 1995 under Minnesota Statutes, chapter 89A.06 to promote long-term sustainable management of Minnesota's forests. see www.frc.state.mn.us
- **Minnesota Forest Resources Council Regional Landscape Committees** provide overall leadership and direction to the **MFRC**'s Landscape Program as described in the Sustainable Forest Resources Act of 1995 under Minnesota Statutes, chapter 89A.06. see www.frc.state.mn.us/aboutus_committees_landscape
- **Minnesota Forest Resources Research Advisory Committee (RAC)** was formed under the SFRA to address information needs concerning Minnesota forests. The purpose of the advisory committee is to foster the identification and undertaking of priority forest resources research activities by encouraging collaboration between organizations conducting research, linking researchers in different disciplines conducting forest resources research, and encouraging interaction and communication between researchers and practitioners in the development and use of forest resources research. see www.frc.state.mn.us/initiatives_research_committee
- **Minnesota Forest Resources Partnership** was organized in 1995 and is recognized in Minnesota Statutes, chapter 89A.04. It is a voluntary, self-funded partnership of forest landowners, managers, and professional loggers dedicated to improving the health and productivity of Minnesota's forest resources and economically viable forest dependent communities. see www.mnforestpartnership.com
- **Minnesota Shade Tree Advisory Committee (MnSTAC)** was established in 1974 to advise Minnesota's governor, Legislature, other legislative and administrative branches of the state, the University of Minnesota, the counties and communities, and the people of Minnesota on the best ways to preserve, protect, expand and improve Minnesota's urban and community forests. see www.mnstac.org
- **Sustainable Forests Education Cooperative (SFEC)** was established in 1997 to alert natural resource professionals to continuing education opportunities and current research findings, new technologies, and state-of-the-art practices, in a broad range of fields including forest ecology and management, wildlife biology, forest hydrology, botany, best management practices, technology transfer and others. see http://sfec.cfans.umn.edu

Regional Committees

- **Great Lakes Forest Alliance (GLFA)** was established and chartered in 1987 under the Lake States Forestry Alliance. In 1997, Ontario, Canada joined the organization creating the Great Lakes Forest Alliance, Inc. The organization is incorporated as a 501(c) (3) non-profit organization established to foster

and facilitate cooperative efforts that enhance management and sustainable use of public and private forest lands in Michigan, Minnesota, Ontario, and Wisconsin. see http://www.greatforests.org/index.html

- **Great Lakes Regional Collaborative (GLRC)** was formed in 2004 by the Great Lakes Interagency Task Force (eleven federal agencies) and is comprised of six states (Minnesota, Wisconsin, Michigan, Indiana, New York, Ohio) and one Canadian province (Ontario). It also brings together local communities, tribes, regional bodies and other interested parties to develop and carry out the most coordinated and comprehensive protection and restoration strategy for the Great Lakes Basin. see http://www.epa.gov/grtlakes/glri/glmyrapo.pdf

Indicator 51: Statewide or Regional Forest-related Organizations

The following organizations work closely with all levels of government and private entities to assure quality and monitoring of forest lands in the state.

- **Minnesota Forestry Association (MFA)** works on behalf of Minnesota family forest owners, through education and advocacy to promote stewardship of woodlands, especially woodland stewardship plans for owners of 20 or more wooded acres. see www.minnesotaforestry.org
- **Minnesota Association of Consulting Foresters (MACF)** was organized by experienced consultants in 1981 to maintain the professional standards pf private forestry work. Membership and participation in the association demonstrate the continuing desire for up-to-date information and techniques, promote the best interests of the clients, and strengthen the professional capabilities of the member. see www.paulbunyan.net/users/norfor
- **Minnesota SWCD Forestry Association (MASWCD)** began in 1952 as a 501(c) (3) non-profit organization to provide information, leadership and a common voice for Minnesota's soil and water conservation districts and to maintain a positive, results-oriented relationship with rule making agencies, partners and legislators; expanding education opportunities for the districts so they may carry out effective conservation programs including private landowner forestry plans under the 2001 Sustainable Forest Incentive Act. see www.maswcd.org
- **Minnesota Forest Industries (MFI)** represents eight major forest industry manufacturing production companies dedicated to enhancing Minnesota's woodland resources . Their mission is to encourage conservation, proper forest management and industry development that fosters sound environmental stewardship, forest management and industry development, multiple use of timber lands and the long-term viability of timber supply. Through diligent practices and communications provided through workshops and written form, MFI supports teachers and school children, professional loggers, private landowners, and researchers in learning about sustainable forest management practices. see www.minnesotaforests.com
- **Associated Contract Loggers and Truckers (ACLT)** represents the largest logging trade association in Minnesota and provides its members with a strong and unified representation intent on ensuring the continued prosperity for businesses engaged in the timber industry. This organization is active in the issues of logging, state regulations, fuel adjustments and the importation of wood products and follows closely economic trends and public policies that affect forest management. see www.acltmn.com
- **Minnesota Logger Education Program (MLEP)** was established in 1995 as a 501 c 3 non-profit organization to assist logging business owners in meeting everchanging demands of their profession. MLEP provides assistance to Minnesota's logging community through educational programming. This objective is accomplished by partnering with numerous groups to identify needs and facilitating the development, design, delivery and evaluation of programs which focus on sustainable forest management, transportation, safety and business management. see www.mlep.org

The following websites represent organizations that are frequently consulted regarding sustainable forest management and used frequently by MFRC, government agencies and private organizations.

American Indian Affairs
Minnesota American Indian Affairs Council www.indians.state.mn.us

Conservation & Environmental Organizations
The Nature Conservancy www.tnc.org
Audubon Society www.audubon.org
Minnesota Audubon Council www.audubon.org/chapter/mn/mn
Izaak Walton League of America www.iwla.org/
Minnesota Center for Environmental Advocacy www.mncenter.org
Sierra Club www.sierraclub.org/
North Star Chapter www.northstar.sierraclub.org/
Great River Greening www.greatrivergreening.org
Minnesota Deer Hunters' Association www.mndeerhunters.com
Ruffed Grouse Society www.ruffedgrousesociety.org/
Woodcock Minnesota www.woodcockminnesota.org
American Forest Foundation www.affoundation.org
American Forests www.amfor.org
National Wild Turkey Federation www.nwtf.org
MN Association of Soil and Water Conservation Districts www.maswcd.org

Education
University of Minnesota Extension
- Forestry Extension www.cnr.umn.edu/FR/extension/
- Wood & Paper Science Extension www.cnr.umn.edu/WPS/exten/index.html
- Fisheries & Wildlife Extension www.fw.umn.edu/Extension/extension.html

University of Minnesota Center for Continuing Education www.cnr.umn.edu/CCE/
Center for Water and the Environment www.nrri.umn.edu/cwe/default.htm
University of Minnesota Regional Sustainable Development Partnerships
www.regionalpartnerships.umn.edu
Center for Applied Research and Technology Dev www.nrri.umn.edu/cartd/cartd.html
University of Minnesota College of Natural Resources www.cnr.umn.edu
- Department of Forest Resources www.cnr.umn.edu/FR/
- Department of Wood & Paper Science www.cnr.umn.edu/WPS/
- Department of Fisheries & Wildlife www.fw.umn.edu/
- Institute for Sustainable Natural Resources www.cnr.umn.edu/CCE/
- Minnesota Logger Education Program www.mlep.org

Forestry Associations & Organizations
Society of American Foresters www.safnet.org
American Forests www.amfor.org
National Association of State Foresters www.stateforesters.org
Forest History Society www.lib.duke.edu/forest/
Minnesota Association of Consulting Foresters www.paulbunyan.net/users/norfor

Forest Resource Research
MFRC sponsored research www.cnr.umn.edu/FR/people/facstaff/perry/FRCriparian/fr/
University of Minnesota College of Natural Resources www.cnr.umn.edu
Forest Products Industry Minnesota Forest Industries www.minntrees.org
American Forest and Paper Association www.afandpa.org
Private Landowners Minnesota Forestry Association www.mnforest.com
Rural Partners minnesotaruralpartners.org
Forest Stewardship www.foresteward.org
American Tree Farm System www.treefarmsystem.org/index.html
Association of Consulting Foresters www.acf-foresters.com/

State Forestry and Natural Resources Departments
Minnesota Department of Natural Resources www.dnr.state.mn.us
National Association of State Foresters www.stateforesters.org
Tourism and Recreation Minnesota Hospitality www.hospitalitymn.com
Minnesota Office of Tourism www.exploreminnesota.com
Minnesota Parks & Trails Council www.mnptc.org
USDA Forest Service & State and Private Forestry Home Page www.fs.fed.us/
Chippewa National Forest www.fs.fed.us/r9/chippewa
Superior National Forest www.fs.fed.us/r9/superior
North Central Research Station www.ncrs.fs.fed.us/

Chapter 3: Benefits of Forests

Forests cover approximately one-third of Minnesota. While this is considerable lower than in presettlement times, this still represents a significant resource and divergent benefits on many levels for the state.

All forest lands produce significant timber and reforestation efforts which add over $6 billion to the state's economy. Forests provide a myriad of tangible and intangible benefits including wildlife habitat, non-timber crops, clean water, recreational opportunities, beauty and biological diversity. Forests provide opportunities for hunting, fishing, birding, skiing, snowmobiling, camping, motorized and non-motorized off-highway recreation and other outdoor activities. Forests protect waterways and water quality by reducing erosion, filtering runoff, and shading streams. They provide a rich and diverse habitat for native plants and animals.

Key Benefits:

- **Improving Habitat.** The state works with federal, tribal, county, rural, urban and other partners to maintain and improve habitat for game and nongame species. The primary activity is the joint planning of timber harvesting and other forest management activities. Other joint efforts and activities include managing shrub and grassland habitats, carrying out prescribed burns, and building hunter/walking trails and access points.
- **Protecting Biological Diversity and Cultural Resources.** The state works with several ecological partners to conserve biological diversity and sustain healthy forest ecosystems. A key effort is the joint development of subsection forest resource management plans(SFRMP), which includes addressing old-growth forests, extended rotation forests, areas of high and outstanding biological diversity significance, rare and endangered native plants and communities, use of the natural heritage database and newly developed ecological classification system, and ecologically important lowland conifers. Archaeologists review state timber sales and road projects to identify and protect important cultural or historic resources.
- **Keeping Forests Healthy.** The state monitors the condition of state lands for sustainable management purposes. Plans are done for timber harvests and tree planting to help keep forests healthy and productive. The state Legislature requires that forest land must be reforested to the amount of land equal to land harvested for timber each year. Improvements are also made to existing forests with activities such as thinning, removing damaged, sick, and poor-quality trees; employing new management techniques that limit the amount of pesticides and herbicides in new plantings; ensuring that the right tree species are planted in the right soil conditions; monitoring and fighting wildfires; educating the public as to forest health risks; and monitoring and treating forest pest outbreaks. Healthy forests include sustaining the quality of all tree species and the interwoven habitats that support sustainable wildlife habitats. Sustainable forest management will also ensure that quality trees are harvested, thus contributing to a healthy timber industry, while continuing to protect the soil and water quality of the state.
- **Maintaining Forest Roads.** The state maintains over 2,300 miles of state forest roads, which do not include federal, county, or private road systems. (The state is in the process of identifying all other ownership forest road patterns but this remains a gap in information at this time). The state road system alone supports two major industries including industry and forest products and tourism. More than 95% of state forest road use is open for recreation.
- **Providing Recreational Opportunities.** State forest lands and the state forest road and trail system provide diverse recreational opportunities, including, hunting, fishing, hiking, birding, berry picking, camping, picnicking, cross-country skiing, and motorized and non-motorized off-highway recreation, including OHVs, horseback riding and mountain biking.

Emerging Benefits:

Minnesota is a state with abundant forest land, expansive clean lakes, rivers and watersheds which have the potential to offset increasing emerging threats such as climate change, new invasive species, or changes in land use patterns due to fragmentation and parcelization. However, the state will need to be vigilant and pro-active in protecting key forest and water resources for future generations. For example, climate change is seen as being one of the most important environmental issues to emerge in the 21st century. Forests and urban trees can play a major role in the mitigating effects of climate change. Minnesota is well positioned to address the issue of climate change and monitor forest changes for the foreseeable future.

Research is currently being conducted in the state on both the potential for bio-fuels and carbon sequestration in helping to alleviate adverse effects of climate change. Research is also being conducted to assess the mitigating effects of urban trees on climate change. With predictions of the state becoming hotter and drier in the near future, forests play and will continue to play a major role in combating these climate change trends. It is imperative therefore that the state's forests and trees remain healthy through proper management to ensure quality forests, trees, soil, clean water and wildlife habitats for future generations.

Chapter 4: Issues, Threats and Opportunities

Minnesota forests and ecosystems face several major issues and threats. The state has identified the following as key issues and threats to address in the management of forest lands. These identified issues are not in any order of priority and occur at state, regional and local levels.

Maintenance of Minnesota's Forest Land Base: Increasing Threats of Forest Fragmentation and Parcelization

Minnesota's forest land ownership is shared among state, county, federal, and private landowners. Nearly half (46%) of Minnesota forest land is privately owned, with over 80% of the land owned by family forest land owners (also referred to as non-industrial private forest land owners). These various public and private ownerships are intermixed, creating a checkerboard ownership pattern over much of the state.

Minnesota's forests face an enormous challenge today: development pressures are increasing and impacting the state's ability to sustain its working forests. The state's private and public forest lands interact with each other across the landscape to create a working forest that provides many essential benefits Minnesotans care deeply about. Conserving this interconnected network of private and public lands as working forest is integral to Minnesota's overall quality of life. However, several factors are converging that could lead to the breaking up of Minnesota's working forest land base and the potential loss of public access for recreation, timber production and jobs, wildlife habitat, wetlands, and other forest values:

- Up until the recent economic downturn, forest land prices had been increasing. Forest land prices increased an average of 13% per year between 1989 and 2003. This increases the likelihood of parcelization (the breaking up of land ownership into smaller blocks) and decreases the purchasing power of land protection efforts. In 2003, the cost to protect land from development was five times greater than in 1989.
- The timber industry is restructuring. The owners of large tracts of forest land were typically forest products companies. In the 1990s many of these companies began to sell their forest land base to other types of owners, especially financial investors. These new owners value forest lands not only for their ability to supply forest products, but also for their investment potential through real estate development and other options.
- Major land ownership changes are occurring. More than 400,000 acres of Minnesota industrial forest land have changed ownership since 1998. Nearly 1 million acres of large, mostly undeveloped private forest is at risk of being sold and converted into smaller parcels. This change in ownership opens the doors to parcelization and fragmentation of large tracts of working forest land that have long been valued and used for public recreation, forest products production, and wildlife habitat. In central and southern Minnesota, key small, forested parcels are at risk of being developed, further reducing the region's already fragmented forest cover.

Changes in ownership and fragmentation/parcelization can threaten the future of public recreational access to large tracts of forest land. They can also limit access to public lands for timber and habitat management. Parcelization and related development may threaten the competitiveness of the timber industry and contribute to habitat fragmentation, which can increase the spread of invasive species and reduce wildlife habitat and water quality. The checkerboard pattern of ownership in Minnesota makes the management of lands, both public and private, more expensive than if they were consolidated.

Retaining a strong and sustainable working forest, adequate to meet the full array of forest benefits for current and future generations, needs to be a first conservation priority. Retention must be complemented by strategies that work to enhance the health, diversity, and productivity of Minnesota's forests. For example, recognizing the checkerboard ownership pattern and the trend of forest land parcelization, it is especially important that adequate expertise, resources, and incentives are available to Minnesota's 173,000 family forest land owners to manage their land to its full potential.

Maintenance and protection of water quality and quantity

Minnesota is known as the Land of 10,000 lakes, but in reality there are close to 12,000 lakes over 10 acres in size. The state also boasts an extensive system of all classes of wetlands totaling approximately 9.3 million acres. This is further enhanced by 92,000 miles of river systems, including the headwaters of three major US rivers: Mississippi, St. Lawrence, Red River of the North. Two other prominent river systems, including the St. Croix and Minnesota, add to make the state one of the most important water states in the nation. All these water systems contribute to high degrees of fresh water supplies, hydropower, irrigation, drinking water, recreation, habitat and fishing resources and waste disposal.[86]

In addition, an abundant underground water supply in unconsolidated and consolidated aquifers, provides approximately 75% of the state's drinking water and 90% of water used for agricultural irrigation purposes.[87]

Given the prominence of water bodies and systems in the state, it is imperative to manage these resources wisely. Currently the MPCA, BWSR, and the DNR's Division of Waters share this responsibility along with other state, local, and federal agencies. Many of these agencies are shifting their planning and monitoring focus to the 81 watersheds in the state. In particular, the MPCA has initiated a program to intensively inventory these watersheds on a 10 year cycle to identify healthy and impaired water systems as a way to streamline their total daily maximum loads (TMDL) through the federal EPA 319 program. Additional pressures on staff time in the near future include pressures to provide mitigation and replacement opportunities on public lands in NE Minnesota for impact by the mining industry to wetlands, surface and underground waters. Revised or expanded federal regulations on water resources such as the Army Corps of Engineers (ACE) 404 permit process will add further pressure on management and monitoring of water resources in the state, as will the demands from forest certification organizations.

It is very important that the forestry community be aware of the planning and monitoring activities of all these agencies, because the policies and regulations they develop as a result, could have significant impacts on forest and land management practices. This creates a need for forest management staff to develop and maintain collaborative contact with agencies such as BWSR, MPCA, and the DNR Division of Waters, so that they can provide timely pro-active input into individual watershed issues and policies as they are developed, rather than a reactive response late in the process. This also requires a commitment of staff time and training to be effective. This will be a challenge at the current level of state staffing within the state Division of Forestry. If the state is committed to properly manage and monitor its water resources, it must be prepared to address current and future staffing shortages.

Forest Health and Productivity

Minnesota's forests face many threats including global economic, ecological and social impacts of declining forest health, especially related to invasive terrestrial plants, insects and diseases. The state's forests and trees are critical to the economy and create approximately $6 billion annually in forest products. Tourism is an equally important part of the economy and depends on forested areas as a major attraction for outdoor recreation activities. Together these two industries employ almost 200,000 Minnesotans.

[86] "*Minnesota Shoreland Management Resource Guide*" www.shorelandmanagement.org
[87] "*USGS Ground Water Atlas of the US – Iowa, Michigan, Minnesota, Wisconsin" available at* http://pubs.usgs.gov/ha/ha730/ch_j/J-text1.html

Trees play a critical role in helping Minnesota meet its environmental goals and reduce adverse impacts of global climate change. Trees contribute by sequestering carbon dioxide, reducing, energy usage, and reducing storm water runoff – an annual value estimated at $126 per urban tree. Because of global trade and increased travel, new pests threaten the health and survival of many of the state's tree species. Invasive species are regarded as the fastest growing threat to biodiversity of forested lands in the United States and are second only to habitat loss in human-related causes of extinction. The failure to quickly detect and eradicate invasive tree pests could cost hundreds of millions of dollars and result in serious harm to Minnesota's environment and economy. Once a new invasive pest enters the state, success in eradicating it depends on early detection, rapid response, and the involvement and cooperation of property owners. Active management and monitoring of trees and forests for signs of invasive species is focused on known pathways for these pests, which may leave certain areas of the state unmonitored, unprotected and vulnerable. This creates a risk, that invasive species may become established and remain undetected for an extended period of time.[88]

There are good relationships between state and federal agencies and tribes that work in partnership to address forest and tree pests. Interagency coordination among state agencies (including the DNR and MN Department of Agriculture - MDA) and the federal government is strong. However, the state does not currently have a source of emergency response funds to immediately access and is dependent of federal agencies for support. While the federal government has in the past been a strong partner in response efforts for certain pests, federal budget problems have left states and local governments more at risk. More work also needs to be done to maintain these partnerships and to extend them to critical stakeholders including counties, townships, cities, and various nonprofit associations to address the risk to Minnesota's forest and trees.

In 2008, a statewide forest protection plan was developed through t MFRC[89] to prepare the state for early detection, appropriate response, and education of the public regarding invasive pests that threaten the state's forest resources. These pests include invasive insects, diseases, and plants. Also included was a need to address current storm damage responses and how that might be improved for forest health and to minimize vulnerability to pest infection. Key recommendations include:

- Because of the many agencies involved, a clear "front door" to access information and report concerns, needs to be established along with an ongoing public education and communications plan, so that the public can help identify possible invasions and actively participate in control measures and follow-up monitoring activities.
- To strengthen the forest protection system, more work is needed in risk assessment, further developing a statewide structure for response including clear definition and explanation of roles and responsibilities, and encouraging local governments to include forest and tree planning in their comprehensive plans.
- A desired next step is taking the awareness, planning, coordination, and early detection efforts to the local level of involving local units of government, tree advisors, and community volunteers.
- Ongoing and emergency response investments are needed to help avoid the hundreds of millions of dollars of costs that other states have expended in fighting major invasions. Funding is recommended for emergency response, statewide early detection and public education, community forest management, local tree removal and replanting, and management of storm damage and tree replacement.
- Ongoing forest protection planning is needed to further outline, explain, and clarify roles and responsibilities, engage all key stakeholders including local governments and the public, and form the overall framework for more invasive species specific plans such as the emerald ash borer plan.

For a review of the complete report go to:
www.frc.state.mn.us/documents/council/MFRC_ForestProtectionPlan_2008-01-01_Report.pd

[88] *"2008 MAD Forest Protection Plan"*

[89] The task force included members from academia, tribes, local units of government, forest products industries, nursery and landscape businesses, arborists and tree inspectors, tree advocacy organizations, master gardeners, and shade tree groups. Key state and federal agencies involved in forest and tree protection in Minnesota served as ex officio members of the task force.

Reducing Wildfire Risks

The DNR Division of Forestry trains and tracks current qualifications on the over 800 full-time and emergency personnel who are available to respond to fires statewide. Through the state's partnership in the Minnesota Incident Command System (MNICS), federal fire response personnel are also readily available. Agreements with federal agencies including USFS, USFWS, BIA, NPS and state tribes, allow for the sharing of personnel and equipment resulting in quick initial response to wildfires throughout the state.

DNR Forestry also maintains relationships with the states of Wisconsin and Michigan as well as the provinces of Ontario and Manitoba through the Great Lakes Forest Fire Compact (GLFFC). This relationship allows for the coordination and sharing of, and not only fire response personnel and equipment, but the sponsorship of training and expertise exchanges that benefit the member states and provinces.

The state maintains a strong relationship with USFS Northeast Area State and Private Forestry staff. This staff supports the state's efforts in the areas of national mobilization for emergency response, grant programs for preparedness and volunteer/rural fire department assistance, and access to federal excess property as referenced above. This relationship is of great value to the state's fire program in Minnesota and throughout the Northeast Region (USFS Region 9).

All the above relationships are considered very important to the state and provide opportunities to continue to partner and share resources such as personnel, equipment and support with all involved in wildfire preparedness and management.

A major concern in wildfire preparedness and management revolves around the aging of the state's overall workforce replacement of knowledgeable and experienced wildfire leadership staff as they reach retirement age. Many of the leaders in fire management in Minnesota and elsewhere are nearing retirement age, and/or are no longer physically able to actively take part in wildfire response. Replacing these personnel will involve major efforts in wildfire training along with acquiring needed experience and leadership skills. Support from federal and tribal partners and coordination among states will be needed to effectively replace wildfire leadership personnel and to continue the partnering efforts and established relationships.

Mitigation and Adaptation to Climate Change

The largest and most long-reaching issue for the state of Minnesota's forests is the threat of global climate change and increased atmospheric carbon dioxide on all ecosystems. According to the newly released *2009 Global Climate Change Impacts in the United States,* the Midwest including Minnesota could see substantial changes in temperature and amounts of precipitation, within a 50-year time span. How the state reacts to this major threat will directly impact the future and health of the state's forests.

Below are summaries of climate impacts on specific environmental categories as discussed in the *2009 Global Climate Change Impacts in the United States* report by the US Global Change Research Program.[90]

Ecosystem Process Impacts

Higher temperatures and more precipitation are predicted for Minnesota and have already been recorded by the state climatology office. While this appears to favor forest and tree growth, there are some factors, which could adversely impact the stability of the present forest lands and change the composition of these forests. It is now evident that carbon dioxide levels are increasing in the atmosphere and this favors rapid vegetative growth for both invasive species, which are adapted to quick changes in growth conditions and young forests. A higher atmospheric carbon dioxide concentration causes trees and other plants to capture more carbon from the atmosphere, but experiments show that trees put much of this extra carbon into producing fine roots and twigs, rather than new wood. The effect of carbon dioxide in increasing growth thus seems to be relatively modest, and generally is seen most strongly in young forests on fertile soils where there is also sufficient water to sustain this growth. Much of this pattern is evident in parts of Minnesota. On the other hand, in areas of the state where

[90] Thomas R. Karl, et al.

droughts have the potential to continue, water could be scarce, forest productivity could decrease and tree deaths may increase. Monitoring will be essential to show trends in these areas in the future.

Species Range Shifts and Changes

Climate change is already showing impacts on both plant and animal species in the US and the state of Minnesota. Ice is receding earlier on lakes, spring is arriving earlier, some migratory birds are arriving earlier, and the growing season is lengthening. This will over time, result in species redistribution and habitat changes. Forest tree species are expected to shift their ranges northward and upward in response to climate change, which could cause major changes to the composition and character of northern Minnesota forests. It is projected that southern species such as the oak-hickory forest will expand, while the maple-beech-birch forest will contract. In northern Minnesota, the spruce-fir forests are likely to disappear completely from the landscape. Sensitive native species are especially vulnerable to extinction both from not being able to adapt quickly to climate changes or being over-run by invasive species, which thrive on climate change. Evidence of this can already be found in the state's forests with buckthorn, earthworm, gypsy moth, and garlic mustard infestations. The 2009 discovery of emerald ash borer in the state may increase the risk of ash tree species becoming a minor component in Minnesota forest lands.

The Intergovernmental Panel on Climate Change[91] has estimated that if warming of 3.5 to 5.5 degrees F. occurs in the future, 20-30% of species would be outside their normal range of habitats and at risk of extinction. In Minnesota, recent research on mammals and fish species has indicated the same.[92] Climate change is thus superimposed on other stresses such as habitat loss and over-harvesting of some species, with considerable declines and potential extinctions in some state species.

Insects and Diseases

Forest insect and disease pests are sensitive to climate change and variations in their life cycles but generally favor warm conditions over cold. In Minnesota pest outbreaks are cyclical depending on weather and other conditions. However, rising temperatures will increase insect outbreaks and favor conditions for disease organisms to cause significant losses in a number of ways. Firstly, warmer winter temperatures will allow more insects and disease organisms to survive the cold season that normally limits their numbers. Secondly, longer growing seasons will allow these pests to develop faster and possibly complete multiple life cycles in one season, as in the case of insects. This would exponentially raise these insect species numbers. Thirdly, warmer conditions will help these species expand their ranges northward and become established and significant outside their historic ranges. Fourthly, if droughts continue in parts of the state, trees will be increasingly stressed and be more attractive to some insect and disease organisms as well as have a diminished capacity to resist successful attacks of insect and disease organisms, thus potentially leading to greater losses. Finally, such warm weather insect and disease outbreaks will contribute to dead forests, which increases the fuel loads for wildfires.

Forest Fires

Minnesota tracks and responds to forest fire occurrences throughout the state. The climate predictions of hotter and longer summer seasons, coupled with increased land fragmentation and pest/pathogen/disease outbreaks will contribute to more intense needs to combat forest fires, especially between the rural/urban interface. More forest fires will also mean reduced moisture and increased drying of vegetation and soils, thus increasing the potential for more intense and catastrophic fires in the future.

Invasive Species

Problems related to invasive plant species arise from a mix of human-induced changes such as land clearing for development, deliberate or accidental transport of nonnative species, the increase of nitrogen for agriculture which in turn affects many plant species, including aquatic species and rising carbon dioxide concentration in the atmosphere. All these influences combine to encourage the spread and growth of invasive species.

The increasing atmospheric carbon dioxide concentration stimulates the growth of most plant species but seems to especially favor the growth rate and vigor of invasive plant species. When these plants grow faster,

[91] Thomas R. Karl et al.

[92] DNR Fisheries

taller and stronger than native plants, they out-compete the natives. Invasive plants also tolerate wider ranges of environment and can establish themselves quicker than native plants and are not usually dependent on external pollinators or seed dispersers to reproduce. For these reasons, invasive plants present a growing problem to the health and vitality of Minnesota's forests in an increasingly warmer climate.

Invasive aquatic species will also likely increase in numbers and distribution due to an increasingly warmer climate. Native freshwater mussels, for example, are particularly vulnerable to conditions that will favor an increase in zebra mussel infestations.

Water Protection

Climate change will increase water temperatures in Minnesota. Already there have been some indications of this. Fresh water fish are showing the signs of increased stress through increased metabolism, higher rates of disease and lower rates of reproduction. Riparian canopy cover is critical in stabilizing cool stream water temperatures but these environments will be in jeopardy as warmer temperatures affect soil moisture content and tree growing conditions. Brook trout in Minnesota are particularly vulnerable to warmer waters and could disappear entirely from state streams, in the near future. Other species of fresh water fish which favor warmer water environments will probably increase including muskie, smallmouth bass and bluegills. Research is being conducted to monitor these changes in the state.[93]

Climate change in the state could also lead to fewer precipitation events, prolonged droughts and increased flood intensity and duration. These scenario changes will affect freshwater systems by changing stream flows and velocities, in addition to temperature which will likely change water volumes in lakes and groundwater supplies, further strengthening the need to retain or manage for forest and riparian canopy cover. The increased demands that humans will place on the state's rivers and streams as sources of freshwater for private, municipal, commercial, and agricultural uses, will create new challenges which will be difficult to address in a rapidly changing warmer environment.

Forests and Carbon Storage

Forests provide many services important to the well-being of Minnesotans including air and water quality maintenance, water flow regulation and watershed protection; wildlife habitat and biodiversity conservation; recreational opportunities and aesthetic and spiritual fulfillment; raw materials for wood and paper products and non-timber products; and climate regulation and carbon storage. A changing climate will alter the state's forests and services they provide and could cause detrimental changes including economic losses to the state.

Currently, forest growth and long-lived forest products offset approximately 20% of fossil fuel carbon emissions in the US. The carbon 'sink' in Minnesota is more than 16 million acres of forest land and nearly 6 million acres of peat lands. These lands contain very large carbon stocks in standing plant biomass (1.6 billion metric tons in forest lands and 4.25 billion metric tons in peat lands). Warmer climates could alter the carbon 'sink' capacity, if, a scenario for these lands lean towards a drying out effect; (either through loss of moisture from lack of precipitation, or catastrophic wildfires).

Recreational Shifts

Minnesota enjoys higher than average rates outdoor recreation participation in the United States. The state is especially noted for its vast amounts of lakes, rivers, and streams in forest or woodland settings. Weather conditions are an important factor influencing the tourist participation in the outdoors. Already changes have been observed in the state's outdoor participation in relation to weather, especially with winter sports. Lakes are freezing later and melting earlier in the spring, meaning that ice-fishing is experiencing a shorter season. The same can be stated for both snowmobiling and cross-country skiing, which rely on good snow packs and consistent snow cover. Both have been more frequently absent in the past few years. This has had adverse effects on resort owners who depend on good winter conditions for their operations. Adverse effects could also be possible through the loss of some fish species which depend on cold weather for their survival. If specific fish species disappear from the state's waters due to warming water trends, this could negatively impact a very healthy fishing industry in the state. However, other outdoor recreational activities could see increases, most

[93] DNR Fisheries

notably summer water activities and fall hunting activities. Both will have extended periods in which to participate as the climate becomes warmer.

Support of a Healthy Forest Products Industry

Minnesota is a leader in timber production in the continental United States. Timber production and all its subsidiary economic activities provide over $6 billion to the state's economy each year, and directly supports 38,000 jobs, which makes this the fourth largest industry in the state. Healthy forests are key to retaining jobs in forest products manufacturing and in supporting industry and tourism. The main tool for accomplishing sustainable forest management in the state is commercial timber harvesting. For this reason, it is important to maintain strong and diverse markets for forest products. A healthy, integrated and competitive primary forest products industry that continues to attract investment is vital to Minnesota's economy as well as to the health of the state's forests.

Use of Woody Biomass for Energy

Legislative efforts to mitigate climate change and concerns over energy security are producing structural change in wood-using industries and is increasing the demand for renewable resources. While Minnesota's forests can and have historically been a source of renewable energy, competitive visions for the use of woody resources are emerging. Demand for woody biomass in renewable energy production is forecast to increase from 5% of total U.S. wood consumption in 2008 to 40% U.S. wood consumption by 2022. A challenge exists for Minnesota to harvest and maintain its wood resources in a way that provides: 1) a sustainable source of renewable energy, 2) works in conjunction with our forest products industry, 3) produces quality timber, and 4) maintains healthy and productive forests. Wood resources are large enough to offset around 3% of fossil energy needs in the state; this resource is meaningful if incentives and policies target wood strategically in the energy economy.

Economic development and growth in the timber industry and in the field of renewable energy will be dependent upon efficient utilization and procurement of available resources. In order for wood to be used in a broad range of energy applications, the state must enhance productivity on available forested lands and sustain its logging and wood industry. Meeting expanding demands for wood fiber while optimizing the productivity of all forest resources requires expanded investments and improved flexibility in the management of low productivity forest stands that cannot support a viable timber sale. Additionally, an opportunity exists for the state to grow its resource availability by developing procurement technologies for the sustainable harvest of brushlands.

Maintenance and Enhancement of Rare Ecological Features

Minnesota has identified a variety of forest systems that provide important values to the state's biodiversity and sustainable forest systems including old growth, high conservation value forest, areas with state and federally listed species among others. These areas are not only rare on the landscape but also provide a variety of values to the state's forests as a whole. Therefore as the state focuses on managing healthy forest systems, maintenance and enhancement of rare ecological features as part of these forest systems should become a priority to maintain the health and resilience of the system. Many rare ecological sites hold the legacy of the state's forested landscape. As threats such as invasive species, fragmentation, and climate change impact the landscape, careful management and maintenance of identified rare sites can provide a source of resiliency for the future.

Efforts such as forest certification, the "*State Wildlife Action Plan"* (SWAP), the DNR "*Native Plant Community Field Guide"s* and the Minnesota County Biological Survey (CBS), coupled with federal and non-profit identification and restoration efforts, provide guidance for preservation of rare ecological features and systems for the future of forests within the state.

Recreational Use of Forest Lands

Minnesota has a long tradition of forest recreation in the 16.7 million acres of forest land in the state. Forest Recreation includes a wide variety of activities such as hunting, cross-country skiing, taking a leisurely walk to see the autumn leaf colors, camping, backpacking, horse riding or berry picking and much, much more. In recent years geocaching and all-terrain vehicle riding in some forests have become very popular. These have all been opportunities for recreationists to keep in touch with the natural environment.

Forest recreation promotes physical and emotional health. The state encourages responsible forest recreation and sees it as an opportunity for people to get beneficial physical exercise and as a way to get some respite from the daily stress of work and life in general. The forest is also a great learning environment that has many lessons to teach about the value of inter-dependence and the ethical uses of planet earth. Stewardship of the state's natural resources, whether public or private, is encouraged by a better understanding of the way humans are dependent on healthy forests. In turn, healthy forests contribute to a healthy society.

Urban and Community Forestry

Urban and community forestry (U&CF) in Minnesota is a statewide collaboration that unites many agencies, organizations, communities, decision makers, and citizens. DNR provides financial and technical assistance to these collaborations to support cooperative programs, research, and education to advance a comprehensive approach to the management of trees in cities. Through the support of the Federal Urban and Community Forestry Program, the following goals have been identified for implementation:

- support local community urban and community forestry programs
- support and expand the partnership efforts with the University of Minnesota and non-profits to provide technical assistance, educational outreach and administrative support to meet the increased interest and demand from communities
- strengthen advocacy and expand volunteer participation to support local, state, and national initiatives through fundraising and legislative efforts

Several challenges have been identified within urban and community forestry including the recent discovery of EAB in southwestern Wisconsin and also the heart of Minneapolis-St. Paul. There is a highly accelerated need for public information and community assistance to combat this new invasive species. Other challenges include a greater need for expertise, training in current technologies and technical assistance to Minnesota communities; a need for heightened political awareness and support that will result in state funding initiatives; a need for increased partnerships among organizations and communities in Greater Minnesota (outstate); loss of forest land to urbanization (and subsequent tree losses), technical assistance for shade tree pests and tree maintenance; lack of vision for sustainable community design and ecosystem approaches for local land use planning.

Specific priorities are emerging within urban and community forestry including the following:

- Expand the DNR-led statewide Tree Inspector certification program to include cities in Greater Minnesota who are facing the greatest threat from EAB.
- Involve more statewide organizations to improve coordination with MDA in monitoring and planning for greater state investments in exotic invasive pest control (gypsy moth, EAB, etc.).
- Involve more private and public tree practitioners in the Minnesota Society of Arboriculture (MSA) and Minnesota Shade Tree Advisory Committee (MnSTAC) in efforts to improve professional standards statewide.
- Build upon the partnership with the USFS iTree Team to promote the use of these tools by public and private practitioners, and continue to build upon the awareness created by the "Trees Pay Us Back" publicity campaign to garner greater state and local investments in urban and community programs.

Chapter 5: State Geo-Spatial Priorities

Methodology and Analysis documentation

Four spatial models were created to depict significant areas in Minnesota's Forests. This chapter describes the models and methodology & data layers used to identify these areas.

The **Threats and Risks map** and **Economic Impact map** were created by simple overlay analysis. GIS layers (described for both maps in more detail below) that represent individual contributions to each theme were developed or converted to raster layers. The cells in each layer represented the presence or absence of the input phenomenon (0 = not present in this area) and in most cases a low, medium or high value (1,2,3 respectively) to represent the amount or impact of the phenomenon in any pixel of interest. Once each contributing layer was created, they were added together to create a map with values from 0 to max, where max was the sum of highest values from each contributing layer. In this intermediate layer, pixels with a value of 0 represented areas on the ground with none of the contributing factors, and pixels with a value of max represented areas with all of the highest contributing factors.

Once the layers were added, the values of the resulting maps were again grouped into values of high, medium, low and none. The exact thresholds were determined by creating example maps and asking subject area experts to determine which map most closely represented the Risk/Impact for areas of Minnesota's forests.

The **Ecological Values map** and **Recreational Values map** were created for a different project with goals very similar to this statewide assessment. The project, entitled "*Minnesota Forests for the Future"*, intends to use the results of the four spatial models to identify areas with the highest return for long term forest easements. The two maps developed by MFF project staff used a more specialized approach to identify target areas. Although the outcome (a map of high value areas) is the same for all maps, the reader may notice the difference between these two methodologies when reviewing this chapter. The methodology used to create the final maps is described after the contributing layers for these maps.

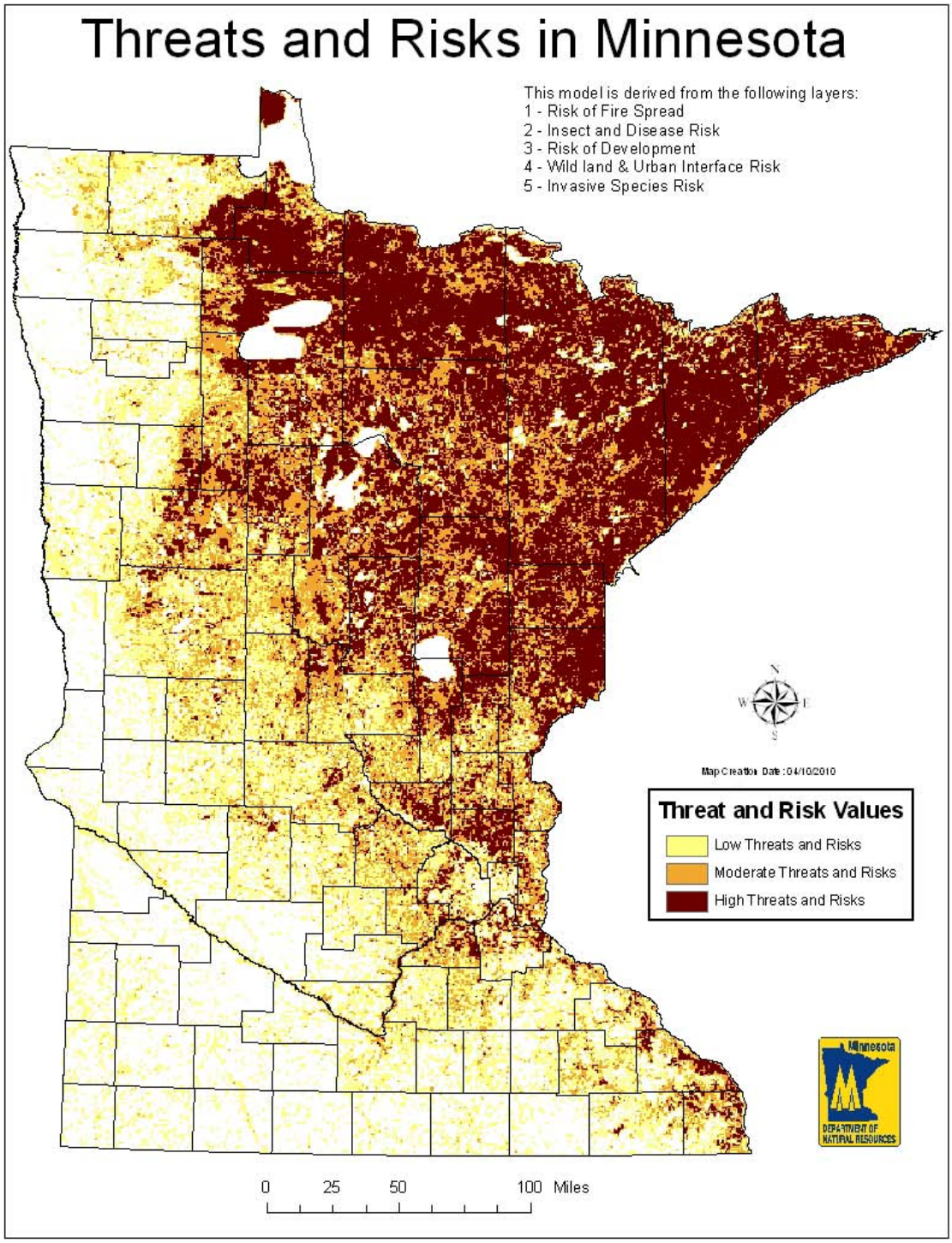
Threats and Risks map
This model is the result of an overlay analysis of five datasets important to assessing Minnesota's vulnerability to fire, insect & disease, invasive species threats and the risk of development. The model created from this overlay highlights areas of low, moderate and high risk. (Figure 76: Figure Layers 77-81)

Economic Impact map
To depict the potential economic impact of Minnesota's forested areas, seven datasets were evaluated and used in the overlay analysis; including lands with permanent forest conservation easements (e.g., forest legacy lands), trust fund lands, lands with Forest Stewardship plans, and mill locations. The resulting model highlights areas of low, moderate and high potential economic impacts. (Figure 82: Figure Layers 83-90).

Ecological Values map
The DNR created these habitat models to help determine what remaining natural areas should be protected in the face of rapid suburban development. The results are not meant to be the definitive locations of important ecological areas, but rather as a starting point for future field assessments. This landscape scale product is useful for region wide planning efforts, such as park planning, locating conservation corridors or countywide general planning and zoning. These habitat models evaluate terrestrial and wetland areas based on land cover characteristics: size, shape, connectivity, species diversity, and compatibility of adjacent land uses. (Figure 91)

Recreational Values map
This map was created to identify areas with high opportunities for scenic outdoor recreation such as bicycling, walking, camping and sightseeing. (Figure 92).

• Figure 76. Threats and Risks in Minnesota



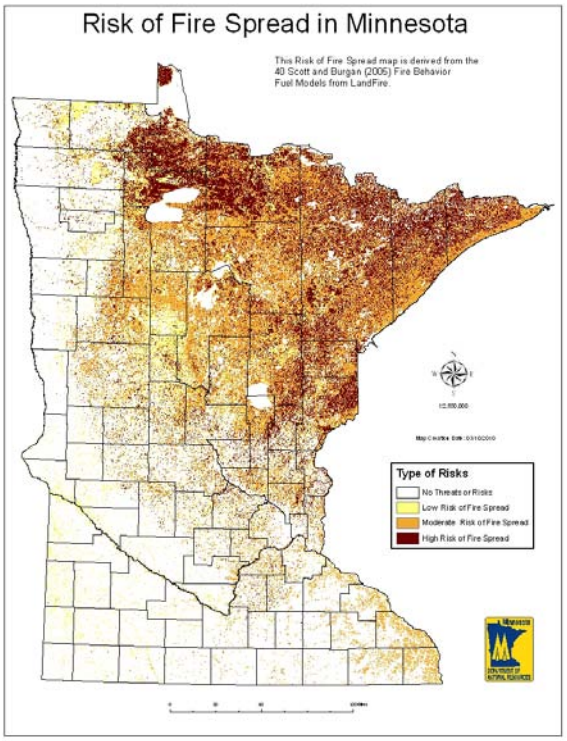
Low Threats and Risks	= 7,709,975 Acres
Moderate Threats and Risks	= 7,594,246 Acres
High Threats and Risks	= 14,197,492 Acres[JN1]

The following five data layers were used to create the **Threats and Risks** map.

1. Risk of Fire

This LANDFIRE fuel data describe the composition and characteristics of both surface fuel and canopy fuel. This layer shows areas at elevated risk from wildfire damage. It was created from the LANDFIRE 40 Scott and Burgan (2005) Fire Behavior Fuel Models. The layer was then re-classified to three fuel types, low, moderate and high risk of fire spread based on the original fuel type models.

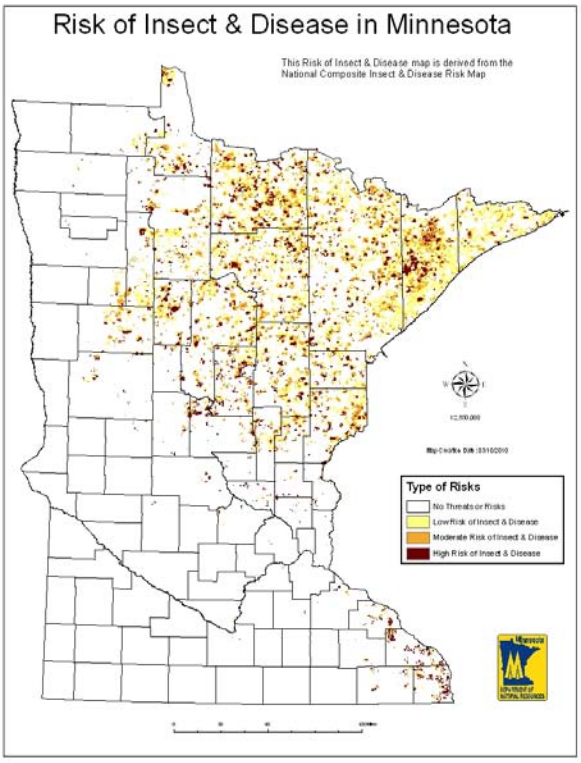
• Figure 77. Risk of Fire Spread



2. Risk of Forest Pests

A national "risk mapping" effort performed by the U.S. Forest Service, Forest Health Technology Enterprise Team formed the layer used to identify forest areas at risk of mortality from insect and disease infestation. The layer was classified to three risk categories, low, moderate & high based on percentage of predicted loss of basal area. This layer was a national effort, and as such the resolution of the data is 2 kilometers by 2 kilometers. Areas at risk are shown in gradation from yellow (lowest) to dark red (highest).

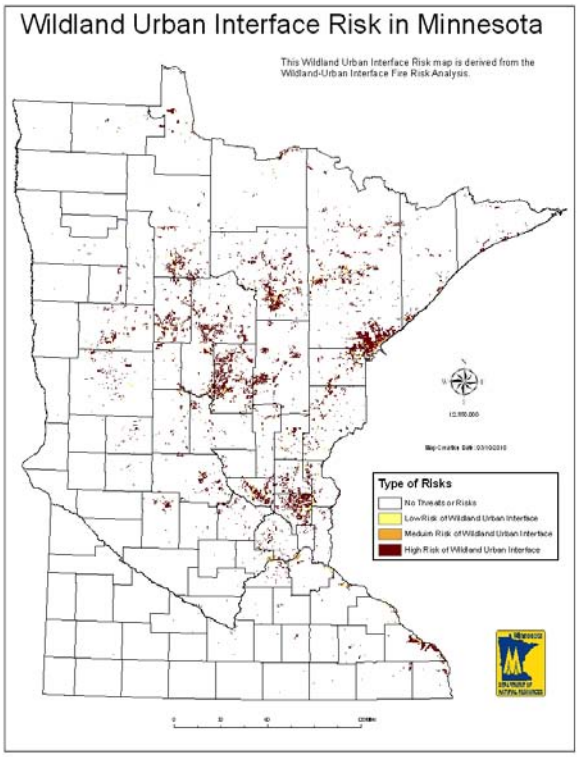
• Figure 78. Risk of Insect & Disease



3. Risk from the Wildland-Urban Interface

The "Wildland-Urban Interface (WUI) is the area where houses meet or intermingle with Undeveloped Wildland vegetation". This WUI layer was created by integrating U.S. Census and USGS National Land Cover Data to map the Federal Register definition of WUI explained above. The layer was then classified to three specific types of risk, low, moderate & high risk based on population density and vegetation intermix.

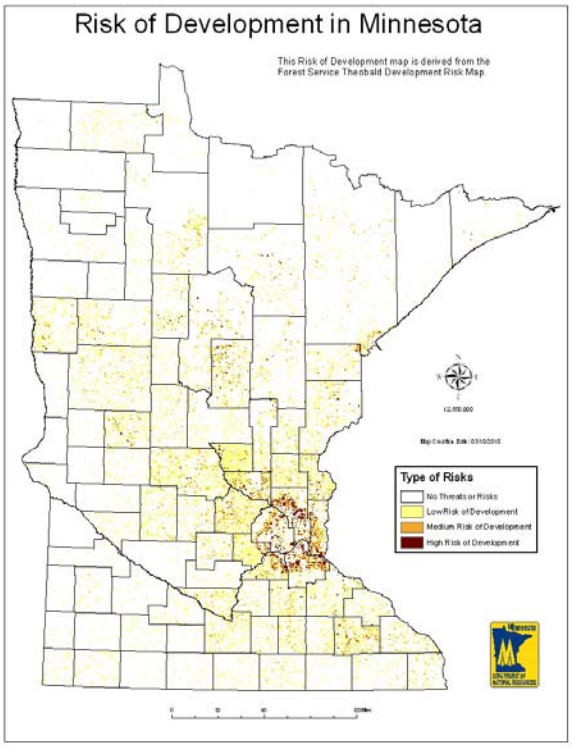
• Figure 79. Wildland Urban Interface Risk



4. Risk of Development

This Development Risk layer is the result of a subtraction of the US Census Bureau Block 2030 and 2000 datasets to produce a classification of predicted housing density. The development risk data layer is intended to emphasize areas that are projected to experience increase housing development in the next 30 years. The Development Risk layer was then classified to three housing density types, low, moderate & high development risk based on the original definitions.

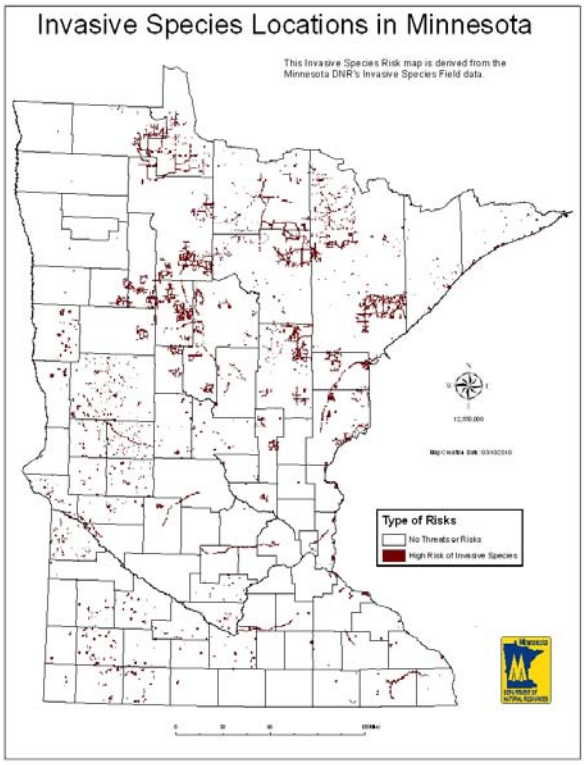
• Figure 80. Risk of Development



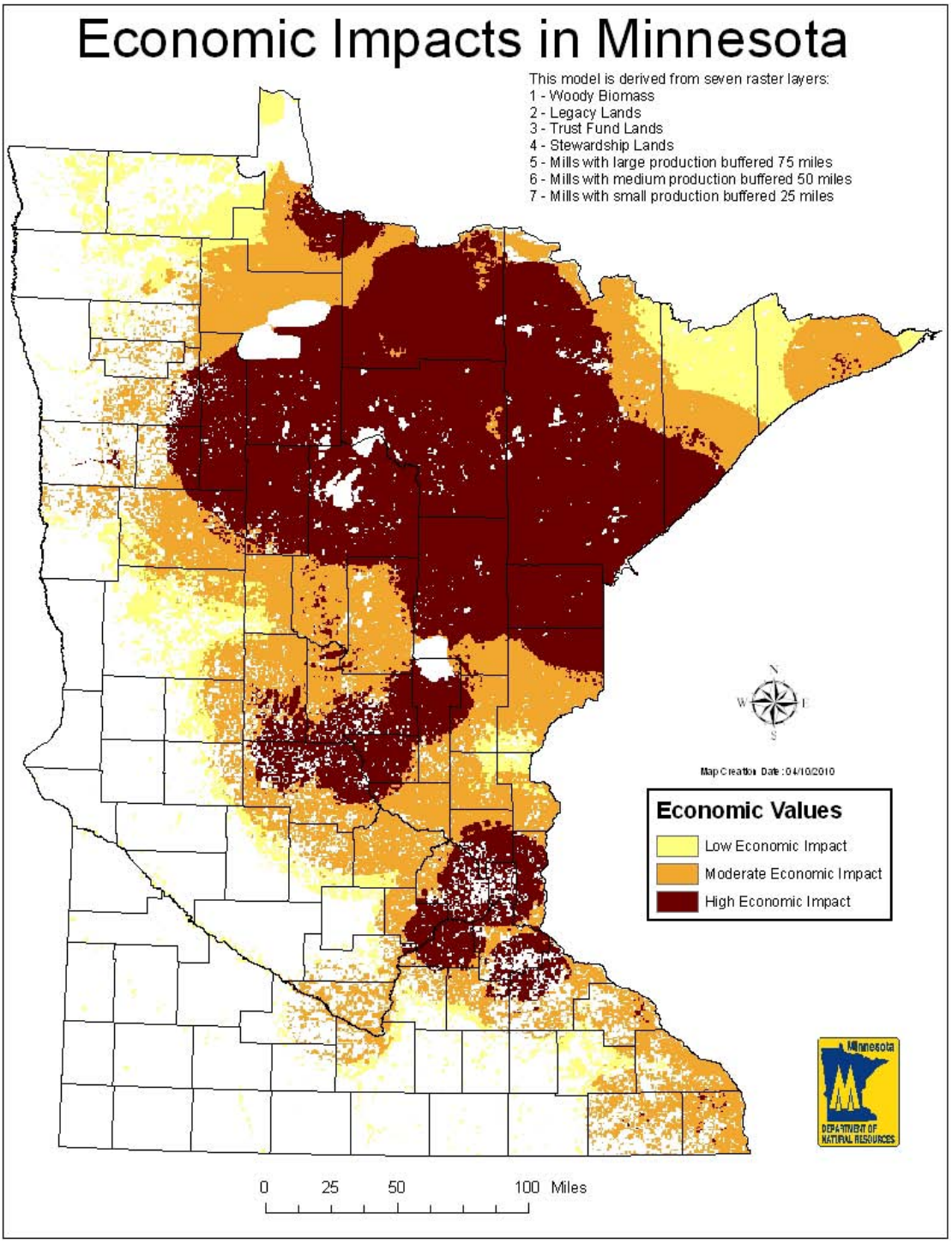
5. Terrestrial Invasive Species

This layer is an ongoing Multi-Divisional effort to record GPS locations of selected terrestrial invasive plants on Minnesota DNR land and other selected locations. The original dataset is a point file containing estimated area of infestation. This dataset was buffered to the estimated area then re-classified to a binary raster.

- Figure 81. Invasive Species Locations



• Figure 82. Economic Impacts



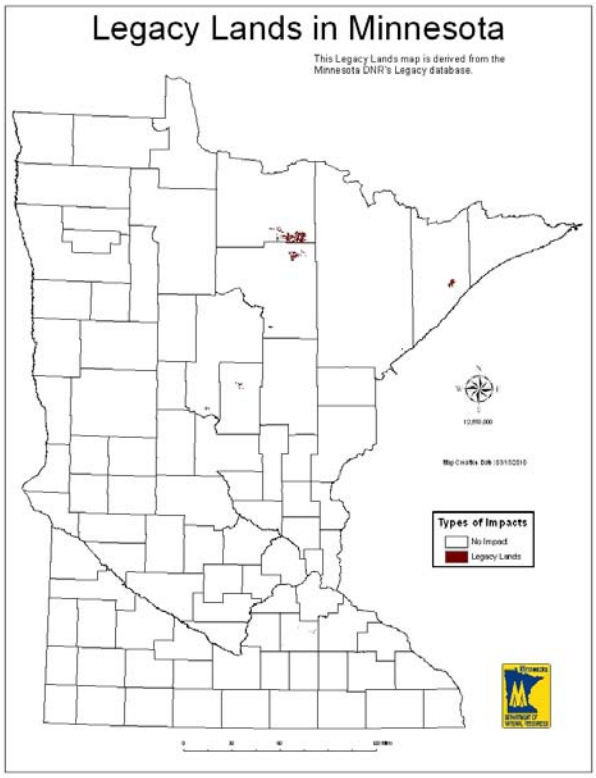
Low Economic Impacts	= 3,309,209 Acres
Moderate Economic Impacts	= 9,750,477 Acres
High Economic Impacts	= 13,753,919 Acres

The following seven data layers were used to create the **Economic Impacts** map.

1. Legacy Lands

The Minnesota Forest Legacy Program protects environmentally important forests throughout the state threatened by conversion to non-forest uses. Federal funds and local matching funds are used to purchase development rights and conservation easements on these forests in targeted areas of Minnesota to keep them intact and continuing to provide forest benefits. This layer is included given the importance placed on these conservation easement lands as "working forests."

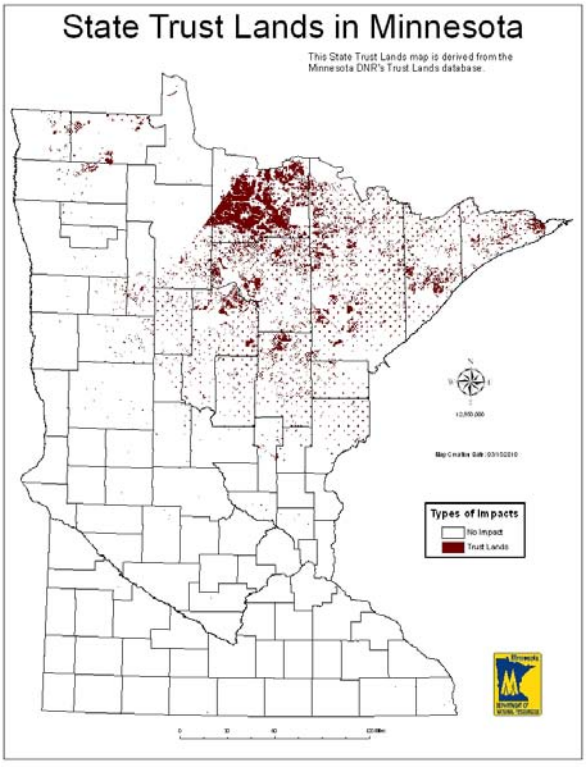
• Figure 83. Legacy Lands



2. State Trust Lands

This State Trust Fund Lands layer merges the DNR Control Point Generated PLS layer with IBM mainframe-based land records. The data are limited to a PLS forty or government lot level of resolution. This layer shows the location of Trust Fund lands in Minnesota. It is included in the analysis given the importance of these lands in generating revenue for the permanent School Trust Fund.

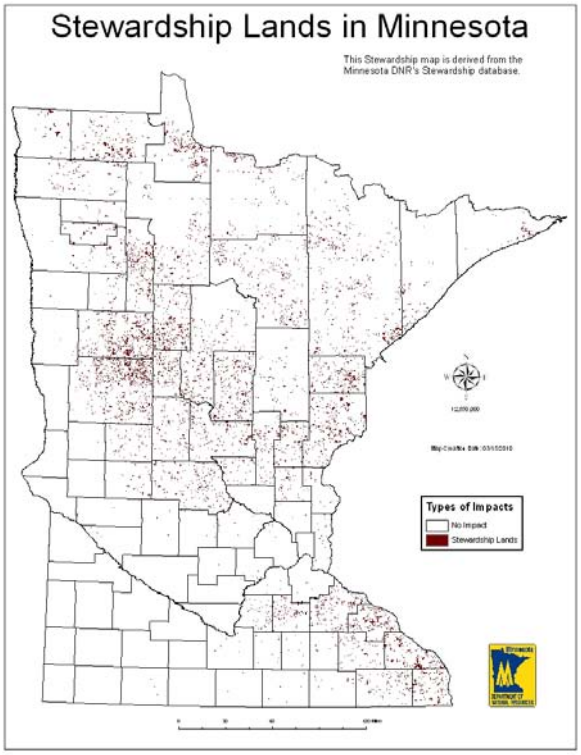
• Figure 84. State Trust Lands



• Figure 85. Stewardship Lands

3. Stewardship Lands

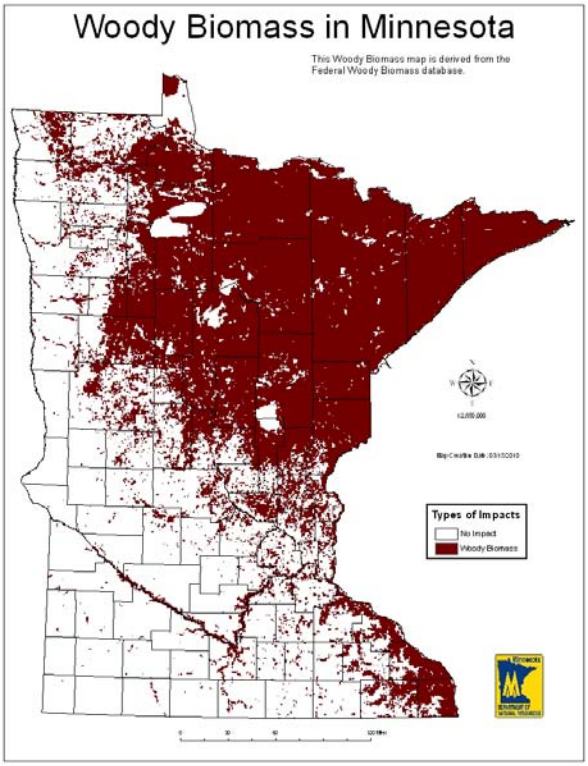
In the fall of 2004, Minnesota DNR and the U.S. Forest Service began working together to create a digital database of existing forest stewardship plans and also a GIS layer representing the level of "benefit" gained from potential forest stewardship work. This layer was included in the analysis given the investments and interest of associated landowners in carrying out active forest management.



• Figure 86. Woody Biomass

4. Woody Biomass

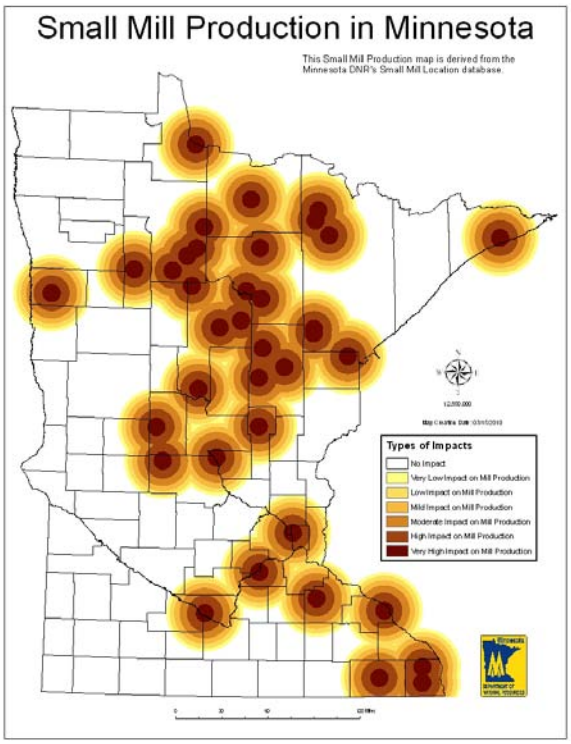
The USDA Forest Service FIA, Remote Sensing Applications Center created this layer. It is a spatially explicit dataset of aboveground live forest biomass was made from ground measured inventory plots for the conterminous U.S., Alaska and Puerto Rico. The plot data are from the USDA Forest Service Forest Inventory and Analysis (FIA) program. Models were then developed to relate field-measured response variables to plot attributes serving as the predictor variables. The geospatial predictor variables included MODIS, NLCD, topography, climate parameters and other ancillary variables.



5. Small Mills

For this model, small sized mills are defined as having a production rate of less than 75 board feet annually. To demonstrate the economic impact small mills will have on an area these mills were extracted from the DNR's mill location database and buffered using a Euclidean distance of 25 miles. The resulting layer was then re-classified to six specific buffer zones depicting the relative proximity and potential importance of an area to the associated mill.

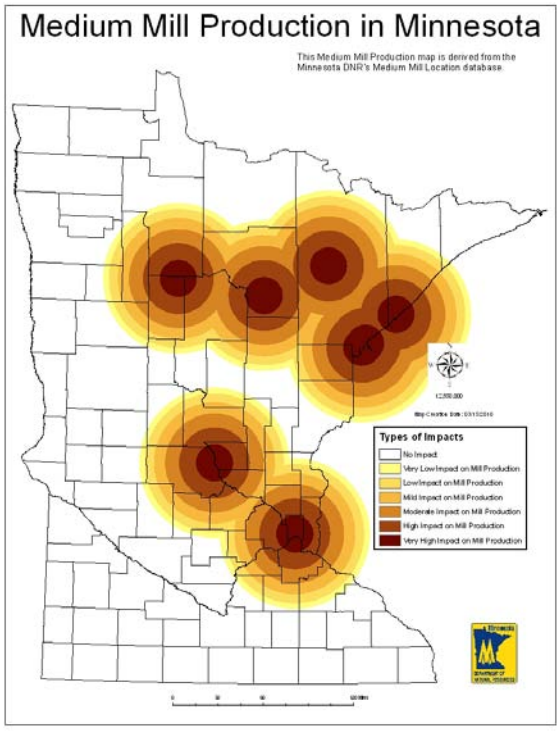
• Figure 87. Small Mill Production



6. Medium Mills

For this model, Medium sized mills are defined as having a production rate of 75 to 200 board feet annually. To demonstrate the economic impact medium mills will have on an area these mills were extracted from the DNR's mill location database and buffered using a Euclidean distance of 50 miles (woody biomass energy mill were included in this category). The resulting layer was then re-classified to six specific buffer zones depicting the relative proximity and potential importance of an area to the associated mill.

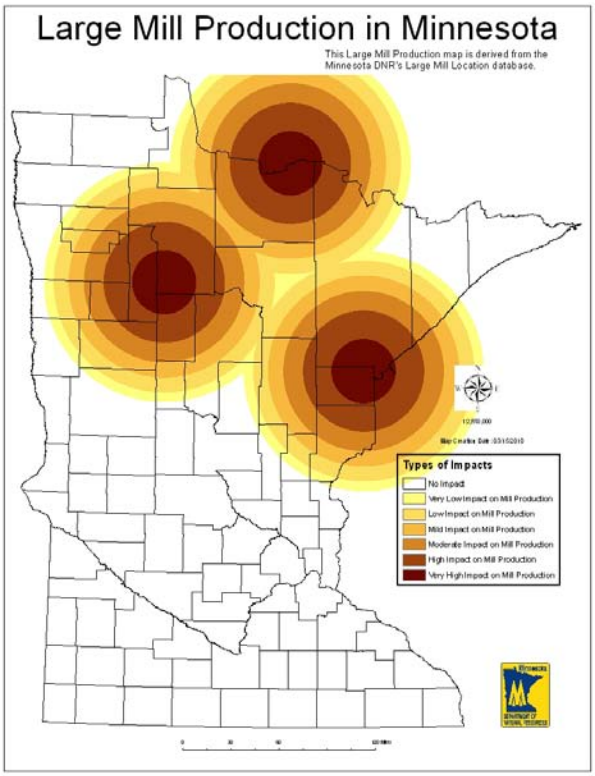
• Figure 88. Medium Mill Production



7. Large Mills

For this model, large sized mills are defined as having a production rate of greater than 200 board feet annually. To demonstrate the economic impact large mills will have on an area these mills were extracted from the DNR's mill location database and buffered using a Euclidean distance of 75 miles. The resulting layer was then re-classified to six specific buffer zones depicting the relative proximity and potential importance of an area to the associated mill.

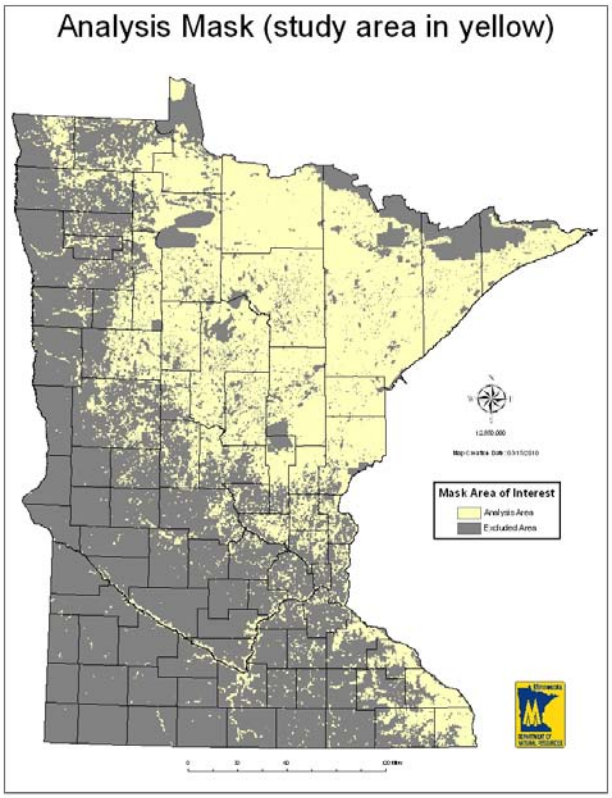
• Figure 89. Large Mill Production



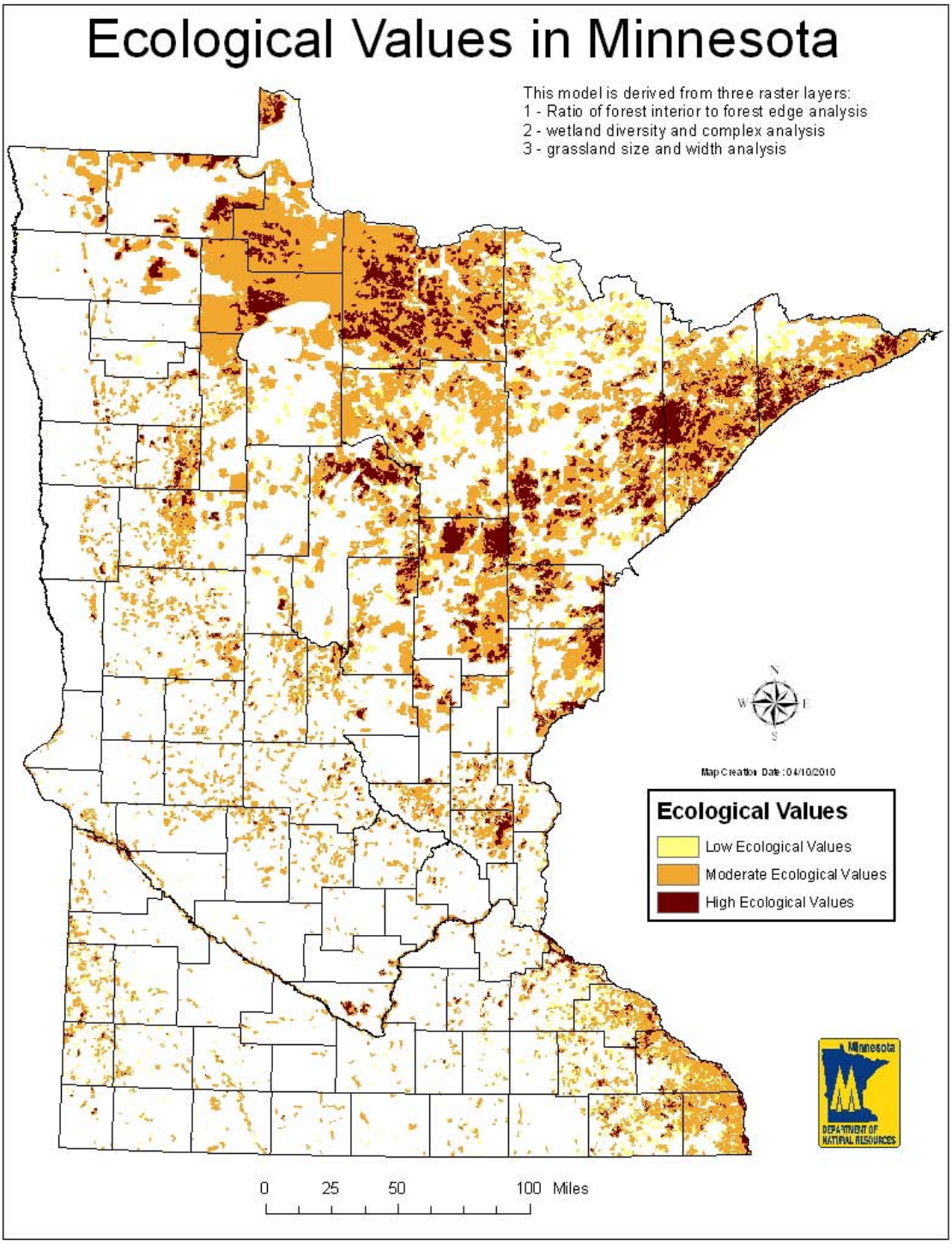
Analysis Mask

The area of interest for the Economic Impact and Threats & Risks models was constrained to areas of the state with woody biomass excluding the Boundary Water Canoe Area Wilderness, Voyageurs National Park and Minnesota State Park Lands.

• Figure 90. Analysis Mask



• Figure 91. Ecological Values



Low Ecological Values = 834,907 Acres
Moderate Ecological Values = 8,243,558 Acres
High Ecological Values = 2,590,333 Acres

The following models were used to create the **Ecological Values** map.

Due to the limitations of satellite interpretation and land use data layers, the forest models were run using land cover that included natural forest stands as well as semi-natural working forests including tree farms, nurseries, and plantations.

1. Ratio of Forest Interior to Forest Edge Analysis

The habitat requirements of 5 bird species, the red-eyed vireo, wood thrush, scarlet tanager, ovenbird and eastern wood pewee, were used to map interior forest. Interior forest (core) patches were identified and scored based on:

- forest patch size (minimum patch size was 24 hectares)
- edge effect (edges, by definition not forest interior, were 120 meters wide)
- percent of total patch that was core
- distance to a source patch (i.e., forest patch 100 hectares or greater in size with more than 40% core)
- additional forest areas at least 150 meters wide and connected to a forest core patch were included for their habitat, buffer, and connectivity benefits

2. Wetland Diversity and Complex Analysis

While many wetlands are regulated under state and/or federal laws, this model evaluates wetlands on 2 characteristics: A. connectivity to uplands and other wetlands; B. diversity of wetland and upland cover types associated with the wetland.

A. **Wetland Complex:** The model finds wetlands that are close enough to separated by thin strips of upland natural vegetation. Wetlands were identified and scored based on:

- wetland size (minimum wetland size 10 hectares)
- connection to other wetlands (3 or more wetlands connected by natural vegetation within 120 m of a wetland)
- complex size (minimum 60 hectares)

B. **Wetland Diversity:** The model finds large wetlands with a diversity of cover types. Wetlands were identified and scored based on:

- wetland size (minimum 10 hectares)
- diversity of cover (individual wetlands must have at least 2 different natural cover types, one being at least 25% of the total area)

3. Grassland Size and Width Analysis

Due to satellite limitations some of the grasslands used in the model may be semi-natural vegetation, such as: hayfields, fallow fields or infrequently mowed grass. Grasslands in the GAP data used in the models is not well represented, and most likely has been under counted.

This model identifies ‘tall grasslands’, which are relatively large areas of unmowed grasses, both native and non-native.

Grasslands were identified and scored based on:

- size (minimum size for tall grasslands was 16 hectares with a minimum width of 90 meters)
- maintained grasslands (i.e., infrequently mowed hayfields and pastures) at least 90 meters wide and connected to tall grasslands 16 hectares or greater in size were included for their habitat, buffering, and connectivity benefits

MCBS mapped native plant communities

All native plant communities mapped to date by the Minnesota County Biological Survey (MCBS) were incorporated. These native plant communities were ranked according to the Biodiversity Significance Rank of the MCBS sites within which they occurred. Biodiversity Significance Ranks have been applied to sites by the MCBS program. All sites with ranks of outstanding, high and moderate are considered by the MCBS program to be significant, but relative ranks help to prioritize sites for preservation. Brief definitions of these ranks follow:

Outstanding biodiversity sites contain the best occurrences of the rarest species and/or the most outstanding examples of the rarest native plant communities, and/or the largest, most intact ecological landscapes present in the state.

High biodiversity sites contain very good quality occurrences of rare species and/or high quality examples of rare native plant communities, and/or important ecological landscapes. These areas may be smaller in size, or have fewer occurrences of rare plants and/or plant communities than have the outstanding sites.

Moderate biodiversity sites contain important occurrences of rare species, and/or moderately disturbed native plant communities, and/or landscapes that have a strong potential for recovery

Ecological Patch Composite Model

Patch Scores

Natural areas identified through the individual forest, wetland, and grassland models are integrated with Minnesota County Biological Survey sites to identify the final ecological patches. The patches are then assigned a final score of 3, 2, or 1 (3 being the highest) based on how well the area meets standards for size, shape, connectivity, adjacent land use/cover, and species diversity.

Score 3 - These areas tend to be larger in size, and/or with few adjacent land cover types or land uses that could adversely affect the area; may have greater diversity of vegetation cover types; or the area may be an isolated native plant community mapped and given a score of outstanding biodiversity significance by the Minnesota County Biological Survey.

Score 2 - These areas tend to be moderate in size and/or with more adjacent land cover types or land uses that could adversely affect the area and may have less diversity of vegetation cover types; or the area may be an isolated native plant community mapped and given a score of high biodiversity significance by the Minnesota County Biological Survey.

Score 1 - These areas tend to be smaller in size while still meeting the minimum size requirements for regional significance (minimum size is variable based on cover type); may have less diversity of vegetation cover types; may have more adjacent cover types or land uses that could adversely affect the area; or the area may be an isolated native plant community mapped and given a score of moderate biodiversity significance by the Minnesota County Biological Survey.

Patch Composite Methodology

Integrate the results of the habitat models (forest interior, forests with wetlands, floodplain forests, grasslands, and wetlands) with the MCBS native plant community data. Use a maximum score rule where patches overlap, such that the highest score overlapping data is given to area.

Identify lakes associated with these integrated patches and incorporate the lakes into the patch. Select lakes where at least 60% of the lake is surrounded by a preliminary patch.

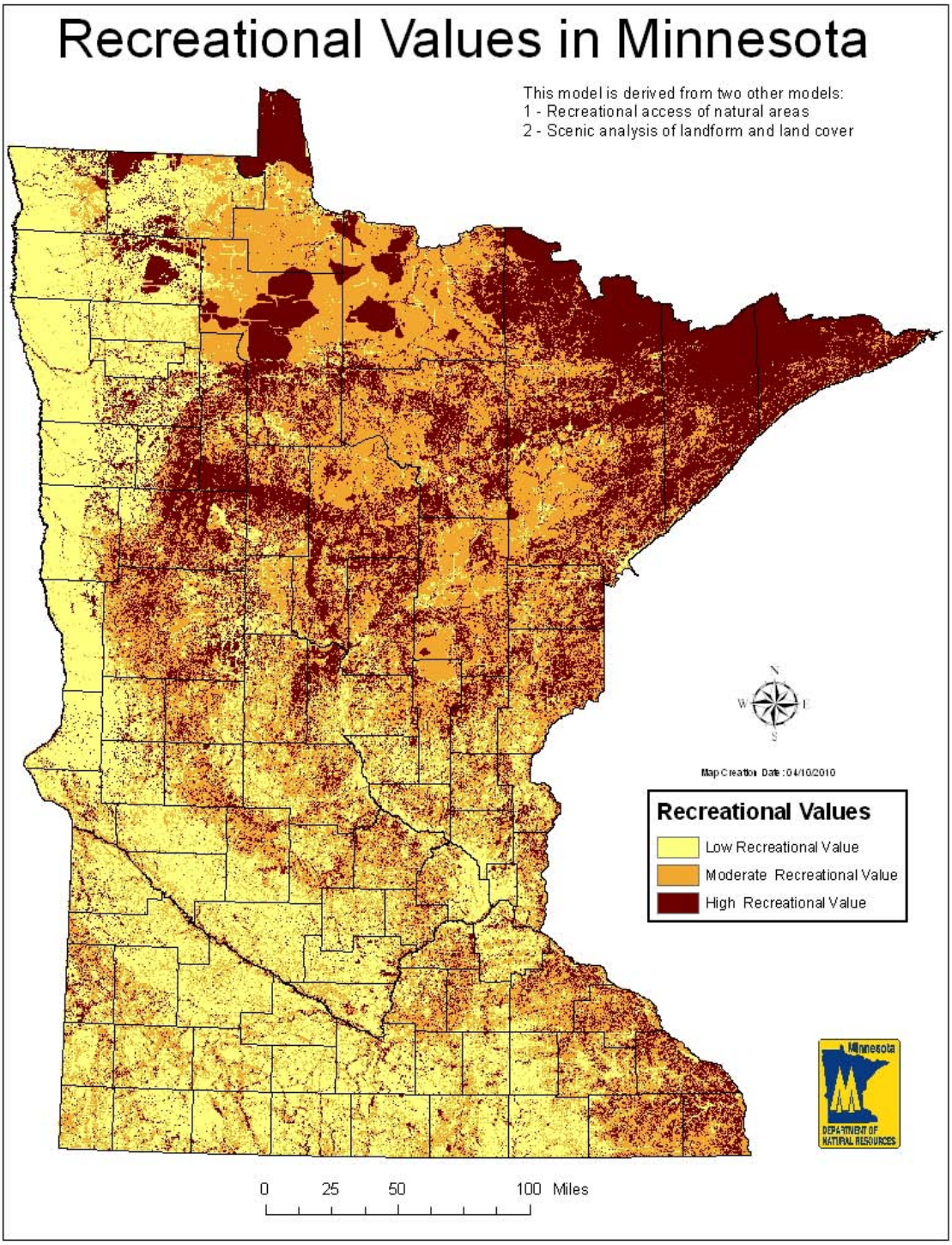
Fill the holes in the patch when the holes are natural vegetation (referencing the Hybrid Land Cover data). Merge the natural vegetation holes with the preliminary patches.

Score the patches using a majority rule. After identifying the percentages of scores within each patch, apply the following rules:

- Score 3: 51% or greater of the entire patch area is score 3
- Score 2: 51% or greater of the entire patch area is score 2
- Score 1: 51% or greater of the entire patch area is score 1, and no score 3s are present
- Score 2: 51% or greater of the entire patch area is score 1, and score 3's are present.

Delete patches that are less than 10 hectares.

• Figure 92. Recreational Values



Low Recreational Values = 1,856,188 Acres
Moderate Recreational Values = 20,029,023 Acres
High Recreational Values = 14,820982 Acres

The **Recreational Values** map is based on integrated scores of the degree of public access to natural areas via roads, trails or waterways, and a scenic assessment that integrates topographic diversity (elevation change and aspect variations), the degree of naturalism, and road density.

The public access analysis used the refined National Land Cover Data (NLCD) land cover data to identify "natural areas". Minnesota Department of Transportation (MnDOT) roads, DNR Forest Roads and DNR trails (including waterways), were used as routes of access. The natural areas adjacent to the access routes were given the highest score, while those furthest away were given the lowest score.

The scenic assessment used the NLCD data and 30 meter Digital Elevation Model (DEM) data and was composed of a topographical analysis, a land cover analysis and a road density analysis. For the topographical analysis, separate models were run that identified 1) areas with the most elevation change, and 2) areas with the most curved surfaces or variety of hills (aspect variety). These results were added together, and the areas with the highest scores had the most landform scenic potential. The scenic land cover analysis gave each cover type a scenic potential score – with natural areas having the highest and built up areas having the lowest. The road density analysis was conducted on MnDOT road data layer.

The final scenic assessment was created by adding the landform and land cover scenic layers together and then subtracting the road density values. Areas with the highest scores are natural areas with the most variety in topography and the least amount of road density.

The following models were used to create the **Recreational Values** map.

Access to natural areas

1. Convert all roads and trails to 30 meter grid, value = 1
2. Conduct a Euclidean distance analysis [road_trail_access]
3. Create a binary grid of natural and non-natural cover types – [natural_cover]

a. 0 = land cover values < 30
b. 1 = land cover values >= 30

4. Using a conditional statement, remove all non-natural areas from the Euclidean distance grid
5. Using slice, natural areas closer to roads and trails (lower cell values) are given higher a higher score [r_t_slice2]

Scenic Assessment

<u>Land cover</u>

1. Reclass the land cover to scenic value [scenic_landcover_lookup_table and landcover_scenic_score]

<u>Topography – aspect variety</u>

1. Using the 30 DEM grid, create an aspect grid
2. Using the 30 DEM grid, set all the areas in the aspect grid that have a slope < 1 degree "flat"
3. Group the aspect data into 8 ordinal classes, plus value 9 for no aspect (flat) [aspect]
4. Run a majority filter on the grouped aspect grid 10 times. [mmaj_10]
5. Find the aspect variety by running focal statistics on the above grid, using a 5 cell circle and VARIETY. [asp_var_5]
6. Score the results with the look up table [aspect_reclass and aspect_score]

<u>Topography – range variety</u>

1. Using the 30 DEM, the range of elevation by running focal statistics, using a 3 cell circle and RANGE. [range_c_3]
2. Score the results with the look up table [range_reclass and range_score]

Topography – final

1. The final score is the average of the aspect and range. Add the aspect score and range score together and divide by 2. [topo_score]

Road density

1. Using the MnDOT road layer, create a road density grid with the LineDensity command.
2. Score the density layer using SLICE and natural breaks. [road_score]

Final Scenic score

1. Average the land cover scenic score and the topography scenic score and subtract the road density score [topo_score] – [road_score] + ([landcover_scenic_score] *0.8) = [scenic_score]
2. Create a grid of 10 natural breaks using slice [scenic_slice]

Final Recreation Score

1. Create the final recreational score by running weighted sum of the final scenic and access grids – [scenic_slice], factor 2 + [r_t_slice2] , factor 1 = [recreational_score]

Chapter 6: Multi-state Priorities

Minnesota has long been instrumental in working with forestry and watershed partners in neighboring states and internationally with Canada. Key existing partnerships include the Upper Mississippi Forest Partnership, Invasive Species management and monitoring including gypsy moth, EAB and European buckthorn, the Great Lakes Regional Collaborative (GFLI), the Driftless Area, the Great Lakes Fire Compact, and the North Country Trail Initiative. The state is interested in establishing further partnerships and has identified the following key multi-state priority areas for continuing and future collaboration efforts. These include protection of Lake Superior tributaries, oak region regeneration and restoration, white pine and jack pine regeneration and restoration, Karner Blue butterfly habitat restoration, inter-state and provinces Firewise assessments, preservation of private forest management, management of the St. Croix River watershed, woodsheds that cross state boundaries, sustaining the timber industry and increasing biomass, and the completion of the North Country Trail through Minnesota. Below are brief descriptions of some of these identified multi-state priorities from Minnesota's perspective. However, not all of the above are discussed in detail as some are discussed under other indicators in this document. It should also be noted that on-going discussions with neighboring states during this document process, revealed a general consensus of top multi-state priorities, which are identified and discussed in the accompanying Strategies document under the multi-state priorities chapter.

Upper Mississippi Watershed

The Upper Mississippi watershed and river system is encompasses portions of Minnesota, Wisconsin, Iowa, Missouri, Illinois and Indiana. Historically this important multi-state geographic area provided abundant habitats for diverse wildlife species and served as an important flyway for many migratory bird species. Over time the river and surrounding landscapes became an important economic generator and natural watershed functions gave way to controlled river functions and a steady increase in water pollution, forest loss and fragmentation and loss of migratory bird habitats. Today urban and industrial growth, continuing habitat loss, erosion, sediment and nutrient loading, and the effects of river regulation and modifications have greatly disrupted the ecological health of the watershed and the river system. Downstream, recent studies of hypoxia problems in the Gulf of Mexico have further pointed out the need for extensive efforts in the Upper Mississippi watershed and river system to reduce nutrient pollution and restore critical natural habitats, such as forests that provide both biological benefits and the ability to protect water quality.[94]

Two recent reports have been produced to come up with recommendations on priority forests for conservation and recommended priority actions for management. These include *the" Identification of Priority Forests in the Upper Mississippi River System"*, which was published in 2006 by the US Geological Survey (USGS) and the US Forest Service and is accessible through
http://www.northeasternforests.org/FRPC/files/1232568116Identification%20of%20Priority%20Forests%20in%20the%20Upper%20Mississippi%20River%20System.pdf

A US Forest Service summary of the report is also available through
http://www.na.fs.fed.us/pubs/watershed/uppermiss_summary_ls.pdf

The US Army Corps of Engineers is now in the final stages of producing the report "*Upper Mississippi River Systemic Forest Management Plan",* which lays out conditions and management recommendations for the Upper Mississippi river system. As ACE states: "The purpose of the UMRS Systemic Forest Management Plan is to provide a guide for the sustainable management of UMRS forests, including opportunities for their restoration, to ensure that the UMRS maintains its recognition as a nationally treasured ecological resource."[95]

[94] USGS and USDA-Forest Service. 2006. "*Identification of Priority Forests in the Upper Mississippi River System*." Prepared for the Upper Mississippi Forest Partnership
[95] USACE St. Paul District. 2010. "*Upper Mississippi Systemic Forest Management Plan*." Produced by Southern University @ Baton Rouge, LA

To review the entire plan go to
ftp://ftp.usace.army.mil/pub/mvp/UMR%20Forest%20Plan/UMRS%20Systemic%20FMP%20PDT%20Draft%20020091222.pdf

Upper Mississippi Watershed

Minnesota's state forester, along with state foresters from Wisconsin, Iowa, Illinois, Missouri and Indiana have joined with the USFS Northeastern Area to study and manage forests in the Upper Mississippi river system (UMRS). The affected states and the USFS formed a partnership which has been in existence since 2004. This partnership was created to build a watershed approach to forestry efforts in the Upper Mississippi river watershed. Among the purposes are to demonstrate the importance of forests in healthy watersheds, assess forest conditions in relation to water quality, promote forestry solutions that reduce sediment and nutrient losses from the basin, and to support and develop forest restoration strategies within the basin. The partnership accomplishes these goals through a variety of methods, including strengthening coordination among state forestry agencies, implementing assessment and demonstration projects, and conducting educational efforts to address key watershed issues.[96]

The partnership has developed and adopted an action plan that focuses on four primary management themes including:

- restoration of bottomland hardwoods
- establishment of riparian forest buffers
- providing critical migratory bird habitat
- conservation of priority forest areas

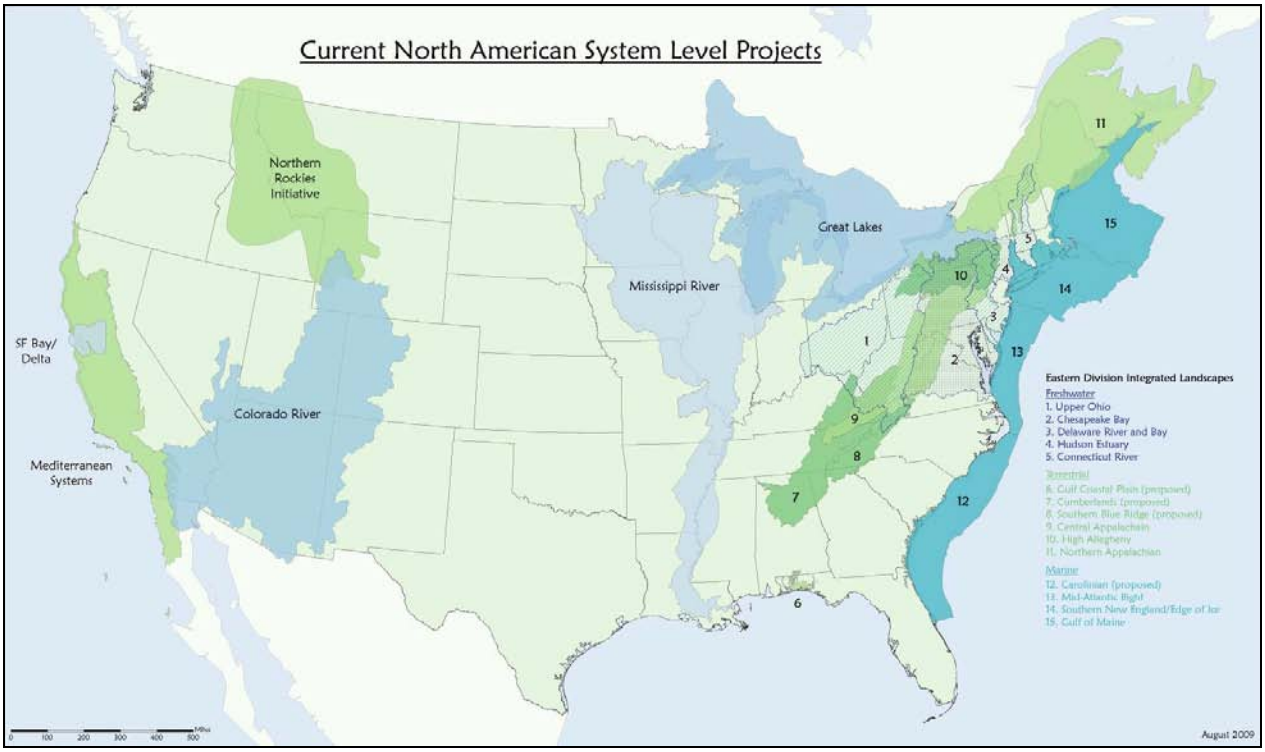
The effort to guide the implementation of the Upper Mississippi Forest Partnership (UMFP) action plan was conducted by a GIS study that will generate products to help the partnership focus its activities and limited resources. Further information is available through www.na.fs.fed.us/watershed/watershed_projects.shtm

The Nature Conservancy Large Landscapes

The Nature Conservancy (TNC) has long been a leader in identifying and determining large landscapes of conservation significance both nationally and internationally. Over several years, TNC has identified the entire Mississippi river system from Minnesota to Mississippi as a critical watershed and landscape and is working with several states, federal agencies and partners to further identify, monitor and address threats to priority conservation and water management sites within this large landscape. While TNC and their partners have concentrated on the Lower Mississippi river system, they have identified the entire Mississippi watershed as a North American system level project including an extensive portion of Minnesota. "TNC and partners seek to address water quality issues and altered and fragmented habitat by protecting critical areas, reforesting marginal farmlands through incentive-based programs, seeking increased funding for wetland restoration, recreating corridors of forested wetland habitat needed by birds and wide-ranging species, developing new wetland restoration techniques and supporting sustainable agricultural and forestry practices."[97] TNC has recently provided funding to the state to begin mapping priority landscapes including the Mississippi Headwaters for the MFF initiative, which seeks to identify key priority landscapes that will need protection over the next 10 to 25 years. (Figure 93).

[96] USFS: http://www.na.fs.fed.us/watershed/upper_mississippi_partnership/
[97] Memo text from TNC "*Suggestions for Large Landscapes*." 11/04/2009. TNC Paul Trianosky to NAASF Steve Koehn.

• Figure 93. National Nature Conservancy Priority Landscapes



Great Lakes Regional Collaborative (GLRI)

The Great Lakes Regional Collaborative was formed in 2004 by the Great Lakes Interagency Task Force (11 federal agencies) and is comprised of six states (Minnesota, Wisconsin, Michigan, Indiana, New York, Ohio) and one Canadian province (Ontario). It also brings together local communities, tribes, regional bodies and other interested parties to develop and carry out the most coordinated and comprehensive protection and restoration strategy for the Great Lakes Basin.

The Great Lakes Multi-year Restoration Action Plan Outline advances the Great Lakes Restoration Initiative by strategically identifying goals, objectives and targets for programs and projects to address the most significant environmental problems in the Great Lakes ecosystem. The US Environmental Protection Agency (EPA), together with its federal agency partners on the Great Lakes Interagency Task Force, is leading this effort in consultation with many other stakeholders. Minnesota has applied for grants under the program and will continue to collaborate with the other partnering states for project funding through both the EPA and the USFS. The recently completed 2010-2014 draft action plan will be used as the basis for focus areas as identified in the plan. Refer to http://www.epa.gov/grtlakes/glri/glmyrapo.pdf

Great Lakes Forest Alliance (GLFA)

Minnesota, along with Wisconsin and Michigan and the province of Ontario have had a long history of identifying and cooperating on forestry and water issues related to their respective landscapes bordering the upper reaches and northern boundaries of the Great Lakes. In 1997, the Great Lakes Forest Alliance (GLFA), a non-profit organization established to foster and facilitate cooperative efforts that enhance management and sustainable use of public and private forest lands in the states of Minnesota, Wisconsin, Michigan and the province of Ontario, Canada, was formed to give structure to an increasingly complex set of forest/water issues. Goals include improving and diversifying the region's economy while enhancing environmental, amenity and

recreation values; and to build public support for and organizational cooperation on forestry objectives. The organization identifies and promotes cooperation and coordination of programs to assure sustainable supplies of all forest goods and services for present and future generations. This helps create a nationally and internationally recognized image of the Great Lakes forest uses and values.

In June 2008, the GLFA convened a landmark conference to raise awareness and identify actions to enhance forest-based industries and the role they play in sustaining the region's economy, environment, and quality of life. Emerging themes that came out of that conference include:

- *Green building and forest certification:* Develop a strategy to engage the forestry community in the green building movement and associated certification systems.
- *Ecosystem services and emerging markets:* Support the development and implementation of new markets for carbon, bioenergy and other products of the bioeconomy, and ecosystem services.
- *Forest management capacity:* Develop a toolbox to assist landowners and managers with integrating present and future markets, including transportation, infrastructure, and industry capacity issues.
- *Regional research collaborative:* Enhance collaboration among research institutes. Communicate and support research to more fully understand issues and opportunities facing the Great Lakes region.
- *Ecological integrity:* Encourage the development of policies, research and educational information that support the ecological sustainability of forests and promotes understanding, mitigation and adaptation to climate change.

For further information go to www.greatforests.org

Great Lakes Forest Fire Compact (GLFFC)

The Great Lakes Forest Fire Compact is comprised of three states (Minnesota, Wisconsin, Michigan) and two Canadian provinces (Ontario, Manitoba). The membership group is a relatively active compact. Most of the interchange on a multi-state level occurs in the three state's training programs (along with Ontario and Manitoba). The group also shares in the development and production of wildfire prevention materials for educational purposes across the compact. (Figure 94).

Operationally, the group experiences very good cooperation and exchange when a compact member is in need of resources. These needs are typically treated as a high priority need by the sending member. In Minnesota, a compact order is treated in much the same way as the state treats moving resources from one internal region to another. These requests receive higher priority and expedience than an order through the national system. Sharing between compact members, related to these program areas is very good at present and all members are fully engaged in this compact.

- Figure 94. Member States and Provinces in the Great Lakes Forest Fire Compact (GLFFC)

For further information go to www.glffc.com

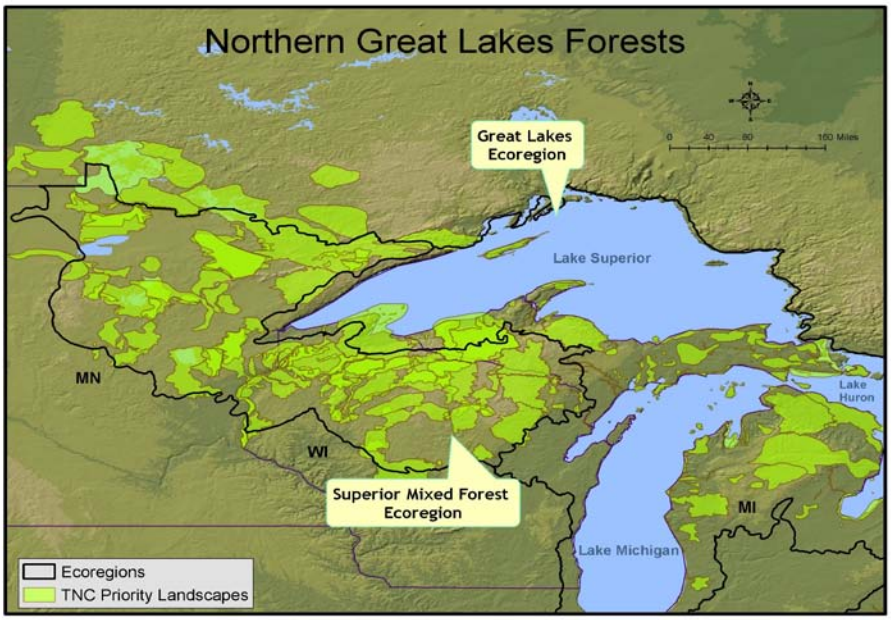
The Nature Conservancy: Northern Great Lakes Forests Priority Landscape

From pre-settlement time (pre-1800s) to the 21st century, most Northern Great Lakes forests have undergone change from complex, mature forests to younger and less diverse forests, thus reducing their capacity to provide a diversity of ecosystem services, including quality habitat, production of a variety of forest products, resistance to invasive species and resiliency to climate change and other stressors. To address this need, TNC and partners including the USFS, DNRs in Minnesota, Michigan, and Wisconsin, county and private forest managers, are working to develop landscape-scale goals and desired future scenarios, refine management prescriptions at the scale of managed forests, and implement experimental and proven silvicultural practices that account for ecological and economic goals. (Figure 95).

At the landscape scale, TNC is contributing tools such as LANDFIRE (developed in cooperation with the USFS) to assist land managers in modeling future scenarios, enabling an assessment of the costs and benefits, both in terms of economics and ecology, of various treatments in light of increasing stresses. Within priority landscapes, these modeling approaches will assess management practices and conservation strategies of future scenarios and ensure that healthy forests will be part of the sustainable future.[98]

[98] Text and map adapted from TNC Paul Trianosky memo TNC "*Suggestions for Large Landscapes* "to NAASF Steve Koehn. 11/04/09

- Figure 95. Nature Conservancy Great Lakes Priority Landscapes



USFWS Upper Midwest and Great Lakes Landscape Conservation Cooperative

The USFWS is in the process of establishing a national network of Landscape Conservation Cooperatives, of which the Upper Midwest and Great Lakes has been identified as part of this vision. It is anticipated that this effort will be in place with partnerships, capacities (scientific and strategic), timelines, staff, costs and locations identified by the fall of 2010. (Figure 96) For further info refer to www.fws.gov/midwest/climate/LCC/UpperMidwest/

- Figure 96. US Fish & Wildlife Great Lakes Landscape Conservation Cooperative

Midwest Glacial Lakes Partnership

The Midwest Glacial Lakes Partnership works together to protect, rehabilitate, and enhance sustainable fish habitats in glacial lakes greater than 10 acres in size that occur in Minnesota, Wisconsin, Michigan, North Dakota, South Dakota, Iowa, Illinois and Indiana. The goals of the partnership are to:

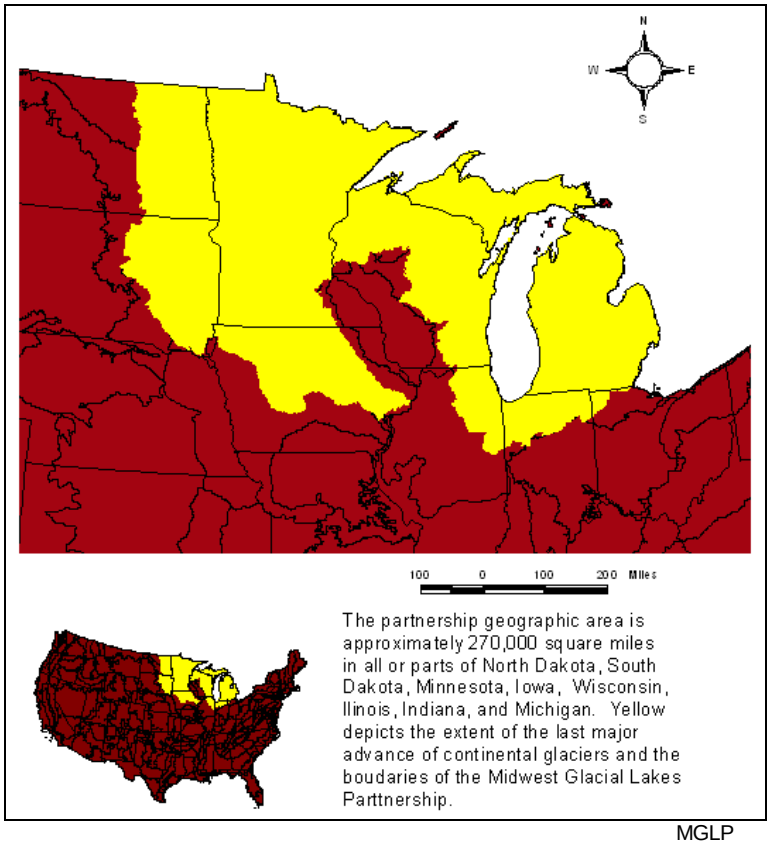
- protect and maintain intact and healthy lake systems
- prevent further degradation of fish habitats that have been adversely affected
- reverse declines in the quality and quantity of aquatic habitats in lakes to improve the overall health of fish and other aquatic organisms
- increase the quality and quantity of fish habitats in lakes that support a broad natural diversity of fish and other aquatic species

Threats and stressors to aquatic habitats include habitat loss, plant removal and woody vegetation removal along with development and shoreline alterations which affect water quality and sedimentation and hydrologic alteration (through ditches, dams, control structures) to many glacial lake systems, which permanently affect aquatic vegetation. Cumulative impacts of these threats coupled with multi-use conflicts of land use has created a dead zone in the Gulf of Mexico which is directly related to activities in the Mississippi river watershed.

In 2009, the Midwest Glacial Lakes Partnership completed its first strategic plan which is a living document that is updated as new information becomes available and will be reviewed on a five-year cycle. The partnership recently received a multi-state conservation grant to develop support services in science, GIS technology, planning, outreach and coordination. The grant is considered a model for other regions of the US to meet the needs of fish habitat partnerships in a cost-effective manner.

For further information refer to www.midwestglaciallakes.org

- Figure 97. Midwest Glacial Lakes Partnership



MGLP

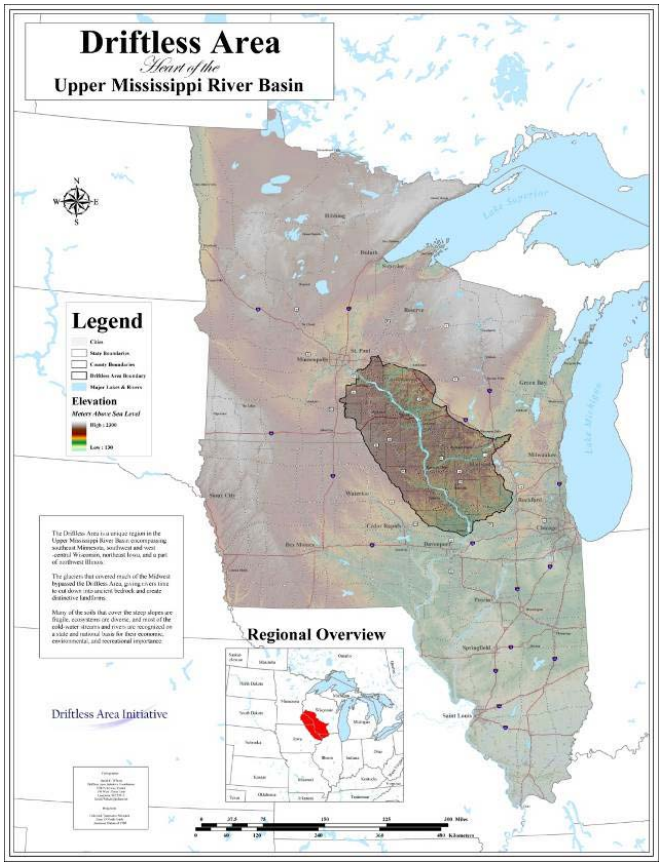
Driftless Area

The Midwest's Driftless Area is a unique natural feature that spans four states and encompasses over 24,000 square miles. The area was bypassed by the last glacial ice-age resulting in distinctive karst topography, steep-sided ridges, caves, towering limestone and sandstone bluffs and outcrops, sinkholes and over 600 spring creeks which feed into over 3,600 stream miles in six major watersheds. This ecosystem contains entire rare plant and animal communities including the endangered Iowa Pleistocene snail and threatened Northern monkshood. The abundant cold water courses are ideally suited for brook trout and are recognized both on the state and national levels for their economic and environmental importance. (Figure 98).

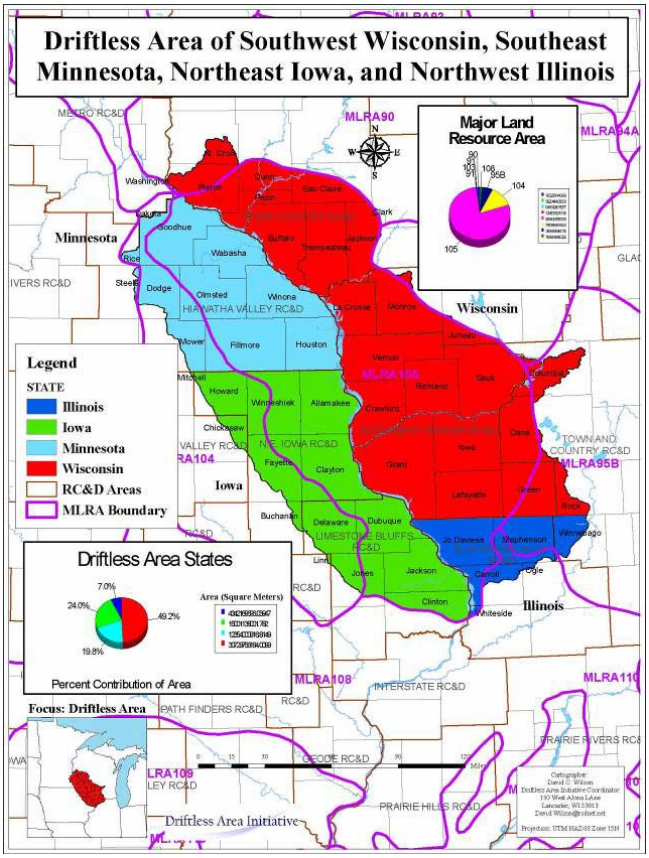
Minnesota through the DNR, participates in the Driftless Area Initiative (DAI) whose mission is to "unite organizations and individuals with the Driftless Area of the Upper Mississippi river basin for collaborative action to enhance and restore the region's ecology, economy, and cultural resources in a balanced, integrated fashion."[99] (Figure 99).

DAI serves as a catalyst for cross-boundary issues and projects. Participating stakeholders include but are not limited to Natural Resources Conservation Service (NRCS), Resource Conservation and Development (RC&D) council members from 4 states, federal and state agencies including USFS, USFWS, Farm Service Agency (FSA), state agriculture, pollution control, natural resources, soil & water conservation including IA, IL, MN,WI. Other partners include non-profit organizations, foundations and concerned individuals. For further information go to www.driftlessareainitiative.org

- Figure 98. Driftless Region in Mid West



- Figure 99. Driftless Region By County



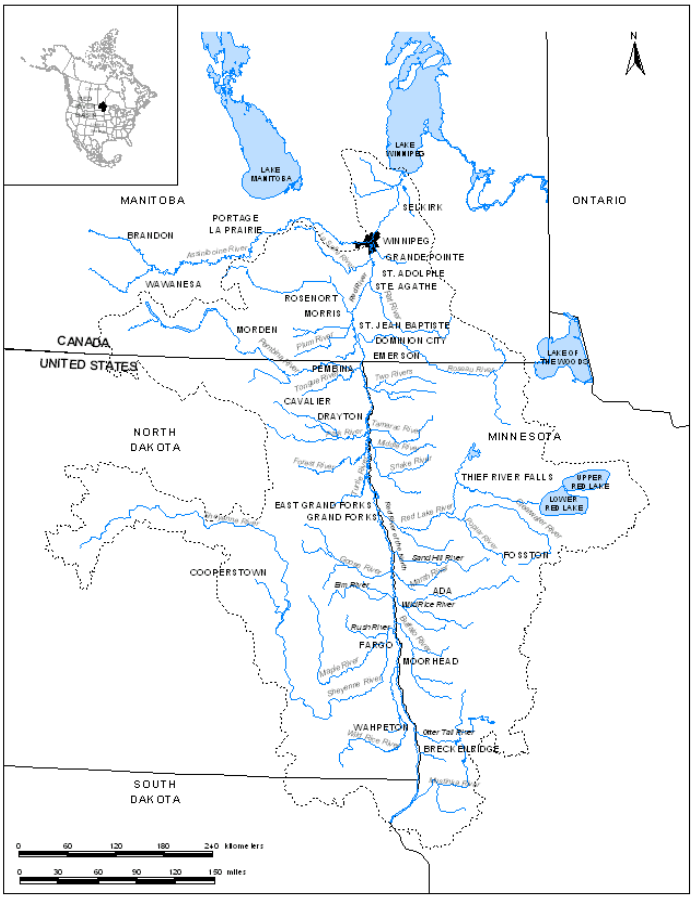
[99] DAI

Red River Basin Watershed

The Red River Basin encompasses both the United States and Canada including three states of Minnesota, North Dakota, South Dakota and one province Manitoba. Due to nature and rarity of the river flowing north and the flat topography, this river basin is prone to extremes in flooding and drought. Over the years there have been many collaborative efforts aimed at mitigation, flood planning/mapping, data collection and integration, river, soil erosion and bank restoration. Much of the cooperation and joint efforts have been between the two federal governments through the International Joint Commission (IJC) and at the state/provincial levels through the Red River Basin Board (RRBB) and the Red River Watershed Management Board (RRWMB). Several agencies including the US Army Corps of Engineers (ACE), Federal Emergency Management Agency (FEMA), Environmental Protection Agency (EPA), US Forest Service (USFS), Natural Resources Conservation Service (NRCS), US Fish & Wildlife Service (USFWS), Minnesota Pollution Control Agency (MPCA), Minnesota Department of Natural Resources (DNR), Board of Water and Soil Resources (BWSR), The Nature Conservancy (TNC), Minnesota Center for Environmental Advocacy (MCEA), International Water Institute (IWI), Soil and Water Conservation Districts (SWCD), Resource Conservation and Development (RC&D), US Department of Agriculture Farm Services Agency(USDA FSA), counties and citizens continue to work cooperatively with the representative governments on goals and implementation of flood damage reduction and natural resource enhancement projects based on comprehensive watershed planning. Early consultation and collaboration among all stakeholders in the basin has been a key to the continuing success of project planning and implementation. (Figure 100).

For more information go to www.nwrdc.org

- Figure 100. Red River Basin Watershed Boundaries



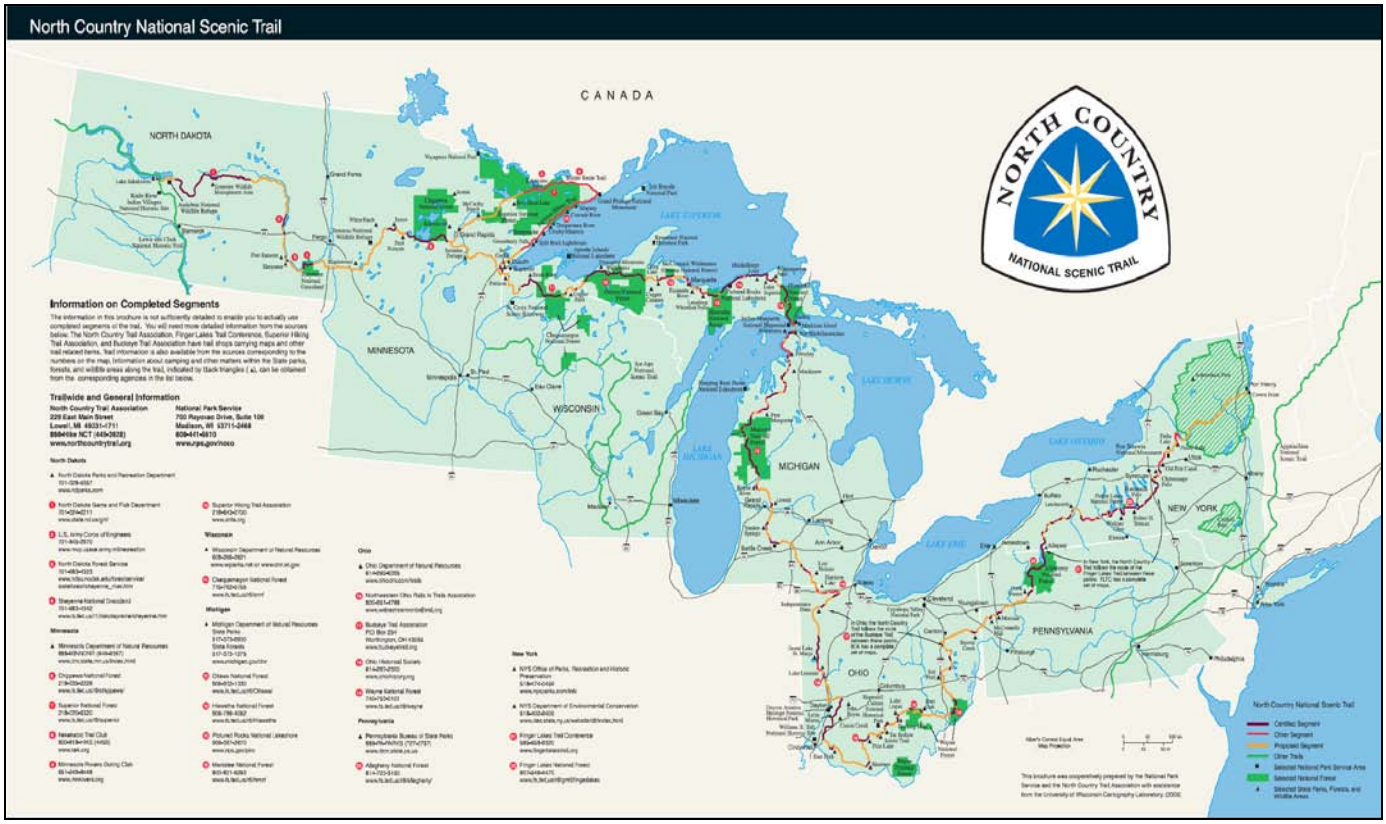
RRBB

North Country National Scenic Trail

The North Country National Scenic Trail is a multi-state initiative linking scenic, natural, historic and cultural areas in seven northern states from New York to North Dakota. When completed, the trail will span 4,600 miles and be the longest continuous hiking trail in the United States and one of the longest footpaths on earth. The trail was established by Congress in 1980 and traverses through more than 100 state forests and parks, 10 national forests and areas managed by the NPS. The trail is approximately halfway constructed with an estimated 2,000 miles yet to complete. Although there are some staff working on land easements, private-sector permissions and government approvals of new trail expansion routes, the North Country Trail is being built and maintained primarily by volunteers who now total over 3,000. (Figure 101).

Minnesota has several agencies and organizations involved with this project including DNR, Chippewa National Forest, Superior National Forest, Kekekabie Trail Club, Minnesota Rovers Outing Club and the Superior Hiking Trail Association. Refer to: http://www.nps.gov/noco/parkmgmt/minnesota-partners.htm

- Figure 101. North Country National Scenic Trail



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Abbreviations

2c	2c Managed Forest Land
ACLT	Associated Contract Loggers and Truckers
ACUB	Army Compatible Use Buffer
AON	Assessment of Need
APWA	American Public Works Association
APHIS-PPQ	Animal Plant & Health Inspection Service Plant Health, Plant Protection & Quarantine
ASLA	American Society of Landscape Architects
BIA	Bureau of Indian Affairs
BMPs	Best Management Practices
CAR	Corrective Action Request
CFA	Cooperative Forestry Act
CoC	Chain of Custody
BWSR	Board of Water & Soil Resources
CFDRS	Canadian Fire Danger Rating System
CRP	Conservation Reserve Program
CREP	Conservation Reserve Enhancement Program
CSP	Conservation Security Program (pre-2009) and Conservation Stewardship Program (2009 to present)
CWPP	Community Wildfire Protection Plans
DNR	Department of Natural Resources
DOF	Department of Forestry
DU	Ducks Unlimited
EAB	Emerald Ash Borer
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
FEMA	Federal Emergency Management Agency
FIA	Forest Inventory & Analysis
FLP	Forest Legacy Program
FRP	Forest Resource Protection Fund
FSA	Farm Service Agency
FSC	Forest Stewardship Council
FSP	Forest Stewardship Partnership
GIS	Geographic Information System
GLFA	Great Lakes Forest Alliance
GLFFC	Great Lakes Forest Fire Compact
GLIFWC	Great Lakes Indian Fish & Wildlife Commission
GLRC	Great Lakes Regional Collaborative
GMSTS	Gypsy Moth Slow the Spread Foundation
GRG	Great River Greening
IJC	International Joint Commission
L-SOHC	Lessard-Sams Outdoor Heritage Council
LCCMR	Legislative Citizens Commission of Minnesota Resources
LMC	League of Minnesota Cities
LUG	Local Units of Government
MACF	Minnesota Association of Consulting Foresters
MCCAG	Minnesota Climate Change Advisory Group
MDA	Minnesota Department of Agriculture
MDH	Minnesota Department of Health
MFA	Minnesota Forestry Association
MFF	Minnesota Forests for the Future
MFI	Minnesota Forest Industries
MFRC	Minnesota Forest Resource Council
MFRP	Minnesota Forest Resource Partnership
MIFC	Maritime Intelligence Fusion Center
MLEP	Minnesota Logger Education Program
MLT	Minnesota Land Trust
MMLC	Minnesota Master Logger Certification
MNICS	Minnesota Incident Command System
MNLA	Minnesota Nursery and Landscape Association
MnDOT	Minnesota Department of Transportation

MnSTAC	Minnesota Shade Tree Advisory Committee
MPCA	Minnesota Pollution Control Agency
MSA	Minnesota Society of Arboriculture
NF	National Forest
NFF	National Forest Foundation
NGO	Non-Governmental Organization
NIPF	Non-Industrial Private Forests
NLCD	National Land Cover Data
NPS	National Park Service
NRCS	Natural Resource Conservation Service
NRRI	Natural Resources Research Institute
RAWS	Remote Automated Weather Systems
RC&D	Resource Conservation & Development
REIT	Real Estate Investment Trust
RIM	Reinvest In Minnesota
RMZ	Riparian Management Zone
RP	Rural Preserve
RRBB	Red River Basin Board
RRWMB	Red River Water Management Board
SAF	Society of American Foresters
SAP	Spatial Analysis Project
SFEC	Sustainable Forests Education Cooperative
SFIA	Sustainable Forestry Incentive Act
SFI	Sustainable Forestry Initiative
SFRA	Sustainable Forest Resources Act (Minnesota)
SGCN	Species of Greatest Conservation Need
S&PF	State & Private Forests
SWAP	State Wildlife Action Plan
SWCD	Soil & Water Conservation District
TCF	The Conservation Fund
TI	Tree Inspector
TIMO	Timber Investment Management Organization
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
TPL	Trust for Public Lands
TSI	Timber Stand Improvement
UA	Utility Arborist
U&CF	Urban & Community Forestry
U&M	Utilization & Marketing Program
U of M	University of Minnesota
USACE	US Army Corps of Engineers
USDA	US Department of Agriculture
USFS	US Forest Service
USFWS	US Fish & Wildlife Service
WFCE	Working Forests Conservation Easements
WHIP	Wildlife Habitat Incentive Program
WMA	Wildlife Management Area

Index of Figures

Index of Tables