3.2 FOREST VEGETATION

This section of the Final EIS analyzes the composition, structure, and spatial arrangement of forest vegetation predicted to occur as the result of the management strategies associated with each of the proposed alternatives. It also discusses the processes, both natural and human-induced, occurring with these management strategies and their potential effects on the composition and structure of future forest vegetation, both at the landscape and local (stand) scales.

For purposes of this Final EIS, the ecological unit at the sub-region level of the National Hierarchical Framework of Ecological Units known as the Section provides the large landscape-scale context for analyzing effects on forest vegetation. The Northern Superior Uplands Section provides this ecological context for the Superior National Forest, while the Northern Minnesota Drift and Lake Plains Section does so for the Chippewa National Forest. Within each of these Sections, landscape ecosystems (LE) have been described and delineated. The LEs provide the mid landscape-scale and primary context for conducting the effects analysis for issues and indicators pertaining to forest vegetation.

3.2.1 Forest Composition and Structure

Composition refers to the biodiversity of an ecological system, including the variety of genes, species, communities, and ecosystems. Structure refers to the physical arrangement of various physical and biological components of an ecological system. The analysis of forest composition and structure for this Final EIS will be focused primarily on the community and landscape levels.

Forest composition refers to all plant species found in a stand or landscape, including trees, shrubs, forbs, and grasses. It also refers to forest communities at the stand or landscape level whose canopies may be dominated by a single tree species or contain a mixture of species.

Forest age is used to reflect one of the primary structural attributes of a particular landscape. It provides some measure of horizontal structure in terms of amounts and distribution of various successional stages. Additionally, individual stands can range from relatively simple to relatively complex in terms of their composition and vertical structural diversity. They can be composed of trees of a single age or of trees with multiple age cohorts within the same stand.

Issue Statement

There are differing opinions about what forest ages and forest tree species will provide adequate forest structure and biodiversity while providing the social and economic needs of people. Forest Plan revision will determine long-term goals for young, mature, old, and old-growth forests. Revision will also establish goals for the species composition of forest communities, types of forest vegetation communities, and distribution of the communities. Revised Forest Plans will determine if old growth will be actively managed, and if so, how it would be managed. Another decision to be made is if old growth will be permanently allocated to specific locations or be transient on the landscape.

Indicator 1 – Amount of Forest Types

The first indicator for forest composition and forest structure is the amount of each forest survey type expected to occur under each alternative. A forest survey type indicates the dominant tree species present, but may not always reflect all of the species present in a forested stand. The amount of each forest type projected under each alternative will be compared to existing conditions and to the amount that occurred historically, i.e. during the time period of 1600-1900AD. This comparison will be made at the national forest and landscape ecosystem levels.

This indicator does a good job of highlighting the differences between alternatives because each proposed forest management strategy will produce varying amounts and distributions of landscape forest communities over time. The amount and distribution of forest communities may have direct implications on available wildlife habitat, scenic quality, forest products, and recreational opportunities.

Indicator 2 – Amount of Forest in Age Groups

The second indicator for forest composition and forest structure is the amount (acres) of each forested landscape ecosystem expected to occur in various age categories under each alternative. The amount of forest in each age category projected under each alternative will be compared to existing conditions and to the amounts predicted to have occurred historically, i.e. during the time period of 1600-1900AD. This comparison will be made at the national forest and landscape ecosystem levels.

This indicator does a good job of highlighting the differences between alternatives because each proposed forest management strategy will produce varying amounts and distributions of landscape forest community ages over time. The amount and distribution of forest communities in different growth stages may also have direct implications on biological diversity, old-growth forests, scenic quality, forest products, and recreational opportunities.

Indicator 3 – Use of Management Treatments that Increase Within-Stand Complexity

Indicator 3 for forest composition and forest structure is the use of forest management treatments, such as harvest cutting methods, underplanting, and prescribed fire that influence the within-stand complexity of the understory, midstory, and overstory layers. Within-stand complexity includes both species and structural diversity. It is a means of comparing a variety of forest stand attributes, such as species diversity and abundance from the ground layer through the canopy, crown closure and density, standing snags, and downed logs, and the diversity of tree ages within a stand. The amounts of harvest treatments, prescribed fire, and under-planting will be projected under each alternative. Additionally, the amounts of untreated stands will also be projected. These amounts will be compared among the alternatives and to what has been implemented over the past fifteen years. This indicator does a good job of highlighting the differences between alternatives because the mix and amounts of treatments proposed within each alternative will result in varying degrees of within-stand complexity over time. Within-stand complexity may implications to both native plant community and wildlife habitat quality.

Indicator 4 – Size, Amount, and Distribution of Old-growth Forest

Indicator 4 for forest age and forest structure is the size, amount, landscape ecosystem representation, and landscape context of old-growth forest. The amount of old-growth by landscape ecosystem projected under each alternative will be compared to existing conditions. Additionally, management strategies for providing and managing old-growth forests will be compared among alternatives. This indicator does a good job of highlighting the differences between alternatives because the amount, distribution, and management strategy of old-growth forest will vary by alternative over time. The type, amount, and distribution of old-growth forests may also have direct implications on biological diversity, scenic quality, forest products, and recreational opportunities.

Analysis Area

The analysis area for considering direct and indirect effects to forest composition and age will be the National Forest System lands managed by the Chippewa and Superior National Forests. Lands under other ownerships within the relevant Sections, i.e. the Northern Minnesota Drift and Lake Plains for the Chippewa, and the Northern Superior Uplands for the Superior, will be considered in addressing the effects of proposed management scenarios.

3.2.1a Affected Environment

Indicators 1 and 2 – Amounts of Forest Types and Ages

The current amounts of forest vegetation in various forest types and age classes are the result of a multitude of factors. The forest conditions that occurred during the 18th and most of the 19th centuries, on what was later to become the Chippewa and Superior National Forests in Minnesota, were primarily shaped by climate, soils, landforms, and natural disturbances (Frelich 1998). The exploitative logging that occurred during the late 19th century, followed by widespread slash-fueled wildfires, drastically altered the composition and structure of those original forests. More recently, timber management activities and fire suppression have contributed to current forest conditions. Throughout this time period, the natural progression of forest succession has also taken place to varying degrees on managed and unmanaged lands within the Chippewa and Superior National Forests.

The affected environment for forest composition (forest types) and forest structure (age classes) at the landscape level is presented at two scales, the National Forest scale and the Landscape Ecosystem (LE) scale. At each scale, information is provided which displays current upland forest conditions for each National Forest and the current conditions for the entire ecological Section it occurs within, the Northern Minnesota Drift and Lake Plains for the Chippewa and the Northern Superior Uplands for the Superior. The range of natural variability (RNV) value for a particular component is also displayed. These values represent the ecological thresholds for defining the range of natural variability for forest communities.

The RNV values were developed for each LE at the ecological Section level and are included for comparative purposes. The RNV values displayed for forest type represent the midpoint amount for a particular forest type that would have been predicted to occur during the time period when the landscape (ecological Section) was operating within its range of natural variability. The RNV values displayed for vegetation growth stages represent the range of amounts of forest within a particular age class predicted to occur during the same time period.

Existing conditions in the ensuing tables are provided for upland forests only. The current age class distribution for lowland conifers is similar on both National Forests. Approximately 1% of all lowland conifer stands are less than ten years old, 80%-90% of them are 50 to 149 years old, and less than 10% of them are 150 years old or older. Lowland black spruce is the dominant forest type composing lowland conifers, with lesser amounts of tamarack and lowland white cedar.

NATIONAL FOREST SCALE - Amount of Forest Types and Age Groups on the National Forests

Tables FAC-1 and FAC-2 display forest-wide perspectives for the current amounts of upland forest types and upland vegetation growth stages on the Chippewa and Superior National Forests, respectively. The RNV values in these tables represent the weighted averages of the RNV values developed for each LE within its respective ecological Section.

The jack pine, white pine, and spruce-fir forest types are considerably under-represented on both National Forests when compared to the relative amounts that would have occurred within the Section under RNV. Aspen amounts on National Forest lands are nearly three times more than what would have been predicted to occur under RNV.

In terms of age class distribution, there is currently two to three times the amount of upland forest in the 0-

9 and 50-99 year age classes, while the 100-149 year age class is considerably under-represented. The 150+ year age class is not represented in the upland forests, even though the amounts predicted to occur under RNV were the greatest for this age class.

LANDSCAPE ECOSYSTEM SCALE

As previously indicated, the Northern Minnesota Drift and Lake Plains Section and the Northern Superior Uplands were further subdivided for landscape planning purposes into Landscape Ecosystems (LE). The following provides a brief description of the upland LEs relevant to this Draft EIS. Complete descriptions of the composition, structure and function of each LE can be found in Appendix B. For each LE, the current landscape conditions for upland forest composition and upland forest structure are provided for that portion of the LE that occurs on National Forest lands and for the entire LE throughout the ecological Section as a whole. The RNV values are also displayed for comparative purposes. The RNV values given were developed specifically for that LE at the ecological Section level and represent the approximate amount(s) of that particular component, forest type or vegetation growth stage that occurred within that LE prior to European settlement of this area (1600-1900AD).

Existing conditions information is supplied for the upland LEs only. Current lowland conifer conditions are as described previously, at the National Forest scale.

Table FAC-1: Existing Upland Forest Conditions on the *Chippewa National Forest* (CNF) Compared to those on All Lands in the Northern Minnesota Drift and Lake Plains Section and to the Range of Natural Variability Values (RNV).

Forest Type	RNV Value	Existing %age (CNF Lands)	Existing %age (All Lands)
Jack Pine	11%	3%	7%
Red Pine	19%	16%	7%
White Pine	8%	1%	1%
Spruce-Fir	12%	7%	5%
Oak	1%	2%	7%
Northern Hardwood	22%	13%	10%
Aspen	19%	49%	56%
Paper Birch	8%	8%	7%
Vegetation Growth Stage (age class)	**RNV Value**	**Existing %age (CNF Lands)**	**Existing %age (All Lands)**
0-9 years old	3-6%	13%	4%
10-49 years old	15-24%	38%	33%
50-99 years old	21-25%	44%	54%
100-149 years old	12-25%	6%	8%
150+ years old	32-46%	0%	1%

Source: Existing amounts for forest type and current age on National Forest lands are based upon the National Forest's Combined Data System information. Existing amounts of forest types and ages for all lands within the Section are based upon Minnesota Forest Resource Council landscape assessment information.

Definitions: Historical data, ecological capability information, and disturbance modeling which predicts the mix of seral stage communities within a particular LE for the entire ecological Section were used to inform the range of natural variability (RNV) values for forest composition. The percentage provided represents the midpoint for that value.

The range of natural variability (RNV) values for forest age is based upon disturbance modeling developed by Frelich (Frelich 2000).

‡Notes: This table information pertains to FAC Tables 1-12.

Northern Minnesota Drift and Lake Plains Section

The Chippewa National Forest falls within the Northern Minnesota Drift and Lake Plains (DLP) Section and manages approximately 8% of lands within this Section. None of the Superior National

Forest falls within this Section. Table GEIS-1 in Appendix G provides acreage figures for each of the landscape ecosystems within the Northern Minnesota Drift and Lake Plains Section. It also provides a breakdown of estimated percent by ownership group.

Five upland LEs within this Section occur within the Chippewa National Forest. They are the Dry Pine, Dry-Mesic Pine, Dry-Mesic Pine/Oak, Boreal Hardwood/Conifer, and Mesic Northern Hardwoods Landscape Ecosystems. They are discussed below.

DRY PINE LE

Approximately 3% of the Dry Pine LE in the DLP occurs on the Chippewa National Forest. This LE comprises about 2 percent of Chippewa National Forest lands.

Historically, jack pine and red pine were the dominant species in this LE; aspen, paper birch, white pine, oak, white spruce and balsam fir were also present. Mixed cohorts of all three native pines were common in the understory. Initially, stands were even-aged, but became multi-aged as stands matured. Jack pine succeeds to red pine at approximately 80 years of age when stand replacement fires do not occur. A third to half of the landscape was characterized as multi-aged, beyond 80 years old.

Table FAC-3 displays a comparison of the existing upland forest conditions within this LE on National Forest lands and on all lands within the DLP to the range of natural variability values developed for this LE within the Section.

DRY-MESIC PINE LE

Approximately 7% of the Dry-Mesic Pine LE in the DLP occurs on the Chippewa National Forest. This LE comprises about 17% of Chippewa National Forest lands.

Historically, this LE had mature and older stands dominated by a supercanopy of red pine and white pine. The subcanopy is a mixed stand of red maple and paper birch. White spruce, balsam fir, aspen, northern red oak, bur oak and bigtooth aspen are also found in this mixed subcanopy in some of the stands at lower stocking levels. Jack pine, red pine and white pine can occasionally occur in pure stands. One-third to one-half of the landscape was characterized as multi-aged, beyond 175 years old.

Table FAC-4 displays a comparison of the existing upland forest conditions within this LE on National Forest lands and on all lands within the DLP to the range of natural variability values developed for this LE within the Section.

DRY-MESIC PINE/OAK LE

Approximately 7% of the Dry-Mesic Pine/Oak LE in the DLP occurs on the Chippewa National Forest. This LE comprises approximately 35% of Chippewa National Forest lands.

Historically, this LE had a jack pine, red pine and white pine supercanopy either alone or as mixed pines. Deciduous trees usually occurred as a subcanopy comprised of quaking aspen, paper birch, northern red oak, bur oak, red maple and bigtooth aspen. These deciduous trees grow to merchantable size and in the absence of pines would form a cover type. These forests, in a mature condition, typically were a mix of pines and deciduous trees, frequently with 2 pine species and a subordinate canopy of 3 deciduous species. The pine coverage would be 50% to 75%, with the deciduous species making up the balance. Table FAC-5 displays a comparison of the existing upland forest conditions within this LE on National Forest lands and on all lands within the DLP to the range of natural variability values developed for this LE within the Section.

MESIC NORTHERN HARDWOODS

Approximately 30% of the Mesic Northern Hardwoods LE in the DLP occurs on the Chippewa National Forest. This LE comprises approximately 13% of Chippewa National Forest lands.

Historically, the canopy of this LE was dominated by sugar maple, basswood, and paper birch. Often listed as associated species present is minor amounts are yellow birch, bur oak and northern red oak. Rare were balsam fir, red pine, white pine and northern white cedar, which are never abundant. Sugar maple, basswood and ironwood are the major understory trees.

Table FAC-6 displays a comparison of the existing upland forest conditions within this LE on National Forest lands and on all lands within the DLP to the range of natural variability values developed for this LE within the Section.

BOREAL HARDWOOD/CONIFER LE

Approximately 7% of the Boreal Hardwood/Conifer LE in the DLP occurs on the Chippewa National Forest. This LE comprises approximately 23% of Chippewa National Forest lands.

Historically, this LE was dominated by mixed stands composed of aspen, paper birch, balsam fir, and northern white cedar. White pine, red pine, ash, basswood, bur oak, white spruce, and elm were also present with minor amounts of red maple, sugar maple, and jack pine. Red maple, aspen, black ash and balsam fir are the most prevalent trees regenerating in the understory of mature stands. The aspen and black ash occurs where small pockets of several trees have blown down. Red maple and balsam fir can regenerate without a disturbance.

Table FAC-7 displays a comparison of the existing upland forest conditions within this LE on National Forest lands and on all lands within the DLP to the range of natural variability values developed for this LE within the Section.

Northern Superior Uplands Section

The entire Superior National Forest (SNF) falls within the Northern Superior Uplands (NSU) Section and manages approximately 42% of lands within this Section. None of the Chippewa National Forest falls within this Section. Table GEIS-2 in Appendix G provides acreage figures for each of the landscape ecosystems within the Northern Superior Uplands Section. It also provides a breakdown of estimated percent by ownership group. Five upland LEs within this Section occur within the Superior National Forest. They are the Jack Pine-Black Spruce, Dry-Mesic Red and White Pine, Mesic Red and White Pine, Mesic Birch, Aspen, Spruce-Fir, and Sugar Maple Landscape Ecosystems. They are discussed below.

JACK PINE-BLACK SPRUCE LE

Approximately 83% of the Jack Pine-Black Spruce LE in the NSU occurs on the SNF. This LE comprises approximately 37% of Superior National Forest lands, and occurs on 22% of SNF lands outside the wilderness.

Historically, jack pine and black spruce dominate the canopy, either individually or as a mixed type. Aspen and paper birch are occasionally present in lesser amounts, although aspen can become the cover type under certain conditions. Balsam fir is usually absent in the canopy.

Table FAC-8 displays a comparison of the existing upland forest conditions within this LE on National Forest lands and on all lands within the NSU to the range of natural variability values developed for this LE within the Section

DRY-MESIC RED AND WHITE PINE LE

Approximately 36% of the Dry-Mesic Red and White Pine LE in the NSU occurs on the SNF. This LE comprises approximately 11% of Superior National Forest lands, and occurs on 15% of SNF lands outside the wilderness.

Historically, this LE was typically dominated by mixed stands that included some of the following species: aspen, paper birch, red pine, white pine, jack pine, balsam fir, black spruce, white spruce, bigtooth aspen and red maple. The jack pine, red pine and black spruce may dominate the stocking on the drier sites, with the other species more common on mesic sites.

Table FAC-9 displays a comparison of the existing upland forest conditions within this LE on National Forest lands and on all lands within the NSU to the range of natural variability values developed for this LE within the Section

MESIC RED AND WHITE PINE LE

Approximately 22% of the Mesic Red and White Pine LE in the NSU occurs on the SNF. This LE comprises approximately 7% of Superior National Forest lands, and occurs on 11% of SNF lands outside the wilderness.

Historically, this LE was dominated by mixed stands that include red pine, white pine, aspen, paper birch, northern white cedar, white spruce and balsam fir. The moist conditions associated with this system favor white pine more than red pine, although both species are depicted here.

Table FAC-10 displays a comparison of the existing upland forest conditions within this LE on National Forest lands and on all lands within the NSU to the range of natural variability values developed for this LE within the Section

MESIC BIRCH, ASPEN, SPRUCE-FIR LE

Approximately 36% of the Mesic Birch, Aspen, Spruce-Fir LE in the NSU occurs on the SNF. This LE comprises approximately 16% of Superior National Forest lands, and occurs on 24% of SNF lands outside the wilderness.

Historically, this LE was dominated by mixed stands of aspen, paper birch, balsam fir and white spruce. Occasionally, northern white cedar, bigtooth aspen or red maple is present. By age 80, natural mortality occurs in the aspen and paper birch. A multi-age stand is developing with a strong conifer component. This results in a multi-aged balsam fir/white spruce condition. Paper birch and northern white cedar are frequently components of the climax tree stage.

Table FAC-11 displays a comparison of the existing upland forest conditions within this LE on National Forest lands and on all lands within the NSU to the range of natural variability values developed for this LE within the Section

SUGAR MAPLE LE

Approximately 22% of the Sugar Maple LE in the NSU occurs on the SNF. This LE comprises approximately 3% of Superior National Forest lands, and occurs on 4% of SNF lands outside the wilderness.

This system within the Superior National Forest is usually within a band not more than 15 miles from Lake Superior. Historically, this LE was dominated by sugar maple with yellow birch present. Rarely, northern white cedar is present. These northern hardwood stands are characteristically short trees, with numerous frost cracks. Only the climatic influence of Lake Superior allows the band of sugar maple dominated stands to be present within 15 miles of the shoreline. Inland from Lake Superior this system also includes basswood, northern red oak and red maple. As the stand matures, the short-lived species would succeed to the understory species, creating a mature stand dominated by sugar maple. Eventually, the stand becomes an all-aged sugar maple stand.

Table FAC-12 displays a comparison of the existing upland forest conditions within this LE on National Forest lands and on all lands within the NSU to the range of natural variability values developed for this LE within the Section

Table FAC -2: Existing Upland Forest Conditions on the *Superior National Forest* (SNF) Compared to those on All Lands in the Northern Superior Uplands Section and to the Range of Natural Variability Values (RNV).

Forest Type	RNV Value	Existing %age (SNF Lands*)	Existing %age (All Lands)
Jack Pine	17%	11%	12%
Red Pine	8%	8%	5%
White Pine	9%	3%	2%
Spruce-Fir	37%	18%	15%
Oak	0%	0%	0%
Northern Hardwood	4%	4%	5%
Aspen	15%	45%	51%
Paper Birch	12%	11%	11%
Vegetation Growth Stage (age class)	**RNV Value**	**Existing %age (SNF Lands*)**	**Existing %age (All Lands)**
0-9 years old	5-10%	16%	7%
10-49 years old	18-29%	31%	29%
50-99 years old	17-22%	45%	46%
100-149 years old	11-15%	8%	15%
150+ years old	26-44%	0%	3%

‡Notes: Existing condition data is only for the area outside the Boundary Waters Canoe Area Wilderness (BWCAW).

Table FAC-3: Existing Upland Forest Conditions on the *Dry Pine LE* on the Chippewa National Forest (CNF) Compared to those for this LE on All Lands in the Minnesota Drift and Lake Plains Section and to the Range of Natural Variability Values (RNV).

Forest Type	RNV Value	Existing %age (CNF Lands)	Existing %age (All Lands)
Jack Pine	69%	29%	25%
Red Pine	22%	39%	20%
Spruce-Fir	2%	1%	5%
Aspen	2%	22%	38%
Paper Birch	1%	3%	4%
Northern Hardwood	1%	1%	1%
Oak	2%	3%	7%
White Pine	1%	1%	0%
Vegetation Growth Stage (age class)	**RNV Value**	**Existing %age (CNF Lands)**	**Existing %age (All Lands)**
0-15years old	13-23%	28%	12%
16-35 years old	16-24%	26%	19%
36-75 years old	21-24%	36%	46%
76-175 years old	20-27%	10%	24%
176+ years old	9-24%	<1%	0%

Table FAC-4: Existing Upland Forest Conditions on the *Dry-Mesic Pine LE* on the Chippewa National Forest (CNF) Compared to those for this LE on All Lands in the Minnesota Drift and Lake Plains Section and to the Range of Natural Variability Values (RNV).

Forest Type	RNV Value	Existing %age (CNF Lands)	Existing %age (All Lands)
Aspen	19%	45%	58%
Paper Birch	14%	11%	8%
Jack Pine	2%	2%	3%
White Pine	22%	1%	1%
Red Pine	22%	15%	3%
Spruce-Fir	5%	5%	2%
Oak	3%	6%	12%
Northern Hardwood	13%	14%	13%
Vegetation Growth Stage (age class)	**RNV Value**	**Existing %age (CNF Lands)**	**Existing %age (All Lands)**
0-15 years old	6-11%	15%	9%
16-35 years old	8-15%	21%	12%
36-75 years old	13-19%	37%	48%
76-175 years old	24-27%	27%	30%
176+ years old	28-49%	0%	0%

Table FAC-5: Existing Upland Forest Conditions on the *Dry-Mesic Pine/Oak LE* on the Chippewa National Forest (CNF) Compared to those for this LE on All Lands in the Minnesota Drift and Lake Plains Section and to the Range of Natural Variability Values (RNV).

Forest Type	RNV Value	Existing %age (CNF Lands)	Existing %age (All Lands)
Aspen	20%	40%	49%
Paper Birch	9%	9%	7%
Jack Pine	24%	6%	11%
White Pine	3%	1%	1%
Red Pine	36%	30%	12%
Oak	1%	2%	10%
Northern Hardwood	4%	8%	7%
Spruce-Fir	3%	4%	3%
Vegetation Growth Stage (age class)	**RNV Value**	**Existing %age (CNF Lands)**	**Existing %age (All Lands)**
0-15 years old	4-7%	16%	11%
16-35 years old	5-9%	22%	17%
36-75 years old	33-35%	30%	42%
76-120 years old	24-27%	29%	28%
121-175 years old	16-20%	2%	3%
176+ years old	9-13%	<1%	0%

Table FAC-6: Existing Upland Forest Conditions on the *Mesic Northern Hardwoods LE* on the Chippewa National Forest (CNF) Compared to those for this LE on All Lands in the Minnesota Drift and Lake Plains Section and to the Range of Natural Variability Values (RNV).

Forest Type	RNV Value	Existing %age (CNF Lands)	Existing %age (All Lands)
Aspen	4%	47%	49%
Paper Birch	1%	10%	11%
Oak	1%	1%	4%
Northern Hardwood	84%	31%	27%
Red Pine	3%	3%	2%
White Pine	1%	1%	1%
Spruce-Fir	6%	6%	6%
Vegetation Growth Stage (age class)	**RNV Value**	**Existing %age (CNF Lands)**	**Existing %age (All Lands)**
0-15 years old	2-4%	13%	9%
16-35 years old	2-4%	20%	19%
36-75 years old	4-7%	35%	35%
76-120 years old	4-7%	28%	31%
121-195 years old	6-10%	4%	5%
195+ years old	69-83%	0%	0%

Table FAC-7: Existing Upland Forest Conditions on the *Boreal Hardwood/Conifer LE* on the Chippewa National Forest (CNF) Compared to those for this LE on All Lands in the Minnesota Drift and Lake Plains Section and to the Range of Natural Variability Values (RNV).

Forest Type	RNV Value	Existing %age (CNF Lands)	Existing %age (All Lands)
Aspen	24%	66%	67%
Paper Birch	7%	7%	7%
Northern Hardwood	23%	11%	11%
Spruce-Fir	32%	11%	8%
White Pine	10%	1%	0%
Red Pine	4%	4%	4%
Vegetation Growth Stage (age class)	**RNV Value**	**Existing %age (CNF Lands)**	**Existing %age (All Lands)**
0-15 years old	7-11%	23%	8%
16-35 years old	9-14%	28%	19%
36-75 years old	25-32%	29%	41%
76-175 years old	23-32%	20%	32%
176+ years old	17-31%	0%	0%

Table FAC-8: Existing Upland Forest Conditions on the *Jack Pine-Black Spruce LE* on the Superior National Forest (SNF) Compared to those for this LE on All Lands in the Northern Superior Uplands Section and to the Range of Natural Variability Values (RNV).

Forest Type	RNV Value	Existing %age (SNF Lands)	Existing %age (All Lands)
Aspen, Aspen/Spruce-Fir	19%	43%	47%
Paper Birch	12%	5%	3%
Jack Pine	35%	27%	32%
Spruce-Fir	23%	13%	11%
Red Pine	9%	9%	5%
White Pine	2%	2%	1%
Vegetation Growth Stage (age class)	**RNV Value**	**Existing %age (SNF Lands)**	**Existing %age (All Lands)**
0-10 years old	9-17%	10%	9%
11-50 years old	28-41%	20%	24%
51-80 years old	14-16%	13%	18%
81-110 years old	10-11%	30%	25%
111-180 years old	9-15%	22%	22%
181-300 years old	7-21%	6%	2%

‡Notes: Existing conditions data is only for the area outside the BWCAW.

Table FAC-9: Existing Upland Forest Conditions on the *Dry-Mesic Red and White Pine LE* on the Superior National Forest (SNF) Compared to those for this LE on All Lands in the Northern Superior Uplands Section and to the Range of Natural Variability Values (RNV).

Forest Type	RNV Value	Existing %age (SNF Lands)	Existing %age (All Lands)
Aspen	15%	59%	61%
Paper Birch	7%	7%	9%
Spruce-Fir	38%	11%	8%
Jack Pine	13%	10%	8%
Red Pine	13%	4%	8%
White Pine	13%	8%	3%
Northern Hardwoods	1%	1%	2%
Vegetation Growth Stage (age class)	**RNV Value**	**Existing %age (SNF Lands)**	**Existing %age (All Lands)**
0-10 years old	3-6%	15%	9%
10-50 years old	11-20%	23%	29%
51-100 years old	13-22%	52%	53%
101-140 years old	10-15%	10%	8%
141-200 years old	10-12%	1%	1%
200+ years old	30-51%	0%	0%

‡Notes: Existing conditions data is only for the area outside the BWCAW.

Table FAC-10: Existing Upland Forest Conditions on the *Mesic Red and White Pine LE* on the Superior National Forest (SNF) Compared to those for this LE on All Lands in the Northern Superior Uplands Section and to the Range of Natural Variability Values (RNV).

Forest Type	RNV Value	Existing %age (SNF Lands)	Existing %age (All Lands)
White Pine	27%	2%	2%
Red Pine	5%	10%	5%
Aspen	15%	52%	56%
Paper Birch	12%	12%	16%
Spruce-Fir	30%	17%	12%
Northern Hardwood	2%	2%	5%
Jack Pine	8%	5%	2%
Vegetation Growth Stage (age class)	**RNV Value**	**Existing %age (SNF Lands)**	**Existing %age (All Lands)**
0-10 years old	4-7%	11%	6%
11-50 years old	12-22%	22%	33%
51-80 years old	10-12%	35%	42%
81-100 years old	5-7%	15%	12%
101-120 years old	5-7%	5%	4%
121+ years old	45-67%	11%	4%

‡Notes: Existing conditions data is only for the area outside the BWCAW.

Table FAC-11: Existing Upland Forest Conditions on the *Mesic Birch, Aspen, Spruce-Fir LE* on the Superior National Forest (SNF) Compared to those for this LE on All Lands in the Northern Superior Uplands Section and to the Range of Natural Variability Values (RNV).

Forest Type	RNV Value	Existing %age (SNF Lands)	Existing %age (All Lands)
Aspen	12%	45%	50%
Paper Birch	13%	13%	16%
Spruce-Fir	54%	27%	20%
Jack Pine	9%	6%	3%
Northern Hardwood	3%	3%	6%
Red Pine	5%	5%	4%
White Pine	4%	1%	1%
Vegetation Growth Stage (age class)	**RNV Value**	**Existing %age (SNF Lands)**	**Existing %age (All Lands)**
0-10 years old	5-10%	10%	6%
11-50 years old	17-28%	27%	33%
51-80 years old	10-16%	39%	38%
81+ years old	47-66%	25%	23%

‡Notes: Existing conditions data is only for the area outside the BWCAW.

Table FAC-12: Existing Upland Forest Conditions on the *Sugar Maple LE* on the Superior National Forest (SNF) Compared to those for this LE on All Lands in the Northern Superior Uplands Section and to the Range of Natural Variability Values (RNV).

Forest Type	RNV Value	Existing %age (SNF Lands)	Existing %age (All Lands)
Northern Hardwood	38%	34%	29%
Aspen	14%	29%	38%
Paper Birch	19%	19%	20%
Spruce-Fir	24%	14%	9%
White Pine	5%	0%	0%
Red Pine	1%	4%	3%
Vegetation Growth Stage (age class)	**RNV Value**	**Existing %age (SNF Lands)**	**Existing %age (All Lands)**
0-10 years old	3-5%	5%	3%
11-50 years old	12-19%	24%	30%
51-100 years old	13-20%	51%	52%
101-150 years old	12-16%	19%	11%
150+ years old	41-60%	1%	3%

‡Notes: Existing conditions data is only for the area outside the BWCAW.

Indicator 3 - Use of Management Treatments that Increase Within-Stand Complexity

This indicator evaluates active management treatments that may affect within-stand complexity. Timber harvest cutting methods, reforestation methods, supplemental planting, and prescribed fire are management activities that affect the compositional and structural complexity of a forested stand. Additionally, natural disturbances such as insect infestations, disease outbreaks, wind events, wildfire, and flooding, as well as forest succession effect within-stand complexity. Succession is a progressive change over time, in species composition and forest structure.

During the time period from 1986 through 2001, the Chippewa harvested timber on approximately 108,800 acres, averaging approximately 6800 acres of harvest per year. Of the total amount of harvest that occurred during this time period, regeneration harvests accounted for approximately 85,000 acres or 78% of the total harvested acres. Of the acres regenerated, approximately 82,400 acres or 97% of them were regenerated using the clearcut method. This primarily occurred on upland landforms in the aspen, spruce-fir, and jack pine types. This clearcut acreage represents approximately 18% of the upland forest types on the Chippewa. Approximately 22% of the total harvest was thinning, and this prescription was implemented primarily in red pine stands and in some white spruce plantations. Thinning from below to create an evenly spaced, thrifty growing stand was the primary objective for most of these stands.

During the time period from 1987 through 2001, the Superior harvested on 121,700 acres, averaging approximately 8100 acres of harvest per year. Of the total amount of harvest that occurred during this time period, regeneration harvests accounted for approximately 113,500 acres or 93% of the total harvested acres. Of the acres regenerated, approximately 113,100 acres or 99.6% of them were regenerated using the clearcut method. This primarily occurred on upland landforms in the aspen, spruce-for, and jack pine types. This clearcut acreage represents approximately 12% of the upland forest types on the Superior outside the wilderness. Approximately 7% of the total harvest was thinning, and this prescription was implemented primarily in red pine stands. Again, thinning from below to create an evenly spaced, thrifty growing stand was the primary objective for most of these stands.

The use of prescribed fire during this same time period has been minimal on both Forests. It has been used as a site preparation method, for brush disposal, and for hazardous fuels reduction in non-forested wet meadows on the Chippewa. More recently, the Superior has used prescribed fire to reduce the hazardous fuels build-up created by the large blowdown event that occurred in and adjacent to the Boundary Waters Canoe Area Wilderness.

Neither the Chippewa or the Superior have actively converted significant amounts of one forest type to another over the past 15-20 years. Recently however, efforts have been made to increase red and white pine as forest types and as components within other forest types on both national forests.

In terms of regeneration methods, the forest types regenerated and the harvest methods used to do so are similar on managed forests under other ownerships within the Drift and Lake Plains and the Northern Superior Uplands. There has been considerable conversion of jack pine to red pine on other forest ownerships within these sections. As it is on national forest lands, the use of prescribed fire in these ecological Sections is minimal.

Indicator 4 - Size, Amount, and Distribution of Old-Growth Forest

Old-growth forests provide a variety of biological, ecological, and social values. Old-growth refers to the entire community of vegetation and animals associated with particular old-growth forests. Because old-growth forests were a major component of our forested landscapes, the patterns and processes associated with them are important to the biological diversity that evolved with and adapted to the forests of northern Minnesota. They represent that portion of the successional sequence likely to be the most biologically diverse stage of the process (Hunter 1990). Old-growth forests are also recognized as valuable reference areas for conducting studies about the composition, structure, and processes associated with these ecosystems as well as controls for monitoring the effects of silvicultural activities designed to mimic natural disturbances. Old-growth forests are also important for their educational, aesthetic, and spiritual appeal. They provide unique settings for a variety of recreational experiences. Very little primary old-growth forest remains in Minnesota and the Lake States region.

The 1986 Forest Plans for the Chippewa and Superior National Forests addressed the issues relating to old-growth or old forest conditions through standards and guidelines for maintaining some old forest values for forested stands and wildlife habitats. This was primarily provided through extended rotation lengths for both short-lived and long-lived species.

Additionally, the Boundary Waters Canoe Area Wilderness (BWCAW) on the Superior provides approximately 800,000 acres of forests that contribute to the old-growth forest conditions on that national forest. A majority of the acres in the BWCAW were not harvested during the turn of the century logging that took place throughout northern Minnesota. Approximately 67% of the BWCAW is in the Jack Pine-Black Spruce LE, 13% is in Lowland Conifer, 7% in the Mesic Birch, Aspen, Spruce-Fir LE, 6% in the Dry-mesic Red and White Pine LE, 3% in the Mesic Red and White Pine LE, and 1% in the Sugar Maple LE. All of the acres in the BWCAW may not necessarily reflect old-growth forest conditions. Natural stand replacement events, such as the extensive blowdown experienced in 1999, will have returned some of these areas to the seedling establishment vegetation growth stage.

Many definitions for old-growth forest conditions exist, incorporating a variety of viewpoints and treatments of associated issues. At a national level, the USDA Forest Service is utilizing a broad definition for old-growth: "Old-growth forests are ecosystems distinguished by old trees and related structural attributes. Old-growth encompasses the later stages of stand development that typically differ from earlier stages in a variety of characteristics, which may include tree size; accumulations of large, dead, woody material; a number of canopy layers; species composition; and ecosystem function". Under this definition, some maturing second growth forests could be included, if allowed to approach old-growth conditions through appropriate management direction (USDA Forest Service 1989a).

The definition given below is largely a product of comparing those given in the Chippewa's Old-growth

Report (USDA Forest Service 1991a), the Superior's Old-growth Resources Report (USDA Forest Service 1992a), and the MN DNR's Old-Growth Forests Guidelines (Minnesota Department of Natural Resources 1994a). There is a great deal of consistency in defining the various terms relating to old-growth among these three entities.

Old-growth is generally defined as a forest that has developed relatively free of stand replacement disturbances over a long period of time. Old-growth ecosystems consist of late successional stages of natural occurring forests dominated by long-lived tree species. These forests are interspersed with old, usually large trees and tree fall gaps invaded by a variety of tree, shrub, and herbaceous species forming multiple canopy layers and increasing structural diversity. These communities contain a high frequency of snags and down logs of various sizes and in various stages of decay. Table FAC-13 displays minimum stand ages by forest type indicating candidate old-growth status has been reached and that the potential for these old-growth forest conditions exists. These ages were derived based upon definitions developed by the Superior and Chippewa National Forests and the Minnesota Department of Natural Resources.

There is no one definition or description that fits all old-growth forest types. The composition and structure of the overstory, midstory, and understory for any given old-growth forest are expected to vary depending on the forest type and the ecological factors exerted upon it. These factors could include natural disturbances (fire, wind, insects, etc.), soil conditions, topography, and a variety of other physical and biological influences. More recently, the vegetation growth stages, defined by disturbance modeling, for individual landscape ecosystems (LE) provide insights into the various compositional and structural phases that accompany forest succession, including old-growth. Table FAC-14 displays the existing amounts of forest in each LE that have reached a stand age that puts them into vegetation growth stage which may provide old-growth forest conditions for that LE. These acres are identified by stand age only and do not necessarily reflect all the characteristics associated with old-growth for these types. Tables GEIS-1 and GEIS-2 in Appendix G provides a breakdown of estimated percent by ownership group for each of the ecological sections containing the Chippewa and Superior National Forests.

Table FAC-13: Minimum Stand Ages for Potential Old-growth Forest Conditions to Exist.

Old-growth Forest Type Group	Minimum Stand Age Criteria
Northern Pine Forest Group	
Red Pine	120 years
Eastern White Pine	120 years
Red Pine-Oak	120 years
Lowland Conifer Forest Group	
Black Spruce	120 years
Northern White Cedar	120 years
Larch	120 years
Mixed Swamp Conifer	120 years
Spruce-Fir Forest Group	
White Spruce	90 years
Upland Black Spruce	80 years
Cedar-Aspen-Paper	120 years
Northern Hardwoods Forest Group	
Black Oak-White Oak	120 years
Red Oak	120 years
Mixed Oak	120 years
Sugar Maple-Yellow Birch	120 years
Sugar Maple-Basswood	120 years
Red Maple (Dry)	120 years
Sugar Maple	120 years
Mixed Hardwoods	120 years
Red Pine-Oak	120 years
Lowland Hardwoods Forest Group	
Black Ash-American Elm-Red Maple	120 years
Red Maple (Wet)	120 years
Mixed Lowland Hardwood	120 years

Source: Minimum ages for considering old-growth come out of the Old-growth Task Team Report.
Definitions: Minimum ages were derived from definitions developed by the Minnesota Department of Natural Resources, and the Superior and Chippewa National Forests.

3.2.1b Environmental Consequences

Forest Succession

Forest succession is the process of change to a particular forest community in a particular location over an extended period of time measured in 10s to 1,000s of years. This process is characterized by a sequential change in relative structure, kind, and relative abundance of the dominant species (Barnes et al. 1998).

Forest communities on the Chippewa and Superior National Forests are constantly changing due to the natural process of forest succession. This process occurs in all forested stands, managed or unmanaged, regardless of age. The progression of changes to forest composition and structure in a particular area is largely dependent on the inherent ecological capability of the site. This inherent capability is a product of the combined influences that soil, topography, and climate exert on the site. Additionally, and equally important to how a forest community changes over time, natural and human-induced disturbances play a critical role in the dynamics of change to composition and structure that occurs within a forested stand. The type, amount, and intensity of a disturbance, or sequence of disturbances, can substantially alter the successional sequence in a particular stand or across an area. The possible successional pathways that a forest community can take, based upon the disturbances they undergo, are still largely dictated by the landscape ecosystems in which they occur. Appendix B provides more detailed insights to the possible successional pathways for the landscape ecosystems present within the Northern Minnesota Drift and Lake Plains (Chippewa National Forest) and the Northern Superior Uplands (Superior National Forest) Sections.

Natural disturbances, such as insect infestations, disease outbreaks, wind events, floods, or fires, can

Table FAC-14: Existing Amounts of Forests in Old-Growth/Multi-aged (OG/MA) Condition in Upland Landscape Ecosystems (LE).

	Acres* of OG/MA Conditions	Percent of LE on National Forest Lands* in OG/MA Conditions	Total National Forest Acres* within the LE	Percent of LE on National Forest Lands	Percent of LE in BWCAW
Landscape Ecosystem (LE) Chippewa National Forest					
Dry Pine	2100	15%	13,584	3%	N/A
Dry-Mesic Pine	7100	7%	105,449	7%	N/A
Dry-Mesic Pine/Oak	18700	9%	207,673	7%	N/A
Mesic Northern Hardwoods	4300	5%	80,434	30%	N/A
Boreal Hardwood/Conifer	7200	5%	155,344	7%	N/A
Landscape Ecosystem (LE) Superior National Forest					
Jack Pine – Black Spruce	64600	22%	298,923	83%	55%
Dry-Mesic Red and White Pine	49180	24%	206,277	36%	7%
Mesic Red and White Pine	22800	16%	143,678	22%	3%
Mesic Birch, Aspen, Spruce-Fir	48900	15%	326,939	36%	6%
Sugar Maple	7400	13%	57,705	22%	2%

Definitions: Ages for Old growth/Multi-aged upland forest is based upon forest type groupings for the old-growth and old-growth/multi-aged habitat groupings (see Appendix D – Wildlife)
‡Notes: * For the Superior National Forest, these acres and percentages do not include BWCAW acres.

occur locally within stands or more broadly to multiple stands or even landscapes. These kinds of disturbances, along with the inherent ecological capability of an area, are primarily what shaped the composition and structure of the natural forests occurring on what now is the Chippewa and Superior National Forests.

Similarly, active forest management activities, such as timber harvesting, road building, fire suppression, and prescribed burning, can have profound influences on the changes to the composition and structure of forests at the local and landscape levels.

Forest succession is a natural phenomenon that occurs and will continue to occur on the Chippewa and Superior National Forests under all alternatives. The potential affects to the successional pathways for each landscape ecosystem and their eventual compositional and structural characteristics due active and passive management strategies are expected to vary by alternative and are analyzed in this Final EIS.

Direct and Indirect Effects

Indicator 1 and 2 – Amounts of Forest Types and Amounts of Forest in Age Groups

During the planning process, objectives for forest composition (forest types) and forest structure (stand ages) were determined for each landscape ecosystem (LE) represented on either the Chippewa or Superior National Forest. These objectives are 100-year projections for each forest type and age class within a particular LE. The amount of forest in a particular forest type or age class varies by alternative based upon its overall theme and accompanying goals and objectives. They provide the long-term forest vegetation goals for that alternative and assisted in guiding the Dualplan model in projecting forest types and ages throughout the 100-year planning horizon.

The direct and indirect effects to landscape forest composition (forest types) and structure (age classes) projected under each alternative are primarily discussed in relation to how they compare to the range of natural variability values developed at the appropriate ecological Section level. This comparison provides information on how management on National Forest lands relates to some aspects of forest conditions predicted to occur while operating within the range of natural variability. However, the appropriate scale for making judgments about whether or not a landscape is operating within RNV is at the ecological Section level. This is the Northern Minnesota Drift and Lake Plains for the Chippewa, and the Northern Superior Uplands for the Superior. Additionally, these indicators are compared to the existing conditions on National Forest lands and existing conditions within the Section.

An evaluation process was used to quantify the differences between an established vegetation objective for an alternative and the RNV value for that particular vegetation component. This process allows the analysis to consistently compare the composition and age objectives of each alternative to the RNV values predicted for each LE. It also allows the analysis to make relative comparisons among the alternatives as to how forest vegetation conditions on national forest lands projected to occur under each of them:

- Compare to existing landscape conditions across the ecological Section;
- Relate to the RNV values for individual forest composition and age components; and
- Contribute, cumulatively with other land owners, towards meeting future conditions within the ecological Section, relative to operating within the range of natural variability.

The RNV value for a forest type is given as a single percentage, not a range. It is assumed to be the midpoint for a range of forest type amounts that would have been predicted to occur during the time period when the landscape (ecological Section) was operating within the range of natural variability. The RNV value for a particular vegetation growth stage is given as a percentage range of amounts of forest within a particular age class predicted to occur during the time period when the landscape (ecological Section) was operating within the range of natural variability. The difference between a vegetation objective and the RNV value for that particular forest component was quantified as a departure from RNV. For purposes of this analysis, a major departure from RNV values represents a considerable effect that will be highlighted for a particular indicator component within an LE.

Figure FAC-1: Summary of Departure Evaluation Information for Comparing Chippewa National Forest Upland Forest Type and Forest Age Long-Term (100 years) Objectives for All Alternatives to the Range of Natural Variability Values

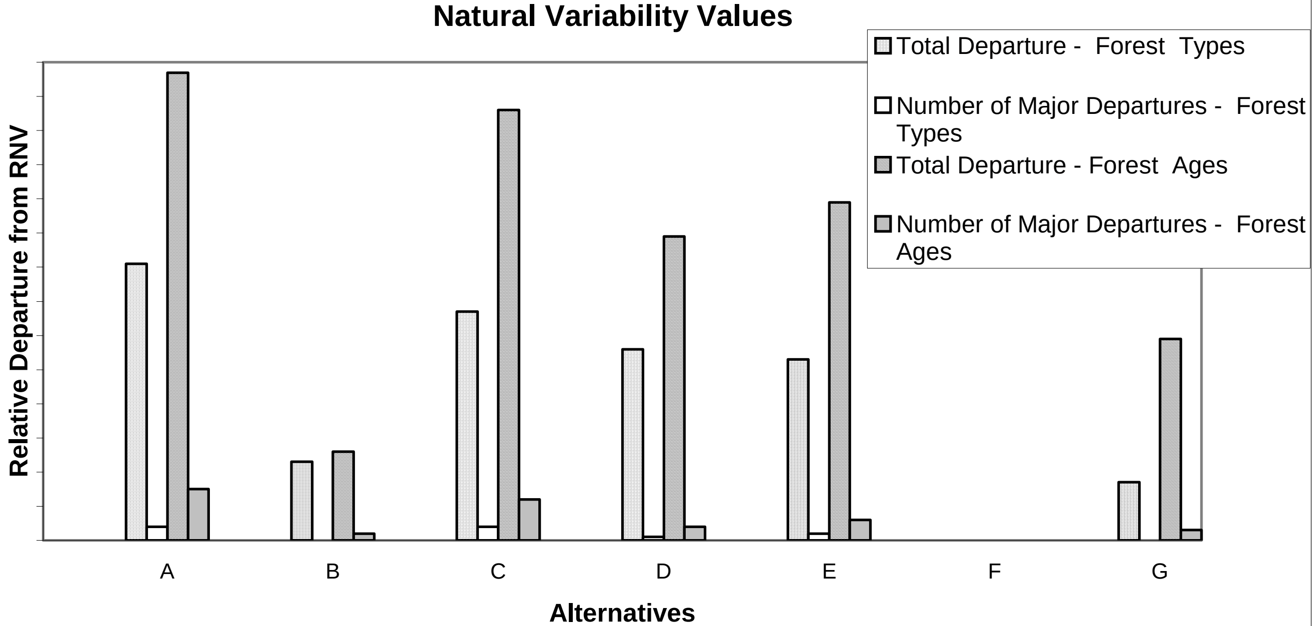
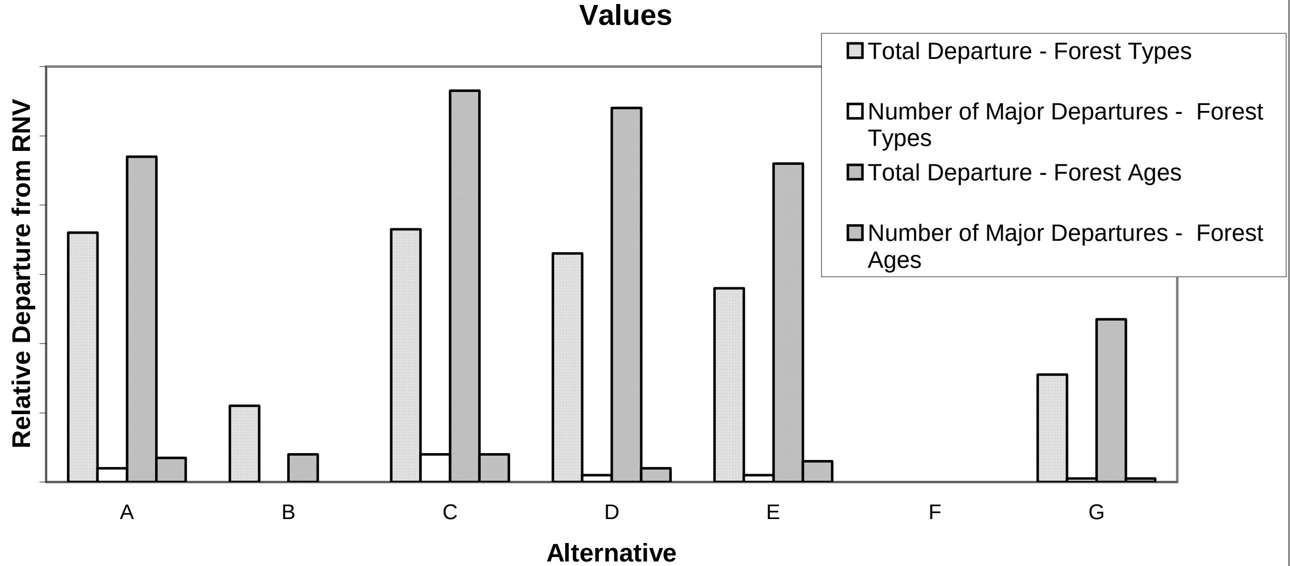


Figure FAC-2: Summary of Departure Evaluation Information for Comparing Superior National Forest Upland Forest Type and Forest Age Long-Term (100 years) Objectives for All Alternatives to the Range of Natural Variability Values



Using the above evaluation process, individual comparison tables for all forest composition (forest type) and forest age (age class) components were completed for each LE by alternative. These tables, along with summaries of this analysis by LE, are part of the project record. A summary of the RNV evaluation information is provided in Figure FAC-1 for the Chippewa National Forest and in Figure FAC-2 for the Superior. This summary information provides a forest-wide perspective on how proposed forest management strategies under each alternative affect long-term forest composition and structure on the Chippewa and Superior National Forests. By comparing the long-term composition and age objectives for a particular alternative to the RNV values, there is some ability to relate how forest management on the Chippewa and Superior National Forests contributes to future forest conditions throughout the Section and to that Section's ability to maintain long-term ecological sustainability. Additionally, this analysis looks at general forest-wide trends through the 100-year planning period by comparing Dualplan model outputs for decades 1, 2, 5, and 10 to their respective RNV values. This information helps to assess whether or not this alternative is moving National Forest lands towards the RNV values used in this analysis; and if so, how quickly it does so. Because these trends are based upon model outputs, they are best used to assist in comparing the alternatives to each other, the existing conditions, and to the RNV values rather than projecting an actual rate of change.

Table FAC-16: Trends in Upland Forest Composition and Forest Age Structure for *Alternative A* on the *Chippewa National Forest* Relative to the Existing Amounts and to the Range of Natural Variability Values.

Forest Composition							
Forest Type	**Existing Amount**	**RNV Value**	**Decade 1 Percent Projected**	**Decade 2 Percent Projected**	**Decade 5 Percent Projected**	**Decade 10 Percent Projected**	**Vegetation Objective**
Jack Pine	3%	11%	3%	3%	3%	3%	4%
Red Pine	16%	19%	16%	16%	18%	18%	15%
White Pine	1%	8%	1%	1%	1%	1%	1%
Spruce-Fir	7%	12%	7%	8%	8%	9%	5%
Oak	2%	1%	2%	2%	2%	2%	2%
Northern Hardwood	13%	22%	14%	14%	15%	16%	13%
Aspen	49%	19%	49%	48%	46%	44%	52%
Paper Birch	8%	8%	8%	7%	6%	6%	8%
Forest Age Structure							
Age Class	**Existing Amount**	**RNV Value**	**Decade 1 Percent Projected**	**Decade 2 Percent Projected**	**Decade 5 Percent Projected**	**Decade 10 Percent Projected**	**Vegetation Objective**
0-9	13%	3-6%	17%	13%	16%	16%	19%
10-49	38%	15-24%	48%	55%	58%	55%	47%
50-99	44%	21-25%	27%	21%	10%	11%	21%
100-149	6%	12-25%	8%	10%	12%	4%	10%
150+	0%	32-46%	1%	1%	3%	14%	3%

Source: The percent projected for each decade is based upon Dualplan model outputs for that forest type.
Definitions: Historical data, ecological capability information, and disturbance modeling which predicts the mix of seral stage communities within a particular LE were used to inform the range of natural variability (RNV) values for forest composition.
‡Notes: This table information pertains to FAC Tables 16-28.

Alternative A

Based on the long-term vegetation objectives for this alternative, the relative amount of upland forest in various forest types and age classes remains essentially the same as the existing forest conditions. For National Forest lands, the combined total departure and total number of major departures from the RNV values used in this analysis are among the highest of the alternatives analyzed. When compared to landscape ecosystem conditions within RNV, the amount of upland forest on National Forest lands in the young age classes projected under this alternative are generally 2-3 times more than the RNV value amounts. Consequently, the oldest age classes are considerably under-represented in many of the LEs on National Forest lands. The amounts of aspen forest type projected to occur on National Forest lands are generally 2-3 times more than would be expected to occur on LEs within RNV. The resulting upland forest composition and age class structure on lands managed by the Chippewa and Superior National Forests will be largely outside the RNV values developed for the LEs within the Northern Minnesota Drift and Lake Plains and the Northern Superior Uplands, respectively.

Chippewa National Forest

Figure FAC-1 provides summary information of the RNV departure evaluation and major departures when comparing the 100-year projected amounts of upland forest types and forest ages for this alternative to the RNV values for each LE. This alternative received 4 major departures in forest composition. Two of these are in the aspen type, where projected amounts are 38% and 39% more than the RNV value. One is in the jack pine type where the projected amount is 37% less than the RNV value; and one is in northern hardwoods where the projected amount is 47% less than the RNV value. It also received 15 major departures in forest age. These occur primarily where projected amounts in the two or three youngest age classes are 11% to 20% greater than the RNV value; and the corresponding amounts in the oldest age classes are projected to be 14% to 64% less than the RNV value.

Table FAC-16 provides general forest-wide trends through the 100-year planning period by comparing Dualplan model outputs for decades 1, 2, 5, and 10 to

Table FAC-17: Trends in Upland Forest Composition and Forest Age Structure for *Alternative A* on the *Superior National Forest* Relative to the Existing Amounts and to the Range of Natural Variability Values.

Forest Composition

Forest Type	Existing Amount	RNV Value	Decade 1	Decade 2	Decade 5	Decade 10	
			Percent Projected	Percent Projected	Percent Projected	Percent Projected	Vegetation Objective
Jack Pine	11%	17%	10%	10%	9%	9%	7%
Red Pine	8%	8%	8%	8%	9%	10%	5%
White Pine	3%	9%	3%	3%	3%	3%	3%
Spruce-Fir	18%	37%	20%	21%	28%	30%	14%
Northern Hardwood	4%	4%	4%	4%	4%	4%	4%
Aspen	45%	15%	44%	43%	39%	37%	56%
Paper Birch	11%	12%	11%	10%	7%	6%	13%

Forest Age Structure

Age Class	Existing Amount	RNV Value	Decade 1	Decade 2	Decade 5	Decade 10	Vegetation Objective
			Percent Projected	Percent Projected	Percent Projected	Percent Projected	
0-9	16%	5-10%	15%	13%	15%	15%	9%
10-49	31%	18-29%	44%	51%	51%	51%	31%
50-99	45%	17-22%	31%	22%	14%	11%	46%
100-149	8%	11-15%	10%	14%	16%	6%	13%
150+	0%	26-44%	0%	1%	4%	17%	N/A

their respective RNV values and to existing upland forest conditions on the Chippewa. The long term trends displayed indicate that this alternative does not appear to be moving the Chippewa uplands towards the RNV values for forest composition and generally moves forest age class distribution away from the RNV values used in this analysis.

Superior National Forest

Figure FAC-2 provides summary information of the RNV departure evaluation and major departures when comparing the 100-year projected amounts of upland forest types and forest ages for this alternative to the RNV values for each LE. This alternative received 4 major departures in forest composition. Three of these are in the aspen type, where projected amounts are 23% to 30% more than the RNV value. One is in the white pine type where the projected amount is 23% less than the RNV value. It also received 7 major departures in forest age. These occur primarily where projected amounts in the 11 – 50 years age class are 16% to 34% greater than the RNV value (4 times); and the corresponding amounts in the oldest age class are projected to be 18% to 32% less than the RNV value (3 times).

Table FAC-17 provides general forest-wide trends through the 100-year planning period by comparing Dualplan model outputs for decades 1, 2, 5, and 10 to their respective RNV values and to existing upland forest conditions on the Superior. The long term trends displayed indicate that this alternative generally moves both forest composition and forest age class distribution away from the RNV values used in this analysis.

Alternative B

Based on the long-term vegetation objectives for this alternative, the amount of aspen forest type would be considerably reduced from existing conditions, while the amounts of jack pine, white pine, spruce-fir, and northern hardwoods would increase. The age class distribution of the forest would shift from the current high amounts in the young age classes to considerably more acreage in the older age classes. For National

Table FAC-18: Trends in Upland Forest Composition and Forest Age Structure for *Alternative B* on the *Chippewa National Forest* Relative to the Existing Amounts and to the Range of Natural Variability Values.

Forest Composition							
Forest Type	Existing Amount	RNV Value	Decade 1 Percent Projected	Decade 2 Percent Projected	Decade 5 Percent Projected	Decade 10 Percent Projected	Vegetation Objective
Jack Pine	3%	11%	4%	5%	6%	6%	8%
Red Pine	16%	19%	17%	17%	20%	22%	25%
White Pine	1%	8%	1%	2%	4%	9%	10%
Spruce-Fir	7%	12%	8%	10%	14%	20%	14%
Oak	2%	1%	2%	2%	2%	2%	1%
Northern Hardwood	13%	22%	14%	17%	23%	30%	23%
Aspen	49%	19%	46%	41%	28%	7%	12%
Paper Birch	8%	8%	8%	7%	5%	4%	7%
Forest Age Structure							
Age Class	**Existing Amount**	**RNV Value**	**Decade 1 Percent Projected**	**Decade 2 Percent Projected**	**Decade 5 Percent Projected**	**Decade 10 Percent Projected**	**Vegetation Objective**
0-9	13%	3-6%	4%	4%	4%	4%	4%
10-49	38%	15-24%	48%	44%	20%	21%	17%
50-99	44%	21-25%	39%	38%	43%	24%	20%
100-149	6%	12-25%	9%	13%	26%	19%	16%
150+	0%	32-46%	1%	1%	6%	32%	43%

Forest lands, the combined total departure and total number of major departures from the RNV values used in this analysis are among the lowest of the alternatives analyzed. For most of the upland forest composition and age factors evaluated on National Forest lands, the amounts projected under this alternative generally fall within what would be expected to occur on landscapes that are functioning within RNV. The resulting upland forest composition and age class structure on lands managed by the Chippewa and Superior National Forests will be generally within the RNV values developed for the LEs within the Northern Minnesota Drift and Lake Plains and the Northern Superior Uplands, respectively.

Chippewa National Forest

Figure FAC-1 provides summary information of the RNV departure evaluation and major departures when comparing the 100-year projected amounts of upland forest types and forest ages for this alternative to the RNV values for each LE. This alternative received 0 major departures in forest composition. It received 2 major departures in forest age. One of these occurs where the projected amount in the 36-75 year age class is 13% greater than the RNV value; and the other occurs where the projected amount in the 36-75 year age class in a different LE is 11% less than the RNV value.

Table FAC-18 provides general forest-wide trends through the 100-year planning period by comparing Dualplan model outputs for decades 1, 2, 5, and 10 to their respective RNV values and to existing upland forest conditions on the Chippewa. The long term trends displayed indicate that this alternative appears to be generally moving the Chippewa upland forests towards the RNV values for forest composition; and to within the RNV values for forest age class distribution.

Superior National Forest

Figure FAC-2 provides summary information of the RNV departure evaluation and major departures when comparing the 100-year projected amounts of upland forest types and forest ages for this alternative to the RNV values for each LE. This alternative received 0 major departures in forest composition and 0 major departures in forest age.

Table FAC-19: Trends in Upland Forest Composition and Forest Age Structure for *Alternative B* on the *Superior National Forest* Relative to the Existing Amounts and to the Range of Natural Variability Values.

Forest Composition							
Forest Type	Existing Amount	RNV Value	Decade 1 Percent Projected	Decade 2 Percent Projected	Decade 5 Percent Projected	Decade 10 Percent Projected	Vegetation Objective
Jack Pine	11%	17%	11%	12%	14%	15%	17%
Red Pine	8%	8%	8%	8%	8%	8%	8%
White Pine	3%	9%	3%	3%	6%	8%	8%
Spruce-Fir	18%	37%	20%	22%	39%	49%	44%
Northern Hardwood	4%	4%	4%	4%	5%	5%	4%
Aspen	45%	15%	41%	40%	22%	9%	9%
Paper Birch	11%	12%	13%	11%	7%	6%	10%
Forest Age Structure							
Age Class	**Existing Amount**	**RNV Value**	**Decade 1 Percent Projected**	**Decade 2 Percent Projected**	**Decade 5 Percent Projected**	**Decade 10 Percent Projected**	**Vegetation Objective**
0-9	16%	5-10%	7%	5%	5%	6%	5%
10-49	31%	18-29%	44%	42%	27%	23%	18%
50-99	45%	17-22%	37%	34%	39%	22%	26%
100-149	8%	11-15%	11%	18%	25%	24%	51%
150+	0%	26-44%	0%	1%	5%	26%	N/A

Table FAC-19 provides general forest-wide trends through the 100-year planning period by comparing Dualplan model outputs for decades 1, 2, 5, and 10 to their respective RNV values. The long term trends displayed indicate that this alternative appears to be moving the Superior uplands towards the RNV values for forest composition; and to within the RNV values for forest age class distribution.

Alternative C

Based on the long-term vegetation objectives for this alternative, the relative amount of upland forest in various forest types and age classes remains essentially the same as the existing forest conditions. For National Forest lands, the combined total departure and total number of major departures from the RNV values used in this analysis are among the highest of the alternatives analyzed. When compared to landscape ecosystems within RNV, the amount of forest in the young age classes projected under this alternative are generally 2-3 times more than the RNV value amounts, while the oldest age classes are considerably under-represented in many of the LEs on National Forest lands. The amounts of aspen forest type projected to occur on National Forest lands are generally 2-3 times more than would be expected to occur within RNV. The resulting upland forest composition and age class structure on lands managed by the Chippewa and Superior National Forests will be largely outside the RNV values developed for the LEs within the Northern Minnesota Drift and Lake Plains and the Northern Superior Uplands, respectively.

Chippewa National Forest

Figure FAC-1 provides summary information of the RNV departure evaluation and major departures when comparing the 100-year projected amounts of upland forest types and forest ages for this alternative to the RNV values for each LE. This alternative received 4 major departures in forest composition. Two of these are in the aspen type, where projected amounts are 42% and 43% more than the RNV value. One is in the

Table FAC-20: Trends in Upland Forest Composition and Forest Age Structure for *Alternative C* on the *Chippewa National Forest* Relative to the Existing Amounts and to the Range of Natural Variability Values.

Forest Composition							
Forest Type	**Existing Amount**	**RNV Value**	**Decade 1**	**Decade 2**	**Decade 5**	**Decade 10**	**Vegetation Objective**
			Percent Projected	**Percent Projected**	**Percent Projected**	**Percent Projected**	
Jack Pine	3%	11%	4%	4%	4%	4%	4%
Red Pine	16%	19%	17%	17%	18%	18%	19%
White Pine	1%	8%	1%	2%	4%	4%	4%
Spruce-Fir	7%	12%	7%	8%	9%	10%	6%
Oak	2%	1%	2%	2%	2%	2%	2%
Northern Hardwood	13%	22%	14%	14%	16%	18%	11%
Aspen	49%	19%	47%	45%	42%	38%	45%
Paper Birch	8%	8%	8%	8%	6%	6%	9%
Forest Age Structure							
Age Class	**Existing Amount**	**RNV Value**	**Decade 1**	**Decade 2**	**Decade 5**	**Decade 10**	**Vegetation Objective**
			Percent Projected	**Percent Projected**	**Percent Projected**	**Percent Projected**	
0-9	13%	3-6%	22%	14%	12%	15%	13%
10-49	38%	15-24%	48%	58%	59%	51%	43%
50-99	44%	21-25%	23%	19%	11%	11%	22%
100-149	6%	12-25%	6%	8%	14%	5%	5%
150+	0%	32-46%	1%	1%	4%	17%	18%

northern hardwood type where the projected amount is 53% less than the RNV value. One other is in the Spruce-fir type where the projected amount is 21% less than the RNV value. It also received 12 major departures in forest age. Similar to Alternative A, these occur primarily where projected amounts in the two or three youngest age classes are 11% to 18% greater than the RNV value (7 times); and the corresponding amounts in the oldest age classes are projected to be 11% to 36% less than the RNV value (5 times).

Table FAC-20 provides general forest-wide trends through the 100-year planning period by comparing Dualplan model outputs for decades 1, 2, 5, and 10 to their respective RNV values and to existing upland forest conditions on the Chippewa. The long term trends displayed indicate that this alternative does not appear to be moving the Chippewa uplands towards the RNV values for forest composition and is generally moving away from the forest age class distribution values used in this analysis.

Superior National Forest

Figure FAC-2 provides summary information of the RNV departure evaluation and major departures when comparing the 100-year projected amounts of upland forest types and forest ages for this alternative to the RNV values for each LE. This alternative received 8 major departures in forest composition. Four of these are in the aspen type, where projected amounts are 24% to 35% more than the RNV value. One is in the white pine type where the projected amount is 22% less than the RNV value. Three are in spruce-fir where the projected amount is 21% to 28% less than the RNV value. It also received 8 major departures in forest age. These occur primarily where projected amounts in the two or three youngest age classes are 21% to 37% greater than the RNV value (5 times); and the corresponding amounts in the oldest age class are projected to be 28% to 40% less than the RNV value (3 times).

Table FAC-21 provides general forest-wide trends through the 100-year planning period by comparing Dualplan model outputs for decades 1, 2, 5, and 10 to

Table FAC-21: Trends in Upland Forest Composition and Forest Age Structure for *Alternative C* on the *Superior National Forest* Relative to the Existing Amounts and to the Range of Natural Variability Values.

Forest Composition							
Forest Type	**Existing Amount**	**RNV Value**	**Decade 1**	**Decade 2**	**Decade 5**	**Decade 10**	**Vegetation Objective**
			Percent Projected	**Percent Projected**	**Percent Projected**	**Percent Projected**	
Jack Pine	11%	17%	11%	12%	15%	15%	16%
Red Pine	8%	8%	8%	8%	9%	9%	8%
White Pine	3%	9%	3%	3%	4%	4%	3%
Spruce-Fir	18%	37%	19%	19%	24%	25%	15%
Northern Hardwood	4%	4%	4%	4%	4%	4%	3%
Aspen	45%	15%	44%	43%	37%	35%	45%
Paper Birch	11%	12%	11%	10%	8%	7%	10%
Forest Age Structure							
Age Class	**Existing Amount**	**RNV Value**	**Decade 1**	**Decade 2**	**Decade 5**	**Decade 10**	**Vegetation Objective**
			Percent Projected	**Percent Projected**	**Percent Projected**	**Percent Projected**	
0-9	16%	5-10%	20%	15%	15%	14%	15%
10-49	31%	18-29%	44%	55%	56%	52%	59%
50-99	45%	17-22%	27%	17%	13%	11%	18%
100-149	8%	11-15%	9%	12%	13%	7%	9%
150+	0%	26-44%	0%	1%	4%	15%	N/A

their respective RNV values and to existing upland forest conditions on the Superior. The long term trends displayed indicate that this alternative does not appear to be moving the Superior uplands towards the RNV values for forest composition or forest age class distribution used in this analysis.

Alternative D

Based on the long-term vegetation objectives for this alternative, the amount of aspen forest type would be substantially reduced from existing conditions, while the amounts of jack pine, white pine, spruce-fir, and northern hardwoods would get a corresponding increase. The age class distribution of the forest would shift substantially from the current high amounts in the young age classes to considerably more acreage in the older age classes. For National Forest lands, the combined total departure and total number of major departures from the RNV values used in this analysis are midway among the alternatives analyzed. When compared to landscape ecosystems within RNV, the older age classes projected under this alternative are generally twice as much as their corresponding RNV values. The amounts of long-lived forest types are increased considerably over what would be expected to occur within RNV. The resulting upland forest composition and age class structure on lands managed by the Chippewa and Superior National Forests will generally fall just outside the RNV values developed for the LEs within the Northern Minnesota Drift and Lake Plains and the Northern Superior Uplands, respectively.

Chippewa National Forest

Figure FAC-1 provides summary information of the RNV departure evaluation and major departures when comparing the 100-year projected amounts of upland forest types and forest ages for this alternative to the RNV values for each LE. This alternative received 1 major departure in forest composition. This is in the red pine type where the projected amount is 22% more than the RNV value. It also received 4 major departures in forest age. These occur where projected amounts in the two or three oldest age classes are 13% to 20% greater than the RNV value (2 times). The

Table FAC-22: Trends in Upland Forest Composition and Forest Age Structure for *Alternative D* on the *Chippewa National Forest* Relative to the Existing Amounts and to the Range of Natural Variability Values.

Forest Composition							
Forest Type	Existing Amount	RNV Value	Decade 1 Percent Projected	Decade 2 Percent Projected	Decade 5 Percent Projected	Decade 10 Percent Projected	Vegetation Objective
Jack Pine	3%	11%	5%	6%	7%	9%	4%
Red Pine	16%	19%	17%	18%	20%	21%	28%
White Pine	1%	8%	2%	3%	8%	11%	11%
Spruce-Fir	7%	12%	7%	8%	11%	17%	18%
Oak	2%	1%	2%	2%	2%	2%	1%
Northern Hardwood	13%	22%	14%	16%	21%	32%	27%
Aspen	49%	19%	44%	40%	28%	4%	6%
Paper Birch	8%	8%	8%	7%	4%	4%	5%
Forest Age Structure							
Age Class	**Existing Amount**	**RNV Value**	**Decade 1 Percent Projected**	**Decade 2 Percent Projected**	**Decade 5 Percent Projected**	**Decade 10 Percent Projected**	**Vegetation Objective**
0-9	13%	3-6%	6%	4%	2%	2%	2%
10-49	38%	15-24%	48%	46%	22%	11%	9%
50-99	44%	21-25%	37%	36%	45%	33%	13%
100-149	6%	12-25%	9%	13%	25%	22%	20%
150+	0%	32-46%	1%	1%	6%	31%	57%

other two occur where the amounts in the middle age classes are projected to be 11% to 22% less than the RNV value.

Table FAC-22 provides general forest-wide trends through the 100-year planning period by comparing Dualplan model outputs for decades 1, 2, 5, and 10 to their respective RNV values and to existing upland forest conditions on the Chippewa. The long term trends displayed indicate that this alternative does appear to be moving the Chippewa uplands substantially towards the RNV values for forest composition and forest age used in this analysis.

Superior National Forest

Figure FAC-2 provides summary information of the RNV departure evaluation and major departures when comparing the 100-year projected amounts of upland forest types and forest ages for this alternative to the RNV values for each LE. This alternative received 2 major departures in forest composition. One is in the jack pine type where the projected amount is 26% less than the RNV value; and one is in the spruce-fir type where the projected amount is 51% greater than the RNV value. It also received 4 major departures in forest age. Three of these occur where projected amounts in the two oldest age classes are 17% to 69% greater than the RNV value. The other occurs where the projected amount in the 11-50 year age class is 22% less than the RNV value.

Table FAC-23 provides general forest-wide trends through the 100-year planning period by comparing Dualplan model outputs for decades 1, 2, 5, and 10 to their respective RNV values and to existing upland forest conditions on the Superior. The long term trends displayed indicate that this alternative does appear to be moving the Superior towards the RNV values for forest composition and forest age used in this analysis over the long term. This alternative is different from the others in that its departures tend to be in the large acreage amounts in the older age classes and in the long-lived forest types.

Table FAC-23: Trends in Upland Forest Composition and Forest Age Structure for *Alternative D* on the *Superior National Forest* Relative to the Existing Amounts and to the Range of Natural Variability Values.

Forest Composition							
Forest Type	Existing Amount	RNV Value	Decade 1	Decade 2	Decade 5	Decade 10	Vegetation Objective
			Percent Projected	Percent Projected	Percent Projected	Percent Projected	
Jack Pine	11%	17%	14%	15%	17%	18%	7%
Red Pine	8%	8%	8%	8%	8%	8%	8%
White Pine	3%	9%	4%	4%	8%	8%	8%
Spruce-Fir	18%	37%	20%	22%	35%	47%	64%
Northern Hardwood	4%	4%	4%	4%	4%	5%	4%
Aspen	45%	15%	40%	36%	20%	9%	3%
Paper Birch	11%	12%	11%	10%	7%	5%	6%

Forest Age Structure							
Age Class	Existing Amount	RNV Value	Decade 1	Decade 2	Decade 5	Decade 10	Vegetation Objective
			Percent Projected	Percent Projected	Percent Projected	Percent Projected	
0-9	16%	5-10%	6%	5%	2%	2%	2%
10-49	31%	18-29%	44%	45%	26%	14%	6%
50-99	45%	17-22%	38%	33%	43%	32%	18%
100-149	8%	11-15%	11%	17%	23%	27%	74%
150+	0%	26-44%	0%	1%	5%	24%	N/A

Modified Alternative E

Based on the long-term vegetation objectives for this alternative, the amount of aspen forest type would be somewhat reduced from existing conditions, while the amounts of jack pine, red pine, white pine, and spruce-fir, would increase slightly. The age class distribution of the forest would shift from the current high amounts in the young age classes to more acreage in the older age classes. For National Forest lands, the combined total departure and total number of major departures from the RNV values used in this analysis are midway among the alternatives analyzed. When compared to landscape ecosystems within RNV, the amount of forest in the older age classes projected under this alternative are generally one-half the RNV value amounts for many of the LEs. The amounts of aspen forest type are generally 2-3 times more than would be expected to occur on LEs within RNV. The resulting upland forest composition and age class structure on lands managed by the Chippewa and Superior National Forests will generally fall just outside the RNV values developed for the LEs within the Northern Minnesota Drift and Lake Plains and the Northern Superior Uplands, respectively.

Chippewa National Forest

Figure FAC-1 provides summary information of the RNV departure evaluation and major departures when comparing the 100-year projected amounts of upland forest types and forest ages for this alternative to the RNV values for each LE. This alternative received 2 major departures in forest composition. One is in the northern hardwood type where the projected amount is 30% less than the RNV value; and one is in aspen type where the projected amount is 26% greater than the RNV value. It also received 6 major departures in forest age. Two of these occur where projected amounts in the oldest age class are 13% to 52% less than the RNV value. Three others occur where the amounts in the 36-75 year age class are projected to be 14% to 17% greater than the RNV value. One other occurs where the projected amount in the 121-195 year age class is 14% more than the RNV value.

Table FAC-24: Trends in Upland Forest Composition and Forest Age Structure for *Alternative Modified E* on the *Chippewa National Forest* Relative to the Existing Amounts and to the Range of Natural Variability Values.

Forest Composition							
			Decade 1	**Decade 2**	**Decade 5**	**Decade 10**	
Forest Type	**Existing Amount**	**RNV Value**	**Percent Projected**	**Percent Projected**	**Percent Projected**	**Percent Projected**	**Vegetation Objective**
Jack Pine	3%	11%	5%	6%	6%	6%	6%
Red Pine	16%	19%	17%	17%	19%	19%	19%
White Pine	1%	8%	1%	3%	5%	6%	6%
Spruce-Fir	7%	12%	7%	8%	9%	11%	9%
Oak	2%	1%	2%	2%	2%	2%	2%
Northern Hardwood	13%	22%	15%	16%	19%	21%	17%
Aspen	49%	19%	46%	42%	35%	29%	32%
Paper Birch	8%	8%	8%	7%	6%	6%	9%
Forest Age Structure							
			Decade 1	**Decade 2**	**Decade 5**	**Decade 10**	
Age Class	**Existing Amount**	**RNV Value**	**Percent Projected**	**Percent Projected**	**Percent Projected**	**Percent Projected**	**Vegetation Objective**
0-9	13%	3-6%	8%	8%	9%	7%	8%
10-49	38%	15-24%	49%	48%	38%	35%	34%
50-99	44%	21-25%	33%	29%	27%	22%	28%
100-149	6%	12-25%	9%	13%	20%	11%	12%
150+	0%	32-46%	1%	1%	6%	24%	17%

Table FAC-25: Trends in Upland Forest Composition and Forest Age Structure for *Alternative Modified E* on the *Superior National Forest* Relative to the Existing Amounts and to the Range of Natural Variability Values.

Forest Composition							
Forest Type	Existing Amount	RNV Value	Decade 1 Percent Projected	Decade 2 Percent Projected	Decade 5 Percent Projected	Decade 10 Percent Projected	Vegetation Objective
Jack Pine	11%	17%	12%	13%	15%	15%	19%
Red Pine	8%	8%	8%	8%	9%	9%	9%
White Pine	3%	9%	4%	5%	6%	6%	6%
Spruce-Fir	18%	37%	19%	20%	28%	30%	21%
Northern Hardwood	4%	4%	4%	4%	4%	5%	4%
Aspen	45%	15%	42%	39%	30%	28%	31%
Paper Birch	11%	12%	10%	10%	7%	7%	10%
Forest Age Structure							
Age Class	**Existing Amount**	**RNV Value**	**Decade 1 Percent Projected**	**Decade 2 Percent Projected**	**Decade 5 Percent Projected**	**Decade 10 Percent Projected**	**Vegetation Objective**
0-9	16%	5-10%	10%	11%	10%	10%	9%
10-49	31%	18-29%	43%	46%	44%	36%	34%
50-99	45%	17-22%	35%	28%	25%	22%	37%
100-149	8%	11-15%	11%	16%	17%	13%	20%
150+	0%	26-44%	0%	1%	5%	19%	N/A

Table FAC-24 provides general forest-wide trends through the 100-year planning period by comparing Dualplan model outputs for decades 1, 2, 5, and 10 to their respective RNV values and to existing upland forest conditions on the Chippewa. The long term trends displayed indicate that this alternative does appear to be moving the Chippewa uplands towards the RNV values for forest composition and forest age used in this analysis.

Superior National Forest

Figure FAC-2 provides summary information of the RNV departure evaluation and major departures when comparing the 100-year projected amounts of upland forest types and forest ages for this alternative to the RNV values for each LE. This alternative received 2 major departures in forest composition. One is in the aspen type where the projected amount is 28% greater than the RNV value; and one is in the spruce-fir type where the projected amount is 23% less than the RNV value. It also received 6 major departures in forest age. Four of these occur where the projected amounts in the oldest age class are 12% to 19% less than the RNV value. One occurs where the projected amount in the 51-80 year age class is 17% more than the RNV value.

Table FAC-25 provides general forest-wide trends through the 100-year planning period by comparing Dualplan model outputs for decades 1, 2, 5, and 10 to their respective RNV values and to existing upland forest conditions on the Superior. Similar to the Chippewa, the long term trends displayed indicate that this alternative does appear to be moving the Chippewa uplands towards the RNV values for forest composition and forest age used in this analysis.

Alternative F

Based on the long-term vegetation objectives for this alternative, the amount of aspen forest type would be considerably reduced from existing conditions, while the amounts of jack pine, white pine, spruce-fir, and northern hardwoods would increase. The age class distribution of the forest would shift from the current high amounts in the young age classes to considerably more acreage in the older age classes. For National Forest lands, the combined total departure and total number of major departures from the RNV values used

Table FAC-26: Trends in Upland Forest Composition and Forest Age Structure for *Alternative F* on the *Chippewa National Forest* Relative to the Existing Amounts and to the Range of Natural Variability Values.

Forest Composition							
Forest Type	**Existing Amount**	**RNV Value**	**Decade 1 Percent Projected**	**Decade 2 Percent Projected**	**Decade 5 Percent Projected**	**Decade 10 Percent Projected**	**Vegetation Objective**
Jack Pine	3%	11%	5%	5%	7%	8%	11%
Red Pine	16%	19%	16%	17%	19%	19%	19%
White Pine	1%	8%	1%	2%	4%	7%	8%
Spruce-Fir	7%	12%	8%	10%	14%	18%	12%
Oak	2%	1%	2%	2%	2%	2%	1%
Northern Hardwood	13%	22%	15%	17%	23%	31%	22%
Aspen	49%	19%	45%	39%	27%	11%	19%
Paper Birch	8%	8%	8%	7%	4%	4%	8%
Forest Age Structure							
Age Class	**Existing Amount**	**RNV Value**	**Decade 1 Percent Projected**	**Decade 2 Percent Projected**	**Decade 5 Percent Projected**	**Decade 10 Percent Projected**	**Vegetation Objective**
0-9	13%	3-6%	5%	5%	5%	6%	4%
10-49	38%	15-24%	48%	45%	23%	23%	20%
50-99	44%	21-25%	38%	37%	40%	22%	24%
100-149	6%	12-25%	9%	13%	26%	18%	15%
150+	0%	32-46%	1%	1%	6%	32%	37%

in this analysis are the lowest of the alternatives analyzed. For the upland forest composition and age factors evaluated, the amounts projected under this alternative on lands managed by the Chippewa and Superior National Forests generally fall within the RNV values developed for the LEs within the Northern Minnesota Drift and Lake Plains and the Northern Superior Uplands, respectively.

Chippewa National Forest

Figure FAC-1 provides summary information of the RNV departure evaluation and major departures when comparing the 100-year projected amounts of upland forest types and forest ages for this alternative to the RNV values for each LE. This alternative received 0 major departures in forest composition and 0 major departures for forest age.

Table FAC-26 provides general forest-wide trends through the 100-year planning period by comparing Dualplan model outputs for decades 1, 2, 5, and 10 to their respective RNV values and to existing upland forest conditions on the Chippewa. The long term trends displayed indicate that this alternative does move the Chippewa uplands towards the RNV values for forest composition; and to within the RNV values for forest age class distribution used in this analysis.

Superior National Forest

Figure FAC-2 provides summary information of the RNV departure evaluation and major departures when comparing the 100-year projected amounts of upland forest types and forest ages for this alternative to the RNV values for each LE. This alternative received 0 major departures in forest composition and 0 in forest age.

Table FAC-27 provides general forest-wide trends through the 100-year planning period by comparing Dualplan model outputs for decades 1, 2, 5, and 10 to their respective RNV values and to existing upland forest conditions on the Superior. The long term trends displayed indicate that this alternative does move the Superior uplands towards the RNV values for forest composition and forest age class distribution used in this analysis.

Table FAC-27: Trends in Upland Forest Composition and Forest Age Structure for *Alternative F* on the *Superior National Forest* Relative to the Existing Amounts and to the Range of Natural Variability Values.

Forest Composition							
			Decade 1	Decade 2	Decade 5	Decade 10	
Forest Type	Existing Amount	RNV Value	Percent Projected	Percent Projected	Percent Projected	Percent Projected	Vegetation Objective
Jack Pine	11%	17%	11%	12%	15%	17%	17%
Red Pine	8%	8%	8%	8%	8%	8%	8%
White Pine	3%	9%	3%	4%	6%	8%	9%
Spruce-Fir	18%	37%	20%	22%	34%	39%	37%
Northern Hardwood	4%	4%	4%	4%	4%	5%	4%
Aspen	45%	15%	43%	41%	26%	18%	15%
Paper Birch	11%	12%	11%	10%	7%	6%	12%
Forest Age Structure							
			Decade 1	Decade 2	Decade 5	Decade 10	
Forest Type	Existing Amount	RNV Value	Percent Projected	Percent Projected	Percent Projected	Percent Projected	Vegetation Objective
0-9	16%	5-10%	7%	8%	7%	9%	8%
10-49	31%	18-29%	44%	45%	37%	32%	24%
50-99	45%	17-22%	37%	30%	30%	20%	24%
100-149	8%	11-15%	11%	17%	22%	15%	44%
150+	0%	26-44%	0%	1%	4%	23%	N/A

Alternative G

Based on the long-term vegetation objectives for this alternative, the amount of aspen forest type would be reduced from existing conditions, while the amounts of jack pine, white pine, spruce-fir, and northern hardwoods would increase. This alternative shifts the current age class distribution by reducing the amounts of forest in the younger age classes and increasing the amounts in the older age classes. For National Forest lands, the combined total departure and total number of major departures from the RNV values used in this analysis are among the lowest of the alternatives analyzed. For most of the upland forest composition and age factors evaluated, the amounts projected under this alternative on lands managed by the Chippewa and Superior National Forests generally fall within the RNV values developed for the LEs within the Northern Minnesota Drift and Lake Plains and the Northern Superior Uplands, respectively.

<u>Chippewa National Forest</u>

Figure FAC-1 provides summary information of the RNV departure evaluation and major departures when comparing the 100-year projected amounts of upland forest types and forest ages for this alternative to the RNV values for each LE. This alternative received 0 major departures in forest composition. It received 3 major departures in forest age. One of these occurs where the amount projected in the 36-75 year age class exceeds the RNV value by 16%. One occurs where the amount projected in the 121-195 year age class exceeds the RNV value by 15%. One occurs where the amount projected in the oldest age class is 34% less than the RNV.

Table FAC-28 provides general forest-wide trends through the 100-year planning period by comparing Dualplan model outputs for decades 1, 2, 5, and 10 to their respective RNV values and to existing upland forest conditions on the Chippewa. The long term trends displayed indicate that this alternative does move the Chippewa uplands towards the RNV values for forest composition and forest age class distribution used in this analysis.

Superior National Forest

Figure FAC-2 provides summary information of the RNV departure evaluation and major departures when comparing the 100-year projected amounts of upland forest types and forest ages for this alternative to the RNV values for each LE. This alternative received 1 major departure in forest composition. This occurs in the jack pine type where the projected amount is 25% more than the RNV value. It also received 1 major departure in forest age. This occurs where projected amount in the 81-110 year age class is 15% greater than the RNV value.

Table FAC-29 provides general forest-wide trends through the 100-year planning period by comparing Dualplan model outputs for decades 1, 2, 5, and 10 to their respective RNV values and to existing upland forest conditions on the Superior. The long term trends displayed indicate that this alternative does move the Superior uplands towards the RNV values for forest composition and forest age class distribution used in this analysis.

Management Treatments of Lowland Conifers within Upland Landscapes

Lowland conifer stands on the Chippewa and Superior National Forests occur as relatively small areas embedded within upland-dominated landscapes, or as large areas where they comprise the dominant native plant community on a landscape. The ability to predict the natural stand-replacement disturbance interval for lowland conifers is somewhat more difficult than it is for the uplands. The ability to predict stand replacement events in these areas are further complicated by the landscapes that surround them and the difficulty with determining the size to age relationships of lowland conifer species from historical Public Land Survey tree data. This makes it

Table FAC-28: Trends in Upland Forest Composition and Forest Age Structure for *Alternative G* on the *Chippewa National Forest* Relative to the Existing Amounts and to the Range of Natural Variability Values.

Forest Composition							
Forest Type	Existing Amount	RNV Value	Decade 1 Percent Projected	Decade 2 Percent Projected	Decade 5 Percent Projected	Decade 10 Percent Projected	Vegetation Objective
Jack Pine	3%	11%	5%	6%	9%	10%	10%
Red Pine	16%	19%	16%	17%	18%	19%	20%
White Pine	1%	8%	1%	2%	4%	7%	7%
Spruce-Fir	7%	12%	8%	9%	12%	15%	11%
Oak	2%	1%	2%	2%	2%	2%	1%
Northern Hardwood	13%	22%	14%	15%	18%	22%	20%
Aspen	49%	19%	45%	41%	30%	19%	21%
Paper Birch	8%	8%	8%	8%	7%	7%	9%
Forest Age Structure							
Age Class	Existing Amount	RNV Value	Decade 1 Percent Projected	Decade 2 Percent Projected	Decade 5 Percent Projected	Decade 10 Percent Projected	Vegetation Objective
0-9	13%	3-6%	7%	7%	7%	7%	7%
10-49	38%	15-24%	48%	47%	30%	29%	26%
50-99	44%	21-25%	36%	34%	37%	25%	25%
100-149	6%	12-25%	8%	12%	21%	13%	15%
150+	0%	32-46%	1%	1%	5%	25%	28%

Table FAC-29: Trends in Upland Forest Composition and Forest Age Structure for *Alternative G* on the *Superior National Forest* Relative to the Range of Natural Variability Values.

Forest Composition							
Forest Type	Existing Amount	RNV Value	Decade 1 Percent Projected	Decade 2 Percent Projected	Decade 5 Percent Projected	Decade 10 Percent Projected	Vegetation Objective
Jack Pine	11%	17%	12%	14%	20%	21%	24%
Red Pine	8%	8%	8%	8%	8%	9%	8%
White Pine	3%	9%	3%	4%	6%	7%	8%
Spruce-Fir	18%	37%	19%	21%	27%	30%	26%
Northern Hardwood	4%	4%	4%	4%	4%	5%	4%
Aspen	45%	15%	43%	39%	26%	20%	21%
Paper Birch	11%	12%	11%	10%	9%	8%	10%
Forest Age Structure							
Forest Type	Existing Amount	RNV Value	Decade 1 Percent Projected	Decade 2 Percent Projected	Decade 5 Percent Projected	Decade 10 Percent Projected	Vegetation Objective
0-9	16%	5-10%	8%	9%	9%	10%	7%
10-49	31%	18-29%	44%	46%	40%	36%	27%
50-99	45%	17-22%	37%	29%	30%	21%	34%
100-149	8%	11-15%	11%	15%	18%	13%	32%
150+	0%	26-44%	0%	1%	4%	20%	N/A

difficult to determine expected composition and age class distributions within the historic range of natural variability. It is assumed that the age class distribution of lowland conifers would be more unbalanced, leaning heavily towards the older vegetation growth stages, than that for the uplands due to the combination of environmental factors needed to cause a stand replacement event.

The primary harvest treatment type proposed in all the alternatives is the clearcut method. Harvesting in lowland conifers and the access required to cut and remove the timber can cause a variety of environmental effects. Potential environmental effects of harvesting these forest types include soil compaction resulting from rutting, associated localized changes to water table levels and the rate of water flow, and resulting possible changes in regeneration success, especially forest cover. Deep ruts can act as a dam, blocking water flow through affected part of wetlands (MFRC 1999d) and causing a rise in water levels upslope from the rut. If this damming effect lasts long enough it could significantly change the type of vegetation the site is capable of supporting. In wetland and riparian areas where average growing season depth to the water table is six inches, average growing season increases of as little as two inches can reduce the maximum height achievable for site vegetation from 45 ft to 6ft. over the affected area (Verry 2000).

Most adverse affects associated with accessing or operating equipment in lowland conifer stands, and can be mitigated by restricting harvest activities to frozen ground conditions.

Lowland conifer composition is not expected to change significantly under any alternative during the implementation period of the revised Forest Plans. Table FAC-30 compares the acreage and percentage amounts of lowland conifer to be harvested in the first, second, and fifth decades under the proposed alternatives to the existing conditions.

Table FAC-30: Lowland Conifer Harvest Amounts by Alternative

Alternative	Amount of Lowland Conifer Forest in 0-9 year Age Class							
	Existing		Decade 1		Decade 2		Decade 5	
	(%)	(acres)	(%)	(acres)	(%)	(acres)	(%)	(acres)
Alternative A								
Chippewa	1%	800	2%	1200	23%	14500	2%	1100
Superior	1%	2300	1%	2100	11%	22400	2%	4400
Alternative B								
Chippewa	1%	800	4%	2700	4%	2600	3%	2600
Superior	1%	2300	3%	6600	3%	6700	3%	6700
Alternative C								
Chippewa	1%	800	15%	9100	14%	8600	1%	1000
Superior	1%	2300	6%	12800	24%	48400	2%	4200
Alternative D								
Chippewa	1%	800	0%	0	0%	0	0%	0
Superior	1%	2300	0%	0	0%	0	0%	0
Alternative E (Modified)								
Chippewa	1%	700	5%	3600	5%	3700	4%	2800
Superior	1%	1349	3%	6700	4%	8300	3%	6300
Alternative F								
Chippewa	1%	800	6%	3800	6%	3800	3%	3000
Superior	1%	2300	4%	7300	4%	8300	3%	7800
Alternative G								
Chippewa	1%	800	5%	3300	5%	3300	3%	2700
Superior	1%	2300	2%	5100	3%	5200	2%	5200

Source: Acres of harvest based upon Dualplan model outputs and vegetation objectives for alternatives.
Definitions:
‡Notes:

With the exception of Alternative D, which does not propose any harvests in lowland conifers, all alternatives propose to harvest more in each of the three decades displayed than currently exists in the 0-9 year age class. For most of the decades, in alternatives other than D, there would be at least 3-4 times the amount in this age class than currently exists. Alternatives A and C propose the largest amounts of harvest and vary the amounts considerably among the decades. The other alternatives propose lesser amounts relatively evenly distributed among the decades.

Indicator 3 – Use of Management Treatments Which Increase Within-stand Complexity

For this analysis, within-stand complexity refers to the vertical structure and associated species diversity at the stand scale. Vertical structure is the bottom to top configuration of above ground vegetation within a forested stand and varies with forest types and stand ages. Stand complexity changes markedly during forest succession, from a relatively simple structure in early successional stands to more complex structures displayed as stands age. This increase in complexity generally occurs as the overstory matures with the associated canopy thinning and differential height growth of individual canopy trees. This maturation process takes 10s to 100s of years depending on the forest type. The gradual heterogeneity of the overstory permits more light to penetrate lower levels of forest stand creating conditions for understory establishment and increased vertical complexity. Additionally, as stands age and self-thin themselves, there are increased amounts of standing snags and downed woody debris. As trees die in older forest stands leaving gaps of various sized, vertical structure redevelops through a succession process similar to that at the larger stand scale. The staggered timing and variety of gap sizes and shapes produces variation in the vertical structure of the stand with an associated variation in the overall species composition. (Brokaw and Lent in Hunter et al.1999) Appendix B provides additional detail on possible successional pathways for forest communities by landscape ecosystem.

The natural succession of forested stands to a mature and eventually old-growth condition generally provides the greatest vertical diversity and overall stand complexity of any of the earlier seral stages. The harvesting and removal of large trees has an impact on the vertical structure inherent in a particular stand on a particular site.

The variety of regeneration methods available to implement the proposed alternatives provides varying effects to vertical structure at the stand level. While there is variability even within the types of harvest cutting methods used in terms of the kinds and amounts of trees retained after the harvest, in general, single cohort methods such as clearcutting initially simplify vertical stand structure, and depending on the rotation length, may not have an opportunity to develop prior to the next harvest. The resulting stand complexity from partial harvest, two cohort methods, is increased over that of a clearcut and continues as the amount of retained trees approaches that of a multi-aged stand. Multi-cohort stands created through selection harvests, individual tree or groups of trees, may provide the highest amount of resulting vertical structure of the regeneration methods discussed here. (Brokaw and Lent in Hunter et.al. 1999)

The application of prescribed fire in fire dependent ecosystems can aid in the restoration of the compositional and structural components of the associated native plant and animal communities. Recurring fire prior to European settlement shaped the native plant communities on many of the landscape ecosystems on the Chippewa and Superior. Most of these fires were low intensity ground fires, which maintained the composition and structure of the plant communities of that evolved on those landforms. Some were catastrophic stand replacement fires that swept over these landscapes, creating a mosaic of remaining stand conditions ranging from large areas where few if any live trees remained to other areas with variable amounts of live trees remaining.

Both tree harvesting and prescribed fire can be used as tools to restore the composition and structure that is typical of the native plant communities occurring within the Chippewa and Superior National Forests. The following analysis looks at the general effects to within-stand complexity and native plant communities due to the proposed harvest treatment methods and amount of prescribed fire to be used in each alternative. Additionally, the acres that are not harvested are compared in order to take into account the effects that forest succession has on increasing within-stand complexity.

Tables FAC-31 and FAC-32 display the relative annual amounts of harvest treatment methods to be used during the first two decades of implementation on the Chippewa and Superior National Forests, respectively.

Table FIR-1 displays the amounts and uses of prescribed fire in this alternative on the Chippewa and Superior.

Alternatives A and C

These alternatives rely heavily on even-aged regeneration methods and clearcut is the predominant method used. This has a considerable effect on the within-stand complexity of the regenerating stands. When compared to other regeneration harvest methods, this method simplifies within-stand species and structural diversity. Because prescribed fire is used primarily for site preparation and for hazardous fuels reduction in non-forest situations, its ability to be used a process for molding forest composition and structure of the understory, midstory, and overstory would be minimal.

Table FAC-31: A Comparison of the Annual Proposed and Probable Harvest Management Practices Proposed Under each Alternative for the Chippewa National Forest.

Harvest Treatment Type	Alt. A (acres)	Alt. B (acres)	Alt. C (acres)	Alt. D (acres)	Alt. E (Mod.) (acres)	Alt. F (acres)	Alt. G (acres)
Even-aged Regeneration Methods							
Clearcut % of regen. harvests	5,820 71%	1,610 31%	6,400 62%	0 0%	3,040 43%	2,340 48%	2,110 35%
Shelterwood Cut % of regen. harvests	80 1%	0 0%	830 9%	0 0%	10 0%	0 0%	60 1%
Partial Cut (retain 30BA) % of regen. harvests	1,720 21%	410 8%	1,860 18%	2,110 66%	1,080 15%	240 5%	1,140 19%
Uneven-aged Regeneration Methods							
Partial Cut (retain 60BA) % of regen. harvests	80 1%	880 19%	100 1%	1,080 34%	790 11%	830 17%	900 15%
Multi-age/Selection Cut % of regen. harvests	490 7%	2,280 44%	1,140 11%	0 0%	2,130 30%	1,460 30%	1,810 30%
Intermediate Methods							
Pine Thinning	580	340	1,040	0	930	460	520
Total Regeneration	8,190	5,180	10,330	3,190	7,050	4,870	6,020
Total Harvest	8,770	5,520	11,370	3,190	7980	5,330	6,540
Total Not Harvested*	539,310	542,560	537,710	544,890	540,100	542,750	541,540

Source: Amounts are derived from Dualplan outputs by decade on all forested acres. Percentages given for regeneration methods are percent of total regeneration acres. Acreages and percentages are based upon an average over the first two decades of implementation.
Definitions: Harvest treatment terminology is based upon Society of American Foresters definitions.
‡Notes: *Acres displayed are forested acres only.
BA is basal area in square feet. Harvest treatment method selected is based upon the theme of the alternative, the forest type, and economic efficiency.

Overall, the regeneration harvest methods and prescribed fire uses in these alternatives greatly minimizes the ability of either Forest to increase within-stand complexity or restore native plant communities through active management treatments. Of the alternatives analyzed, these alternatives propose to harvest on a relatively high amount of acres. The availability and proposed amounts of regeneration harvest cutting methods provides the least flexibility in terms of management practices for improving stand level compositional and structural components for both Forests.

Alternative B

On the Chippewa, this alternative relies primarily on uneven-aged regeneration methods and multi-aged/selection harvest is the predominant method used. This has a considerable effect on the within-stand complexity of the regenerating stands. When compared to other regeneration harvest methods, these methods tend to increase within-stand species and structural diversity. On the Superior, this alternative relies on a mixture of even-aged and uneven-aged regeneration methods, with a majority of the acres receiving even-aged methods. The use of prescribed fire as a tool for molding forest composition and structure of the understory, midstory, and overstory is available in this alternative.

Table FAC-32: A Comparison of the Annual Proposed and Probable Harvest Management Practices Proposed Under each Alternative for the Superior National Forest.

Harvest Treatment Type	Alt. A (acres)	Alt. B (acres)	Alt. C (acres)	Alt. D (acres)	Alt. E (Mod.) (acres)	Alt. F (acres)	Alt. G (acres)
Even-aged Regeneration Methods							
Clearcut % of regen. harvest	12,060 80%	3,870 44%	15,200 67%	0 0%	8,660 72%	7,270 72%	6,440 59%
Shelterwood Cut % of regen. harvests	150 1%	0 0%	210 1%	0 0%	110 1%	100 1%	110 1%
Partial Cut (retain 30BA) % of regen. harvests	2,710 18%	1,410 16%	4,310 21%	5,250 83%	2070 17%	710 7%	2,440 22%
Uneven-aged Regeneration Methods							
Partial Cut (retain 60BA) % of regen. harvests	0 0%	2,460 28%	0 0%	1,070 17%	710 6%	1,310 13%	1,110 10%
Multi-age/Selection Cut % of regen. harvests	300 2%	1,140 13%	620 3%	0 0%	420 3%	710 7%	1,110 10%
Intermediate Methods							
Pine Thinning	1,290	510	1,340	0	1210	1,160	1,130
Total Regeneration	15,220	8,880	20,340	6,320	11,970	10,100	11,210
Total Harvest	16,510	9,390	21,680	6,320	13,180	11,260	12,340
Total Not Harvested* (outside the BWCAW)	1,195,790	1,202,910	1,190,620	1,205,980	1,199,120	1,201040	1,199,960
Total Not Harvested* (including the BWCAW)	1,957,790	1,964,910	1,952,620	1,967,980	1,961,120	1,963,040	1,961,960

Source: Amounts are derived from Dualplan outputs by decade on all forested acres. Percentages given for regeneration methods are percent of total regeneration acres. Acreages and percentages are based upon an average over the first two decades of implementation.
Definitions: Harvest treatment terminology is based upon Society of American Foresters definitions.
‡Notes: *Acres displayed are forested acres only.
BA is basal area in square feet. Harvest treatment method selected is based upon the theme of the alternative, the forest type, and economic efficiency.

When compared to the other alternatives, prescribed fire for this reason would be used in moderate amounts on a moderate scale. The ability to improve fire-dependent native plant community composition and structure is enhanced with the use of prescribed fire.

Overall, the regeneration harvest methods and prescribed fire uses in this alternative provide both Forests with the ability to increase within-stand complexity and restore native plant communities through active management treatments. Of the alternatives analyzed, this alternative proposes to harvest on a relatively low amount of acres. The availability and proposed amounts of harvest cutting methods provides the best mix of management practices for improving stand level compositional and structural components for both Forests.

Alternative D

This alternative proposes to harvest on only a relatively small portion of either Forest. Of the acres to be regenerated, it relies heavily on even-aged regeneration methods and partial harvests that retain 30 square feet of basal area are the predominant method used. The use of clearcut as a regeneration method is normally not available. The use of the partial harvest regeneration method improves the ability to increase within-stand complexity in the regenerating stand over the clearcut method.
The use of prescribed fire as a tool for molding forest composition and structure of the understory, midstory, and overstory is available in this alternative. When compared to the other alternatives, prescribed fire for this reason would be used in high amounts on a large scale. The ability to improve fire-dependent native plant community composition and structure is enhanced with the use of prescribed fire.

Overall, the regeneration harvest methods and prescribed fire uses associated with this alternative provides both Forests with minimal ability to increase within-stand complexity and restore native plant communities through active management treatments. Of the alternatives analyzed, this alternative proposes to actively treat a relatively low amount of acres. The availability and proposed amounts of regeneration harvest cutting methods provides a limited mix of management practices for improving stand level compositional and structural components for both Forests.

Modified Alternative E

On the Superior, this alternative relies heavily on even-aged regeneration methods and clearcut is the predominant regeneration method. This has a considerable effect on the within-stand complexity of the regenerating stand because when compared to other regeneration methods, this method simplifies species and structural diversity. The use of prescribed fire as a tool for molding forest composition and structure of the understory, midstory, and overstory is available in this alternative. When compared to the other alternatives, prescribed fire for this reason would be used in low to moderate amounts on a small scale.

On the Chippewa, this alternative provides a broader mix of regeneration treatments utilizing both even and uneven-aged methods. The use of prescribed fire as a tool for molding forest composition and structure of the understory, midstory, and overstory is available in this alternative. When compared to the other alternatives, prescribed fire for this reason would be used in moderate amounts on a moderate scale. The ability to improve fire-dependent native plant community composition and structure would be enhanced with the use of prescribed fire.

Overall, the regeneration harvest methods and prescribed fire uses in this alternative provide the Chippewa with the ability to increase within-stand complexity and restore native plant communities through active management treatments. Of the alternatives analyzed, this alternative proposes to harvest on a relatively moderate amount of acres. The availability and proposed amounts of regeneration harvest cutting methods provides a good mix of tools on the Chippewa but limited flexibility on the Superior for using management practices to improve stand level compositional and structural components for both Forests. This is especially true on the Superior, where clearcutting is to be used for 72% of the regeneration harvests.

Alternative F

On the Superior, this alternative relies heavily on even-aged regeneration methods and clearcut is the predominant regeneration method. This has a considerable effect on the within-stand complexity of the regenerating stands because when compared to other regeneration harvest methods, this method simplifies within-stand species and structural diversity. On the Chippewa, this alternative provides a somewhat broader mix of regeneration treatments with nearly equal portions of even and uneven-aged methods. The use of prescribed fire as a tool for molding forest composition and structure of the understory, midstory, and overstory is emphasized in this alternative. When compared to the other alternatives, prescribed fire for this reason would be used in moderate to high amounts on a moderate scale. The ability to improve fire-dependent native plant community composition and structure is enhanced with the use of prescribed fire.

Overall, the regeneration harvest methods and prescribed fire uses in this alternative provide both Forests with the ability to increase within-stand complexity and restore native plant communities through active management treatments. The amount of clearcutting proposed for the Superior National Forest under this alternative would limit the ability of this Forest to improve within-stand complexity through timber harvesting. Of the alternatives analyzed, this alternative proposes to harvest on a relatively low to moderate amount of acres. The availability and proposed amounts of regeneration harvest cutting methods provides one of the best mixes of tools for improving stand level compositional and structural components on the Chippewa. The predominant use of clearcut as a regeneration method on the Superior limits the ability of that Forest to improve within-stand structural complexity through timber harvest.

Alternative G

On the Superior, this alternative relies heavily on even-aged regeneration methods and clearcut is the predominant regeneration method. This has a considerable effect on the within-stand complexity of the regenerating stands because when compared to other regeneration harvest methods, this method simplifies within-stand species and structural diversity. However, this alternative does provide additional flexibility for using harvest cutting methods that increase within-stand complexity over Alternatives A, C, and E on the Superior.

On the Chippewa, this alternative provides a broader mix of regeneration treatments with nearly equal portions of even and uneven-aged methods. The use of prescribed fire as a tool for molding forest composition and structure of the understory, midstory, and overstory is available in this alternative. When compared to the other alternatives, prescribed fire for this reason would be used in moderate amounts on a moderate scale. The ability to improve fire-dependent native plant community composition and structure is enhanced with the use of prescribed fire.

Overall, the regeneration harvest methods and prescribed fire uses in this alternative provide the Chippewa with the ability to increase within-stand complexity and restore native plant communities through active management treatments. Of the alternatives analyzed, this alternative proposes to harvest on a relatively moderate amount of acres. The availability and proposed amounts of regeneration harvest cutting methods provides one of the best mixes of management practices available for improving stand level compositional and structural components for the Chippewa. On the Superior, the regeneration harvest methods proposed in this alternative reduce its ability to increase within-stand complexity through timber harvest; however, the availability of prescribed fire for ecological purposes provides some ability to increase stand complexity and restore native plant communities.

Indicator 4 – Size, Amount, and Distribution of Old-Growth Forest

The proposed alternatives provide for future old-growth forest conditions in a combination ways. Some Management Area allocations, along with their accompanying management direction, provide designated areas within which certain old-growth forest characteristics would be expected to develop and occur over time. Tables FAC-33 and 34 display the Management Area allocations that are expected to contribute to old-growth characteristics, now and in the future, for the Chippewa and Superior National Forests, respectively. In general, the individual areas within the Management Areas displayed are relatively large, ranging from hundreds to thousands of acres in size. However, some individual Research Natural

Areas and Unique Areas may be relatively small, less than one hundred acres in size.

Management direction for these Management Areas varies depending on the resource emphasis. In terms of contributing to old-growth characteristics over time, the following table provides a brief description of the values expected under those Management Area allocations that vary among the alternatives:

Wilderness Emphasis - Management provides the full range of old-growth conditions and attributes; limited in the amount of forest communities represented.
Recreation Emphasis - Management provides a limited range of old-growth forest conditions and attributes; limited in the amount of forest communities represented.
Research Natural Area Emphasis - Management provides the full expression of old-growth conditions and attributes associated with the particular forest community(s) represented.
Special Management Complex Emphasis - Management protects maintains, or enhances the full range of old-growth conditions and attributes; most forest communities represented.
Riparian Emphasis - Management provides a limited range of old-growth forest conditions and attributes; limited in the amount of forest communities represented.

A more detailed account of each Management Area and its management direction can be found in Chapter 2 of this Draft EIS. The following discussions deal primarily with changes to the existing conditions for old-growth forests. For example, there is approximately 800,000 acres in the Boundary Waters Canoe Area Wilderness (BWCAW). This approximate acreage does not change from one alternative to another. The BWCAW does contribute substantially to old-growth forest conditions for the Superior under all alternatives. It represents most of the old-growth conditions for the native forest communities in the Border Lakes Subsection. However, it does not necessarily represent all the native forest communities occurring within the Superior National Forest. Approximately 67% of the BWCAW is in the Jack Pine-Black Spruce LE, 13% is in Lowland Conifer, 7% in the Mesic Birch, Aspen, Spruce-Fir LE, 6% in the Dry-Mesic Red and White Pine LE, 3% in the Mesic Red and White Pine LE, and 1% in the Sugar Maple LE. All of the acres in the BWCAW may not necessarily reflect old-growth forest conditions. Natural stand replacement events, such as the extensive blowdown experienced in 1999, will have returned some of these areas to the seedling establishment vegetation growth stage. Forest vegetation within the BWCAW was generally characterized in the Vegetation section for the BWCAW Fuels Treatment Final Environmental Impact Statement (USDA Forest Service 2001a). Based upon this information, there is approximately 415,000 acres of upland forests and 52,000 acres of lowland conifer forests within the wilderness was categorized as being in the “mature/multi-aged” vegetation growth stages. It is presumed that the multi-aged vegetation growth stages are those that best represent the majority of the old-growth characteristics for that particular native forest community. The age at which the mature vegetation growth stages initiate varies by landscape ecosystem, and may begin as early as age 50 for some forest types. So, the lumping of the mature vegetation growth stages with the multi-aged ones over-represents the total acres of old-growth forests in the BWCAW. However, this information represents the best vegetation characterization for the BWCAW available.

Tables FAC-35 and 36 display additional information about how the alternatives provide for old-growth forest conditions in decades 2, 5, and 10 for the Chippewa and Superior, respectively. The acres shown in uplands and lowlands that are 120 years old or older provide an indication of the amounts of stands of long-lived tree species expected to occur in a given decade under an alternative. Some of these acres would overlap with acres in the Management Area allocations. Depending on the alternative, many of these acres are expected to occur outside any special designations. The individual stands or clusters of stands, contributing to these acreage figures, range in size from less than ten acres to hundreds or thousands of acres. All stands that reach 120 years of age or older will not necessarily exhibit all the old-growth characteristics associated with a particular forest type. This is because many of these stands may have received management treatments which may alter development of some old-growth attributes.

The acres shown in old-growth/multi-aged upland forest patches provide an indication of the amounts of stands of long-lived tree species in patches greater than 300 acres in size expected to occur in a given decade under an alternative. Again, some of these patches would overlap with areas in the Management Area allocations. Depending on the alternative, many of these patches are expected to occur outside any special designations. Again, all these upland mature forest patches will not necessarily exhibit all the old-growth characteristics associated with a particular landscape ecosystem, due to prescribed management treatments which may alter development of some old-growth attributes.

Additionally, the long-term vegetation objectives for forest age, set for each alternative, provide the amounts of forest by landscape ecosystem expected to occur in each age class (vegetation growth stage). Those later vegetation growth stages that begin to provide multi-aged stand characteristics also provide old-growth attributes. Under all alternatives, these later vegetation growth stages would be managed to provide old-growth attributes. The ages at which the old-growth/multi-aged conditions begin to express themselves varies with native plant community. Appendix G provides the long-tern vegetation objectives for each alternative by landscape ecosystem.

Alternative A and C

Of the alternatives analyzed, these alternatives provide the least amount of acres in designated Management Areas that are expected to contribute to old-growth forest conditions. With the exception of the Boundary Waters Canoe Area Wilderness (BWCAW) on the Superior, a majority of the contributing allocations made to this alternative are in existing recreation emphasis areas. These areas provide limited old-growth attributes, such as large trees and old forest character, but they are not managed specifically to protect, maintain, or enhance old-growth values. The areas allocated to these Management Areas do not necessarily provide old-growth representation of all of the native forest communities occurring on each National Forest.

When comparing the alternatives for acres of forest types that are 120 years old or older and acres of uplands in old-growth/multi-aged stands in patches greater than 300 acres in size, Alternatives A and C have the least amounts in both categories.

Alternative B

Other than Alternative D, this alternative provides the highest amount of acres allocated to Management Areas that are expected to contribute to old-growth forest conditions. This alternative allocates the full number of identified Special Management Complexes (SMC), and provides a relatively complete old-growth representation of the native forest communities occurring within the two National Forests. SMCs are managed specifically to protect, maintain, or enhance old-growth values. On the Chippewa, the large majority of contributing allocations under this alternative are in SMCs. Additionally, the riparian emphasis allocation is considerable, and contributes limited old-growth attributes associated with riparian areas along large streams and lakes.

With the exception of the BWCAW on the Superior, the majority of contributing allocations under this alternative are in SMCs. Additionally, the semi-primitive recreation emphasis allocation is considerable, and contributes limited old-growth attributes, such as large tree and old forest character in a natural-appearing landscape.

When comparing the alternatives for acres of forest types that are 120 years old or older and acres of uplands in old-growth/multi-aged stands in patches greater than 300 acres in size, Alternative B is second only to Alternative D in having the highest amounts in both categories.

Alternative D

This alternative provides the highest amount of acres allocated to Management Areas that are expected to contribute to old-growth forest conditions. With the exception of the BWCAW on the Superior, the large majority of contributing allocations on both National Forests are in the minimum management natural areas emphasis and the recreation emphasis. Due to restricted timber management under this alternative, a relatively complete old-growth representation of the native forest communities occurring within the National Forests would be provided across a majority of the landscape.

When comparing the alternatives for acres of forest types that are 120 years old or older and acres of uplands in old-growth/multi-aged stands in patches greater than 300 acres in size, Alternative D has the highest amounts in both categories.

Modified Alternative E

This alternative provides a moderate amount of acres in designated Management Areas that are expected to contribute to old-growth forest conditions. On the Chippewa, a large majority of the contributing allocations made to this alternative is in the riparian emphasis area. These areas contribute limited old-growth attributes associated with riparian areas along large streams and lakes, but they are not managed specifically to protect, maintain, or enhance old-growth values. The areas allocated to this Management Area do not necessarily provide old-growth representation of all of the native forest communities occurring on each National Forest.

On the Superior, with the exception of the BWCAW, a majority of the contributing allocations made to this alternative are in the recreation emphasis areas. These areas provide limited old-growth attributes, such as large trees and old forest character, but they are not managed specifically to protect, maintain, or enhance old-growth values. The areas allocated to this Management Area do not necessarily provide old-growth representation of all of the native forest communities occurring on each National Forest.

When comparing the alternatives for acres of forest types that are 120 years old or older, the amounts projected under Modified Alternative E generally rank within the top three or four alternatives contributing upland and lowland acres to this category through decade 2. Beyond that point, Alternatives B and D contribute substantially more acres in the over 120 year old class. When compared to the other alternatives, this alternative ranks in the middle in the amount of acres of uplands in old-growth/multi-aged stands in patches greater than 300 acres in size.

Alternative F

This alternative provides a moderate amount of acres in designated Management Areas that are expected to contribute to old-growth forest conditions. On the Chippewa, a large majority of the contributing allocations made to this alternative is in the unique areas emphasis. Due to restrictions to timber management in this management area, a relatively full expression of old-growth forest attributes is expected. The areas allocated to this Management Area do not necessarily provide old-growth representation of all of the native forest communities. Additionally, the riparian emphasis and the semi-primitive recreation allocations are considerable. These areas contribute limited old-growth attributes, but are not managed specifically to protect, maintain, or enhance old-growth values. They do not necessarily provide old-growth representation of all of the native forest communities.

On the Superior, with the exception of the BWCAW, a large majority of the contributing allocations made to this alternative are in the recreation emphasis areas. These areas provide limited old-growth attributes, such as large trees and old forest character, but they are not managed specifically to protect, maintain, or enhance old-growth values. They do not necessarily provide old-growth representation of all of the native forest communities. Additionally, the allocation to recommended Research Natural Areas is considerable. These areas contribute the full expression of old-growth conditions and attributes associated with the particular forest community(s) represented. They do not necessarily provide old-growth representation of all of the native forest communities.

When comparing the alternatives for acres of forest types that are 120 years old or older and acres of uplands in old-growth/multi-aged stands in patches greater than 300 acres in size, the amounts projected under Alternative F also rank in the middle, with somewhat more than G or E, in both categories.

Alternative G

This alternative provides moderate to high amounts of acres on the Chippewa and moderate amounts of acres on the Superior allocated to Management Areas that are expected to contribute to old-growth forest conditions. This alternative allocates the high quality Special Management Complexes (SMC), and they provide a relatively complete old-growth representation of the native forest communities occurring within the two National Forests. SMCs are managed specifically to protect, maintain, or enhance old-growth values. On the Chippewa, the majority of contributing allocations under this alternative are in SMCs.

Table FAC-33: Management Area Allocations Contributing to Old-growth and Future Old-growth Forest Conditions on the Chippewa National Forest.

Management Area	Alt. A (acres)	Alt. B (acres)	Alt. C (acres)	Alt. D (acres)	Alt. E (Mod.) (acres)	Alt. F (acres)	Alt. G (acres)
Wilderness	0	0	0	0	0	0	0
Recommended Wilderness	0	6,213	0	6,213	0	0	2,727
Semi-primitive Recreation Emphasis	12,365	14,662	12,364	291,676	21,937	11,816	23,240
Recreation Use-Scenic Landscape	3,025	4,646	1,800	11,351	12,469	1,800	1,802
Potential Candidate Scenic and Recreational River	1,537	1,537	1,537	1,537	1,537	1,537	1,537
Research Natural Areas, RNA	2,140	2,140	2,140	2,140	2,140	2,140	2,140
Recommended RNAs	769	6,077	769	5,542	1699	9,261	9,015
Unique Areas	8,105	8,105	8,105	8,105	18,026	36,408	8,105
Special Management Complexes	0	169,098	0	0	0	0	85,621
Minimum Management Natural Areas	0	0	0	323,257	0	0	0
Riparian Emphasis	0	36,108	14,287	0	52,883	21,629	35,498
TOTAL	**27,941**	**248,586**	**41,002**	**649,821**	**110691**	**84,591**	**169,685**

Table FAC-34: Management Area Allocations Contributing to Old-growth and Future Old-growth Forest Conditions on the Superior National Forest.

Management Area	Alt. A (acres)	Alt. B (acres)	Alt. C (acres)	Alt. D (acres)	Alt. E (Mod.) (acres)	Alt. F (acres)	Alt. G (acres)
Wilderness	814,457	814,415	814,434	814,392	814,428	814,437	814,315
Rec. Wilderness	0	17,481	0	60,534	0	0	3,672
Semi-prim. Recreation Emphasis	39,072	261,863	39,071	86,957	72,645	32,842	31,318
Recreation Use-Scenic Landscape	114,331	74,637	113,877	569,770	235,549	110,500	87,406
Pot. Candidate Scenic/ Recreational River	28,457	18,888	28,458	18,278	27,478	27,371	21,650
Research Natural Areas, RNA	3,172	3,172	3,172	3,172	3,172	3,172	3,172
Recommended RNAs	0	43,698	776	39,042	18,990	44,378	33,580
Unique Areas	514	514	514	514	514	514	514
Special Mgnt. Complexes	0	354,751	0	0	0	0	183,302
Minimum Mgnt Natural Areas	0	0	0	615,762	0	0	0
Riparian Emphasis	0	0	0	0	18,446	0	0
TOTAL	**1,000,003**	**1,589,419**	**1,000,302**	**2,208,421**	**1,191222**	**1,033,214**	**1,178,929**

Additionally, the riparian emphasis and semi-primitive recreation emphasis allocations are considerable. They provide limited old-growth attributes, such as large tree and old forest character.

On the Superior, with the exception of the BWCAW, the majority of contributing allocations under this alternative are in SMCs. Additionally, the recreation emphasis allocations are considerable. They provide limited old-growth attributes, such as large tree and old forest character. The allocations to recommended Research Natural Areas are also considerable. These areas contribute the full expression of old-growth conditions and attributes associated with the particular forest community(s) represented.

When comparing the alternatives for acres of forest types that are 120 years old or older and acres of uplands in old-growth/multi-aged stands in patches greater than 300 acres in size, the amounts projected under Alternative G rank in the middle, with somewhat more than E and Somewhat less than F, in both categories.

Cumulative Effects

Each of the proposed alternatives to revising the Forest Plans for the Chippewa and Superior National Forests rely on differing forest management strategies for shaping the future forest composition and structure on lands managed by the U.S. Forest Service. The cumulative effects to forest composition and structure, associated with the implementation of a proposed alternative, are conducted primarily within the relevant ecological Section. This is the Northern Minnesota Drift and Lake Plains (DLP) Section for the Chippewa and the Northern Superior Uplands (NSU) Section for the Superior. The ecological Section provides the appropriate scale for characterizing and considering the forest vegetation conditions that occurred on landscape ecosystems operating within the range of natural variability (RNV). Considering the RNV conditions at this scale provides important insights to ensuring long-term ecological sustainability and maintaining inherent biological diversity.

The Minnesota Forest Resources Council convened Landscape Assessment committees for both the North Central Landscape (DLP Ecological Section) and the Northeast Landscape (NSU Ecological Section). These Landscape committees, which are composed of the major landowners and other interested groups and individuals in Minnesota, have generally agreed to an overall vision of how these landscapes may look over the next 50 years.

As a participant in that process, the Forest Service will coordinate management with other land managers in each landscape. Through continued coordination and interaction among land managers within these landscapes, different landowners may adjust their management to account for, compliment and/or compensate for management by other landowners in order for all to work toward the overall vision. The percent ownership of the DLP Section and the NSU Section, by Landscape Ecosystem, is provided in Appendix G. An overview of the cumulative effects for forest vegetation can be found in Appendix H.

For purposes of this analysis, the long-term National Forest-wide vegetation composition and age objectives for each alternative are compared to the existing conditions on all forested lands within the appropriate ecological Section and to their RNV values. Additionally, the goals expressed by the Landscape Assessment committees and the considerable differences between the existing amounts of various forest types or age classes and their RNV values are used to identify the forest types and age categories to evaluate. The information derived from this analysis can be used to evaluate how individual alternatives for National Forest lands contribute to the overall conditions across the ecological Section. Finally, trends for various forest types under each alternative are compared to the expected state-wide trends identified in the base scenario for the Generic Environmental Impact Statement on Timber Harvesting and Forest Management in Minnesota.

Northern Minnesota Drift and Lake Plains (DLP) Section

The Chippewa National Forest manages approximately 8% of the forested lands in this ecological Section. This percentage varies among the Landscape Ecosystems (LE), and ranges from a low of 3% of the Dry Pine LE to a high of 30% of the Mesic Northern Hardwoods LE. Refer to Appendix B for a complete breakdown of land ownership by landscape ecosystem within the DLP.

Table FAC-35: Vegetation Objectives for Age and Spatial Patterns Contributing to Old-growth and Future Old-growth Forest Conditions on the Chippewa National Forest.

Vegetation Projections	Alt. A (acres)	Alt. B (acres)	Alt. C (acres)	Alt. D (acres)	Alt. E (Mod.) (acres)	Alt. F (acres)	Alt. G (acres)
Upland Forest Types 120+ Years Old							
Existing	8,400	8,400	8,400	8,400	9100*	8,400	8,400
Decade 2	21,000	26,800	17,800	27,200	28,900	26,600	25,800
Decade 5	49,000	92,600	53,800	90,200	81,600	89,000	79,800
Decade 10	73,600	189,400	91,800	191,700	131,000	181,600	142,400
Lowland Forest Types 120+ Years Old							
Existing	17,200	17,200	17,200	17,200	19,100*	17,200	17,200
Decade 2	38,400	43,700	37,000	46,400	44,800	42,800	42,600
Decade 5	62,400	72,300	64,300	83,000	71,000	70,000	69,300
Decade 10	66,200	75,000	70,600	94,200	77,400	75,500	73,300
Old-growth/Multi-aged Upland Forest Patches > 300 ac. In size							
Existing	3,400	3,400	3,400	3,400	3,900*	3,400	3,400
Decade 2	3,200	8,100	5,100	8,600	6,800	6,600	7,200
Decade 5	14,100	30,100	22,600	24,900	24,100	31,400	24,900
Decade 10	36,100	100,600	49,900	110,700	55,000	90,800	64,500

Source: Acres for age 120+ years and acres in Old-growth/Multi-aged upland forest patches > 300 acres in size are based upon Dualplan model outputs for decades 2, 5, and 10.
Definitions: Ages for Old-growth/Multi-aged upland forest is based upon forest type groupings for the old-growth and old-growth/multi-aged habitat groupings (see Appendix D – Wildlife)
* Existing acres for Modified Alternative E vary from the other alternatives based upon the final Dualplan model run for this alternative. For this model run, the ages of forested stands were advanced to 2004.

Table FAC-1 displays a comparison of the existing amounts of forest types and age classes on the Chippewa National Forest and on all lands within the ecological Section to the RNV values. When compared to the amounts predicted to occur under RNV, the existing amounts of jack pine, red pine, white pine, spruce-fir, and northern hardwood forest types are considerably under-represented; and the existing amount of aspen is extremely over-represented. The current amount of upland forest in the 100-149 year age class is considerably under-represented, while that in the 150+ age class is extremely under-represented. The existing amount in the 50-99 year age class is considerably over-represented.

The goals expressed by the Landscape committee are aimed at alleviating some of the differences apparent from this Table. These goals will generally move some existing forest conditions towards RNV. They include: increasing amounts in the old-growth stages, increasing the red and white pine forest types, establishing and maintaining white pine, increasing jack pine in young growth stages, decreasing aspen in pole-mature growth stages.

The alternatives proposed for revising the Chippewa Forest Plan respond to these conditions and goals to varying degrees.

Alternatives A and C

These alternatives generally maintain or decrease the forest types that are currently under-represented in the DLP. They maintain or increase the amount of aspen over the current over-represented amount. When compared to the amounts projected statewide in the GEIS, for some of the major forest types on the Chippewa, Alternative A projects: an increase in aspen which is similar to the GEIS; a slight increase in jack pine which is expected to decrease statewide; and stable white pine type which is expected to increase statewide. Alternative C projects: a stable to slight decrease in aspen while the GEIS projects an increase; a slight increase in jack pine which is expected to decrease statewide; and an increase white pine which is also expected to increase statewide.

They contribute the least amount of acres to the two oldest upland age classes. They provide the least amount of management flexibility for using uneven-aged regeneration methods needed to manipulate and move the over-represented 50-99 year age class to the multi-aged/old-growth stages and for increasing within-stand complexity. They contribute the least amount of old-growth acres, patches, and designations of the alternatives considered.

Overall, these alternatives tend to maintain the current forest conditions on the Chippewa and generally do not contribute to the desired landscape goals for forest vegetation within the DLP or to moving it towards RNV.

Alternative B

This alternative generally increases the amounts of those forest types that are currently under-represented in the DLP. It decreases the amount of aspen considerably over the current over-represented amount. When compared to the amounts projected statewide in the GEIS, for some of the major forest types on the Chippewa, Alternative B projects: a decrease in aspen while the GEIS projects an increase; an increase in jack pine which is expected to decrease statewide; and an increase in white pine which is also expected to increase statewide.

With the exception of Alternative D, it contributes the highest amount (59%) of acres to the two oldest upland age classes. It provides the greatest amount of management flexibility for using uneven-aged regeneration methods needed to manipulate and move the over-represented 50-99 year age class to the multi-aged/old-growth stages and for increasing within-stand complexity. With the exception of Alternative D, it

Table FAC-36: Vegetation Projections for Age and Spatial Patterns Contributing to Old-growth and Future Old-growth Forest Conditions on the Superior National Forest.

Vegetation Projections	**Alt. A** (acres)	**Alt. B** (acres)	**Alt. C** (acres)	**Alt. D** (acres)	**Alt. E (Mod.)** (acres)	**Alt. F** (acres)	**Alt. G** (acres)
Upland Forest Types 120+ Years Old							
Existing	13,000	13,000	13,000	13,000	14,400*	13,000	13,000
Decade 2	43,600	44,700	39,700	44,300	45,500	42,800	42,600
Decade 5	120,400	148,800	105,200	143,200	123,500	140,200	123,800
Decade 10	190,800	337,700	172,700	327,600	238,800	280,900	234,200
BWCAW Uplands*	415,000	415,000	415,000	415,000	415,000	415,000	415,000
Lowland Forest Types 120+ Years Old							
Existing	60,600	60,600	60,600	60,600	63,500*	60,600	60,600
Decade 2	99,900	103,700	81,700	114,000	105,800	103,600	104,200
Decade 5	150,000	170,200	133,000	196,100	172,900	168,400	176,500
Decade 10	157,600	191,400	156,600	257,200	183,300	179,200	198,400
BWCAW Lowlands*	52,000	52,000	52,000	52,000	52,000	52,000	52,000
Old-growth/Multi-aged Upland Forest Patches > 300 ac. In size							
Existing	61,300	61,300	61,300	61,300	69,200*	61,300	61,300
Decade 2	83,500	151,000	68,300	131,700	103,600	131,800	107,700
Decade 5	67,600	142,000	59,000	128,600	79,100	104,500	77,100
Decade 10	84,900	288,100	81,800	343,800	148,300	176,300	151,400

Source: Source: Acres for age 120+ years and acres in Old-growth/Multi-aged upland forest patches > 300 acres in size are based upon Dualplan model outputs for decades 2, 5, and 10.

Definitions: Ages for Old-growth/Multi-aged upland forest is based upon forest type groupings for the old-growth and old-growth/multi-aged habitat groupings (see Appendix D – Wildlife) These acres do not include BWCAW acres.

‡Notes: * The BWCAW acres displayed are not all 120+ years old or in an old-growth/multi-aged condition. These acres represent the upland and lowland forest acres that are in the mature and multi-aged vegetation growth stages. These acreages are taken from the BWCAW Fuels Treatment Final EIS, 2001.

* Existing acres for Modified Alternative E vary from the other alternatives based upon the final Dualplan model run for this alternative. For this model run, the ages of forested stands were advanced to 2004.

contributes the greatest amount of old-growth acres, patches, and designations of the alternatives analyzed.

Overall, this alternative tends to manage Chippewa National Forest lands in such a way as to contribute considerably towards the desired landscape goals for forest vegetation within the DLP and assists in moving it towards RNV.

Alternative D

With the exception of jack pine, this alternative increases the amounts of those forest types that are currently under-represented in the DLP more than any of the other alternatives. It decreases the amount of aspen considerably over the current over-represented amount. When compared to the amounts projected statewide in the GEIS, for some of the major forest types on the Chippewa, Alternative D projects: a decrease in aspen while the GEIS projects an increase; an increase in jack pine which is expected to decrease statewide; and an increase in white pine which is also expected to increase statewide.

It contributes the highest amount (77%) of acres to the two oldest upland age classes. It provides little management flexibility for using uneven-aged regeneration methods needed to manipulate and move the over-represented 50-99 year age class to the multi-aged/old-growth stages. However, the amount of forest harvested under this alternative is drastically reduced from other alternatives. It contributes the most in terms of old-growth acres, patches, and designations of any of the alternatives considered.

Overall, this alternative tends to manage Chippewa National Forest lands in such a way as to contribute considerably towards the desired landscape goals for forest vegetation within the DLP and assists in moving it towards RNV. Additionally, the amounts of aspen and the amounts in the old-growth age classes projected under this alternative may compensate for high over-representation of aspen and the considerable under-representation of acres in the 100+ age classes across the DLP.

Modified Alternative E

This alternative generally maintains or increases the amounts of those forest types that are currently under-represented in the DLP. It decreases the amount of aspen somewhat over the current over-represented amount. When compared to the amounts projected statewide in the GEIS, for some of the major forest types on the Chippewa, Modified Alternative E projects: a decrease in aspen while the GEIS projects an increase; an increase in jack pine which is expected to decrease statewide; and an increase in white pine which is also expected to increase statewide.

It contributes a moderate amount (29%) of acres to the two oldest age classes. It provides a limited amount of management flexibility for using uneven-aged regeneration methods needed to manipulate and move the over-represented 50-99 year age class to the multi-aged/old-growth stages and for increasing within-stand complexity. It contributes a moderate amount of old-growth acres, patches, and designations when compared to the other alternatives.

Overall, this alternative tends to manage Chippewa National Forest lands in such a way as to contribute towards the desired landscape goals for forest vegetation within the DLP and in moving it towards RNV.

Alternative F

This alternative generally increases the amounts of those forest types that are currently under-represented in the DLP. It decreases the amount of aspen considerably over the current over-represented amount. When compared to the amounts projected statewide in the GEIS, for some of the major forest types on the Chippewa, Alternative F projects: a decrease in aspen while the GEIS projects an increase; an increase in jack pine which is expected to decrease statewide; and an increase in white pine which is also expected to increase statewide.

It contributes a relatively high amount (52%) of acres to the two oldest upland age classes. It provides a considerable amount of management flexibility for using uneven-aged regeneration methods needed to manipulate and move the over-represented 50-99 year age class to the multi-aged/old-growth stages. It contributes a moderate amount of old-growth acres, patches, and designations when compared to the other alternatives.

Overall, this alternative tends to manage Chippewa National Forest lands in such a way as to contribute considerably towards the desired landscape goals for forest vegetation within the DLP and assists in moving it towards RNV.

Alternative G

This alternative generally increases the amounts of those forest types that are currently under-represented in the DLP. It decreases the amount of aspen considerably over the current over-represented amount. When compared to the amounts projected statewide in the GEIS, for some of the major forest types on the Chippewa, Alternative G projects: a decrease in aspen while the GEIS projects an increase; an increase in jack pine which is expected to decrease statewide; and an increase in white pine which is also expected to increase statewide.

It contributes a relatively high amount (43%) of acres to the two oldest upland age classes. It provides a considerable amount of management flexibility for using uneven-aged regeneration methods needed to manipulate and move the over-represented 50-99 year age class to the multi-aged/old-growth stages and for increasing within-stand complexity. It contributes a relatively high amount of old-growth acres, patches, and designations when compared to the other alternatives.

Overall, this alternative tends to manage Chippewa National Forest lands in such a way as to contribute considerably towards the desired landscape goals for forest vegetation within the DLP and assists in moving it towards RNV.

Northern Superior Uplands (NSU) Section

The Superior National Forest manages approximately 42% of the forested lands in this ecological Section. This percentage varies among the Landscape Ecosystems (LE), and ranges from a low of 17% of the Rich Swamp LE to a high of 83% of the Jack Pine-Black Spruce LE. Refer to Appendix B for a complete breakdown of land ownership by landscape ecosystem within the NSU.

The Boundary Waters Canoe Area Wilderness contributes approximately 762,000 acres of forest to the Superior National Forest and to the Northern Superior Uplands. This acreage represents approximately 34% of the forested acres on the Superior National Forest and 15% of the forested acres within the NSU. Approximately 67% of the BWCAW is in the Jack Pine-Black Spruce LE; 13% is in Lowland Conifer; 7% in the Mesic Birch, Aspen, Spruce-Fir LE; 6% in the Dry-mesic Red and White Pine LE; 3% in the Mesic Red and White Pine LE; and 1% in the Sugar Maple LE.

With the exception of the Jack Pine-Black Spruce LE, the long-term vegetation objectives for forest composition and age for all other LEs included the acres inside and outside the BWCAW. The long-term vegetation objectives used for analyzing the Jack Pine-Black Spruce LE were for the acres outside the wilderness. This was done because 83% of this LE is in the Superior National Forest. Fifty-five percent of the LE is in the BWCAW. Maintaining the biological diversity associated with this LE is largely reliant on national forest management. Of the landscape ecosystems analyzed on the Superior, this one requires the greatest amount of disturbance to function properly. Our ability to manage this entire LE to provide for its biological diversity is restricted by current wilderness management objectives.

Table FAC-2 on page 3.2-7, displays a comparison of the existing amounts of forest types and age classes on the Superior National Forest and on all lands within the ecological Section to the RNV values. When compared to the amounts predicted to occur under RNV, the existing amounts of jack pine, white pine, and spruce-fir forest types are under-represented; and the existing amount of aspen is extremely over-represented. The current amount of upland forest in the 100+ year age class is considerably under-represented, while that in the 50-99 year age class is considerably over-represented.

The goals expressed by the Landscape committee are aimed at alleviating some of the differences apparent from this Table. These goals will generally move some existing forest conditions towards RNV. They include: increasing amounts in the multi-aged growth stages; increasing the white pine, white spruce, and tamarack forest types; establishing and maintaining white pine; and increasing jack pine.

The alternatives proposed for revising the Superior Forest Plan respond to these conditions and goals to varying degrees.

Alternatives A and C

These alternatives generally maintain the forest types that are currently under-represented in the NSU. They maintain or increase the amount of aspen over the current over-represented amount. When compared to the amounts projected statewide in the GEIS, for some of the major forest types on the Superior, Alternative A projects: an increase in aspen which is similar to the GEIS; a decrease in jack pine which is also expected to decrease statewide; and stable white pine type which is expected to increase statewide. Alternative C projects: a stable aspen type while the GEIS projects an increase; an increase in jack pine which is expected to decrease statewide; and a stable white pine type which is expected to increase statewide.

They contribute the least amount of acres to the two oldest upland age classes. They provide the least amount of management flexibility for using uneven-aged regeneration methods needed to manipulate and move the over-represented 50-99 year age class to the multi-aged/old-growth stages and for increasing within-stand complexity. They contribute the least amount of additional old-growth acres, patches, and designations of the alternatives.

Overall, these alternatives tend to maintain the current forest conditions on the Superior and generally do not contribute to the desired landscape goals for forest vegetation within the NSU or to moving it towards RNV.

Alternative B

This alternative generally increases the amounts of those forest types that are currently under-represented in the NSU. It decreases the amount of aspen considerably over the current over-represented amount. When compared to the amounts projected statewide in the GEIS, for some of the major forest types on the Superior, Alternative B projects: a decrease in aspen while the GEIS projects an increase; an increase in jack pine which is expected to decrease statewide; and an increase in white pine which is also expected to increase statewide.

With the exception of Alternative D, it contributes the highest amount (51%) of acres to the two oldest upland age classes. It provides the greatest amount of management flexibility for using uneven-aged regeneration methods needed to manipulate and move the over-represented 50-99 year age class to the multi-aged/old-growth stages and for increasing within-stand complexity. With the exception of Alternative D, it contributes the greatest amount of additional old-growth acres, patches, and designations of the alternatives analyzed.

Overall, this alternative tends to manage Superior National Forest lands in such a way as to contribute considerably towards the desired landscape goals for forest vegetation within the NSU and assists in moving it towards RNV.

Alternative D

With the exception of jack pine, this alternative increases the amounts of those forest types that are currently under-represented in the NSU more than any of the other alternatives. It decreases the amount of aspen considerably over the current over-represented amount. When compared to the amounts projected statewide in the GEIS, for some of the major forest types on the Superior, Alternative D projects: a decrease in aspen while the GEIS projects an increase; a decrease in jack pine which is also expected to decrease statewide; and an increase in white pine which is also expected to increase statewide.

It contributes the highest amount (74%) of acres to the two oldest age classes. It provides little management flexibility for using uneven-aged regeneration methods needed to manipulate and move the over-represented 50-99 year age class to the multi-aged/old-growth stages and for increasing within-stand complexity. However, the amount of forest harvested under this alternative is drastically reduced from other alternatives. It contributes the most in terms of additional old-growth acres, patches, and designations of any of the alternatives.

Overall, this alternative tends to manage Superior National Forest lands in such a way as to contribute considerably towards the desired landscape goals for forest vegetation within the NSU and assists in moving it towards RNV. Additionally, the amounts of aspen and the amounts in the old-growth age classes projected under this alternative may compensate for high over-representation of aspen and the considerable under-representation of acres in the 100+ year age classes across the NSU.

Modified Alternative E

This alternative generally increases the amounts of those forest types that are currently under-represented in the NSU. It decreases the amount of aspen over the current over-represented amount. When compared to the amounts projected statewide in the GEIS, for some of the major forest types on the Superior, Modified Alternative E projects: a decrease in aspen while the GEIS projects an increase; an increase in jack pine which is expected to decrease statewide; and an increase in white pine which is also expected to increase statewide.

It contributes a moderate amount (20%) of acres to the two oldest upland age classes. It provides a limited amount of management flexibility for using uneven-aged regeneration methods needed to manipulate and move the over-represented 50-99 year age class to the multi-aged/old-growth stages and for increasing within-stand complexity. It contributes a moderate amount of additional old-growth acres, patches, and designations when compared to the other alternatives.

Overall, this alternative tends to manage Superior National Forest lands in such a way as to contribute minimally towards the desired landscape goals for forest vegetation within the NSU and in moving it towards RNV.

Alternative F

This alternative generally increases the amounts of those forest types that are currently under-represented in the NSU. It decreases the amount of aspen considerably over the current over-represented amount. When compared to the amounts projected statewide in the GEIS, for some of the major forest types on the Superior, Alternative F projects: a decrease in aspen while the GEIS projects an increase; an increase in jack pine which is expected to decrease statewide; and an increase in white pine which is also expected to increase statewide.

It contributes a relatively high amount (44%) of acres to the two oldest upland age classes. It provides a limited amount of management flexibility for using uneven-aged regeneration methods needed to manipulate and move the over-represented 50-99 year age class to the multi-aged/old-growth stages and for increasing within-stand complexity. It contributes a moderate amount of additional old-growth acres, patches, and designations when compared to the other alternatives.

Overall, this alternative tends to manage Superior National Forest lands in such a way as to contribute towards the desired landscape goals for forest vegetation within the NSU and assists in moving it towards RNV.

Alternative G

This alternative generally increases the amounts of those forest types that are currently under-represented in the NSU. It decreases the amount of aspen considerably over the current over-represented amount. When compared to the amounts projected statewide in the GEIS, for some of the major forest types on the Superior, Alternative G projects: a decrease in aspen while the GEIS projects an increase; an increase in jack pine which is expected to decrease statewide; and an increase in white pine which is also expected to increase statewide.

It contributes a moderate to high amount (32%) of acres to the two oldest upland age classes. It provides a limited amount of management flexibility for using uneven-aged regeneration methods needed to manipulate and move the over-represented 50-99 year age class to the multi-aged/old-growth stages and for increasing within-stand complexity. It contributes a moderate amount of additional old-growth acres, patches, and designations when compared to the other alternatives.

Overall, this alternative tends to manage Superior National Forest lands in such a way as to contribute towards the desired landscape goals for forest vegetation within the NSU and assists in moving it towards RNV.

3.2.2 Forest Spatial Patterns

Forest spatial patterns refers to the size, shape, and arrangement of forest types, habitats, and vegetation communities resulting from disturbances, both natural and as a result of forest management activities. The spatial configurations of the landscape coarse filter elements of forest age and composition are important indicators of ecosystem function to be considered in forest planning. Some species require or benefit from specific spatial arrangements, including large patches of contiguous habitat, linkages of habitat patches, or juxtaposition of patches (USDA 2000).

Issue Statement

Management direction in the current Plans has led to smaller forest patch sizes and increased forest edge. The maximum size for even-age harvests has generally been 40 acres, with some areas on the Superior National Forests up to 200 acres. This tends to favor wildlife associated with forest edges and disfavors wildlife associated with contiguous or interior forest conditions.

There is general agreement that managed landscapes have fewer large patches of forest than landscapes that are not managed, and that natural disturbance determined the size of forest patches. However, there is disagreement over whether the effects of fewer large patches of forest are beneficial or adverse. There is a concern over the amount of habitat fragmentation on National Forest landscapes and its affects on regional and national biodiversity and on local game populations. There is disagreement in how patch size should be increased, either by reducing or eliminating even-aged timber harvests such as clear-cutting and managing for more uneven-aged stands, or by increasing the size of even-aged timber harvest areas (e.g. size of clear-cuts) as a way to achieve larger patch sizes.

In order to address these concerns, there is a need to re-evaluate the current management direction for the spatial patterns of forests in the Forest Plans. Forest Plan revision may change the management direction for the size and distribution of forest patches.

Spatial Indicators

The analysis of spatial patterns will focus on broad level descriptors (Host and White 2002, USDA COS 1999) calculated for the forest as a whole for existing condition, maximum potential condition, and forest patch patterns predicted by harvest modeling for decades in the future In order to address the most significant issues, spatial indicators focus on upland forest. The exception is for lowland young forest where edge density is examined. Patch size metrics address basic questions of coarse scale spatial patterns (Mladenoff in Meffe 1997) for upland young forest and for upland mature or older forest and provide one index of landscape fragmentation (Host and White 2002). Interior forest, the area remaining after removing a fixed distance interior buffer from patches, addresses patch shape complexity and helps define the quality of forest habitat. Edge density is related to both patch size and patch shape complexity associated with disturbance in forest cover. Spatial indicators used in this programmatic analysis do not examine finer scales of fragmentation, such as roading or trails. These may be more appropriately examined at the project level. A more detailed explanation of how spatial indicators were derived can be found in Appendix B. Data on the full array of patch sizes and numbers, including forest composition and ecosystem composition in large patches, can be found in the project record.

Indicator 1 – Size and Amount of Large Mature and Older Forest Patches

Indicator 1 for forest spatial patterns is the size and amount of large (patches 300 acres or larger) mature and older (age 50 or older) upland forest patches. The size and amount of large mature forest patches projected under each alternative will be compared to existing conditions and the maximum potential within each forest. The contribution of the BWCAW on the Superior NF is accounted for in forest-wide line totals for mature forest patches (table FSP-2) for maximum potential, existing conditions, and indicator decadal totals. Harvest modeling was not conducted for forest within the wilderness and contributions of the wilderness to future conditions forest-wide are assumed to at least be at existing levels.

Three hundred acres was selected as a beginning size for analysis to reflect the proposal for revising forest plans for National Forest in MN in the Notice of Intent (USDA 1997). This size also generally reflects spatial scales used to define some species habitats (Planning Record) and those used to describe landscape spatial conditions in other work (SMC Task Team Report USDA 1998, Wolter and White 2002, Manolis 2003) Existing large mature upland forest patches range from 300 acres to over 10,000 acres on each forest. This indicator addresses the combined elements of large patches, mature/older upland forest, and the effect of vegetation management objectives to represent changes to relatively rare features on the landscape over time (Mladenoff et al. 1993, Wolter and White 2002). This indicator highlights the differences between alternatives, resulting from differing management themes, in the number and acres amount of large mature forest patches varying over time.

Indicator 2 – Size and Amount of Large Young Forest Patches

Indicator 2 for forest spatial patterns is the size and amount of large (>300 acres) young (age 0-9 yrs) forest patches. The size, amount, and distribution of young forest patches projected under each alternative will be compared to existing conditions within each forest. The contribution of the BWCAW to young forest spatial patterns on the Superior NF is accounted for in the forest-wide line total for existing condition only of this indicator (table FSP-3). Harvest modeling was not conducted for forest within the wilderness. While amounts of young forest can be predicted for the future in the wilderness, the contribution of those disturbances to large patches was not predicted in this analysis.

Clustering of harvests creating larger patches of young forest has been demonstrated to increase interior forest over time even while maintaining relatively high harvest levels (Gustafson 1996). This indicator displays the differences between each alternative's capability to maintain or increase spatial diversity, it shows differences in management intensity between alternatives, and how alternatives aggregate vegetation management spatially.

Indicator 3 – Amount of Forest Interior Habitat

Indicator 3 for forest spatial patterns is the amount of forest interior habitat. Forest interior habitat is used as an indication of habitat quality and the extent of large forest patches in a landscape (Sachs et al. 1998). Forest interior habitat was calculated by buffering inward 100 meters from the edge of all forest patches. The resulting area, interior forest habitat, was summed forest-wide for that time period and alternative. Interior forest was calculated for maximum potential forest patches for potential interior habitat, for all existing mature or older forest patches, and for all mature or older forest patches predicted for future time periods under different management alternatives. Interior forest was not calculated for forest within the wilderness. A large proportion of the BWCAW is in mature forest and contributes a large amount of interior forest available within the Superior. Consequently, amounts of interior forest shown for this indicator would be greater when managed (table FSP-4) and unmanaged forest land are considered together.

Indicator 4 – Management Induced Edge Density

Indicator 4 for forest spatial patterns is the edge density (miles/mile^2) of young (age 0-9) forest for uplands and lowlands. The perimeter of young forest stands created by management (i.e. even-aged regeneration timber harvest) was measured, a density amount was calculated for uplands and lowlands forest, and reported forest-wide for that time period and alternative. On the Superior, management induced edge was calculated only for the area outside the BWCAW. The edge density projected over time under each alternative will be compared to existing conditions. This indicator provides a measure of habitat fragmentation resulting from forest management and a measure of management intensity.

Scope of Analysis

The analysis area for considering direct and indirect effects to forest spatial patterns will be the National Forest System land managed by the Chippewa and Superior National Forests. Lands under other ownerships within the proclamation boundaries of the Superior and Chippewa National Forests, as well as those within the relevant Sections, i.e. the Drift and Lake Plains for the Chippewa, and the Northern Superior Uplands for the Superior, will be considered in addressing the cumulative effects of proposed management scenarios.

3.2.2.a Affected Environment

Fragmentation is the separation or isolation of similar types of habitat, either by natural events or human activities.

Within the context of the largely forested landscape matrix of the Chippewa and Superior NF, habitat fragmentation relates primarily to changes in the forest stand size, species composition and age of stands. Limits on harvest size for even-aged management are tending to reduce stand sizes and increase fragmentation effects. Clear-cut harvests currently account for more than 90% of forest acres managed on the Superior or the Chippewa NF. This type of management tends to increase edge and favor occurrence of popular wildlife game species, such as deer. Conversely, it may tend to act against species requiring larger areas of continuous forest. A number of wildlife and plant species have been shown to be associated with conditions existing in the interior of relatively large patches of mature vegetation, or to be adversely affected by the proximity of early seral stage vegetation and associated edge (Morrison, et al., 1992; USDA 1996).

Forest Plan alternatives propose varying approaches and objectives for meeting broad ecosystem conditions that can be described in terms of forest age, composition, and spatial patterns. Meeting these broad ecosystem conditions have been referred to as a coarse filter approach (Hunter 1996, p. 72). If effectively designed, the coarse filter is believed to be an appropriate strategy for conserving multiple species within the same area in a proactive fashion, including those that are unknown, not inventoried, or whose life-cycle requirements are not well documented. The spatial configurations of the coarse filter (i.e. patch size, interior forest, and edge) are important considerations in National Forest planning. Other important considerations in National Forest Planning include accomplishing multiple ecological and social objectives on the same land base. Some species require or benefit from specific spatial arrangements; these may include large patches of contiguous habitat, linkages of habitat patches through the matrix, or juxtapositions of patches with specific composition or structure (USDA 2000, Gustafson and Crow 1994). Many ecosystem processes essential for sustainability of ecosystems operate at large spatial scales. In meeting social objectives, Gustafson (1996) demonstrated that amounts of interior forest could be increased even while maintaining relatively high harvest levels through clustering of disturbance in time and space.

Forest management has created a landscape different from that shaped by the natural disturbances to which species have adapted over evolutionary time (Noss and Cooperrider 1994). Historically, fire, wind, insects, and disease were the disturbance processes that modified habitat connectivity, age, interspersion, and patch size. These disturbances caused disruptions to species and habitats. A landscape dominated by natural disturbances has a greater range of patch sizes with more larger patches and patches with more complex shapes than young, managed forest (Mladenoff et al. 1993). The result is a landscape matrix that maximizes both forest interior habitat and connectivity of patches.

An examination of recent historical trends in landscape spatial patterns across the Northern Superior Uplands and the Drift and Lake Plains Sections of Northern Minnesota showed a 50% decrease in the average size of forest patches between the 1930s and the 1970s (Host and White 2003). Further, an examination of changes in forest cover over a five year period (1990-1995) in northeast Minnesota (Wolter and White 2002) showed a reduction in patches of mature conifer forest, a reduced number of large patches (greater than 500 ha), reduced connectivity of patches, increased edge density, and reduced forest interior habitat in managed portions of the forest landscape. Conversely, the portion of the landscape that was affected only by natural processes (largely wilderness within the BWCA) had significantly greater distances between early successional forest patches than managed forest.

Currently, management practices—including roads, trails, utility corridors, and vegetation management—often cause habitat modifications. At a landscape scale factors such as fragmented ownership patterns and uncoordinated forest management among ownerships has resulted in greater habitat fragmentation by producing smaller average cut-unit sizes (Wolter and White 2002). Additionally, edges created by forest management activities cause physical and biological changes that affect habitat suitability for some plant and animal species (Chen et al. 1999, Matlack 1993). Abrupt stand edges influence the microclimate 4-6 tree heights within the stand (Chen et al. 1999). Changes in light, temperature, litter moisture, vapor pressure deficit, humidity, and understory plants are reported up to 165 feet from the edge (Matlack 1993).

The maximum potential of large upland patches is defined as the combined areas of contiguous forested upland in Federal ownership regardless of age (Table FSP-1 and FSP-2). Maximum potential patches, based on current ownership and landscape patterns, determine a theoretical maximum for a National Forest in large upland patches. Potentially, 80% of the uplands on the Chippewa, and 90% of the uplands on the Superior forest wide (83% outside of the wilderness, and 98% within the wilderness) could be contained in forest patches greater than 300 acres. Of upland acres, currently 21% of the Chippewa, and 53% of the Superior forest wide (32% outside the wilderness, and 84% within the wilderness) are contained within large mature or older patches. These statistics reflect the interaction of ownership patterns within each forest and also the past management intensity in each forest.

3.2.2.b Environmental Consequences

Effects Common to All Alternatives

Resource Protection Methods

Habitat connectivity, implied by the examination of large forest patches, is a fundamental concept needed in considering species viability and sustaining biodiversity. Connectivity is needed to ensure genetic interaction and species recruitment following random catastrophic events.

Forest Plan Direction

Management direction for forest spatial patterns is addressed differently for the different alternatives. . The management direction outlined below would apply to Alternatives E, F and G. Because the spatial patterns generated by Management Area allocations in Alternatives B and D on both forests generally exceeds the standards and guides below, those standards and guidelines would be unnecessary. Because of the themes of Alternatives A and C the standards and guides would be less restrictive than those for Alternatives E, F and G. .

Forest-wide desired conditions, objectives, standards, and guides have been developed to address long-term and short-term management direction. Management direction for forest age and forest tree species composition (also found in Chapter 2) has been directly modeled in the Dualplan model, whereas management direction for spatial patterns has been estimated in the Dualplan model in Alternatives A-D, F, and G. Spatial modeling was coupled with the Dualplan model in Modified Alternative E.

While desired conditions and objectives set the direction for where forests wish to go, standards and guides set a lower limit for amounts or prescribe mitigations to adverse effects.

The following is a summary of management direction for forest spatial patterns in the Forest Plan:

Desired Condition: The diversity of vegetation spatial landscape patterns that have been degraded or greatly diminished on the landscape by past land use are restored to conditions that more closely emulate the landscape scale patterns that would result from natural disturbances and other ecological processes.

On the Superior, spatial zones are used to provide a context for large patch numbers and acres, provide for ecosystem representation, and account for the BWCAW in forest spatial patterns. Standards and guides also address the amount, number, and condition of mature or older red and white pine forest patches. Data for forest spatial patterns by spatial management zones are included in the project record for the FEIS for the selected alternative.

Objectives for Chippewa National Forest All Alternatives, Superior National Forest Alternatives A-D, F, G:

1. Increase the acres and number of patches of mature or older upland forest in patches 300 acres or greater.
2. Maintain a representative array of large patches (>300 acres) of mature or older lowland forest.
3. Increase the amount of interior forest habitat.
4. Manage patches to maintain the characteristics of mature or older native upland forest vegetation communities.
5. Where ecologically appropriate, increase acres and number of patches of temporary openings up to and including 1,000 acres.
6. Increase average size of temporary forest openings

Objectives for Superior National Forest, Modified Alternative E:

1. In Spatial Zones 1 and 2, maintain or increase the acres and numbers of patches of mature or older upland forest in patches 300 acres or greater.
2. In Spatial Zone 3, strive to minimize the decreases in acres and numbers of patches of mature or older upland forest patches 300 acres or larger.
3. In Spatial Zones 1 and 2, maintain or increase the amounts of interior forest habitat.
4. In Spatial Zone 3, strive to minimize the decrease in interior forest habitat.
5. Manage patches to maintain the characteristics of mature or older native upland forest vegetation communities.
6. Where ecologically appropriate, increase acres and number of patches of temporary openings up to and including 1,000 acres.
7. Increase average size of temporary forest openings.

Forest managers adjusted spatial zone boundaries for the Superior National Forest from the draft to the final Forest Plan (Spatial Management Zone Map, Superior National Forest Plan) to better represent the contributions of the BWCAW. This results in an increase in total acres in Spatial Zone 3 (the area proximate to the wilderness) from 569,000 acres (42% of the Superior outside the BWCAW) to 687,000 acres (51% of the Superior outside of the BWCAW). There is a corresponding decrease in total acres in Spatial Zone 1 (a decrease of 96,700 acres) and Zone 2 (a decrease of 21,623 acres). Zone 3 has no standards and guides for minimum patch numbers, acre numbers, or within-patch conditions for large mature or older upland patches. The objectives for this zone are to strive to minimize the decreases in large mature/older upland patches and interior forest. Age and composition objectives will be the primary drivers of forest spatial patterns and conditions.

Except for Zone 3 in Modified Alternative E, all alternatives on the Superior and Chippewa would have standards and guides for forest spatial patterns that generally set minimum patch numbers, acre numbers, or within-patch conditions for large mature upland forest patches. Standards and guides would limit the projected decreases in patch numbers or acres.

General Effects Common to All Alternatives

Increasing the Size of Temporary Openings

All alternatives would increase the size of temporary forest opening due to even-aged regeneration harvests (i.e. clear-cuts, shelter-wood harvest). Under Alternative A harvest size limits would remain 40 acres on the Chippewa and up to 200 acres on the Superior. With the average size of harvests currently at about 18 acres on the Chippewa and about 30 acres on the Superior, harvest areas could still increase under Alternative A to meet the objective. Under all other alternatives, larger harvest areas would be considered with an upper limit of 1000 acres. The relationship of this upper unit size to natural openings is that natural disturbances were often much larger than this on the Chippewa and Superior landscapes. This size is likely implementable given other resource limitations (i.e. visual constraints, habitat constraints). Larger temporary openings would begin to mimic disturbances once more common on fire dominated ecosystems in Minnesota and would help to reestablish spatial patterns and wildlife habitats once more common. When coupled with vegetation age and composition objectives, larger temporary openings would build future large mature forest patches for the future and help to move landscapes back towards the historic range (RNV). Overall, this would help reduce risk in Forests' ability to sustain ecosystems and species. Along with ecosystem context and appropriateness, larger temporary openings would be limited by age, composition, spatial, or other multiple-use objectives of each alternative. Each alternative would have different opportunities to establish large temporary openings.

Land Ownership Patterns

Land management, as affected by ownership, strongly influences landscape patterns. Private non-industrial forestland disproportionately contributes to habitat fragmentation by harvesting smaller patches and creating higher edge densities than other ownership groups (Wolter and White, 2002). Harvest sizes are usually smaller and are not coordinated across the landscape. The Chippewa is more fragmented by other ownerships. Therefore landscape patterns are more heavily influenced by the effect of management on other ownerships on the Chippewa than on the Superior.

Boundary Water Canoe Area Wilderness

There are about 706,299 upland acres in Federal ownership in the Boundary Waters Canoe Area Wilderness. About 82% (579594 acres) is currently within large mature forest patches. This amount is projected to increase as areas affected by the blow-down event in 1999 begin to develop into mature forest. Landscape ecosystem representation within the wilderness is variable but is dominated by the Jack Pine-Black Spruce LE. Of the large mature forest patch acres within the Jack Pine-Black Spruce LE and the Mesic White Pine-Red Pine LE, 85% and 47%, respectively, are found within the BWCAW. Future projections for mature or older forest patches within the wilderness are not made in this analysis, though a 2% decadal rate of disturbance (e.g. creation of young forest) was predicted for future decades (USDA 2001) and, barring catastrophic disturbances, mature forest would increase from existing conditions. Potentially, 98% (692,200 ac) of the upland forest within the BWCAW could form large forest patches. Future amounts of large mature or older upland patches would likely fall between existing (579,594 acres) and potential amounts (692,200 acres) within the wilderness. Potentially, over 14,000 acres of young forest could be created per decade with predicted disturbance rates. As explained earlier , the influence of the BWCAW on spatial diversity for forest land outside the wilderness was accounted for by the use of spatial zones to provide a context for large patch numbers and acres to ensure well-distributed habitats away from the BWCAW.

Disturbance in Lowland Conifer

Disturbance in lowland conifer forest historically was primarily fire and wind. Timber harvest would replace much of the projected disturbance in lowland conifer under all alternatives and outside the BWCAW on the Superior National Forest. Management in lowland conifer forest is projected to increase by a factor of 2 to 9 times current levels among 6 of 7 alternatives. Model results may underestimate the duration of young lowland forest openings. Edge effects (Chen et al. 1999, Matlack 1993) would persist on the landscape longer than indicated by the model. Edge effects include those at the lowland/upland ecotone and those within the lowland community. The depth-of-edge influence may extend four to six tree heights from a recent clear-cut forest edge (Chen et al. 1999). Edge effects generally applicable to lowland forest include increased susceptibility to wind throw adjacent to abrupt edges, extremes in temperature and humidity gradients at edges and into lowland stands that limit dispersal of insects or herpetofauna (e.g. four-toed salamander), and reduced recruitment of moisture-limited species.

Modeling Rules for Succession

In modeling harvests and vegetation management, assumptions (modeling rules) were made and applied to certain forest types to more accurately project harvest volumes and to predict succession to future forest types. While these assumptions help to determine more accurate harvest volumes, these have the effect of over-estimating a loss of certain kinds of habitats. The age of stands affected by succession rules were set back, in some cases to as young as 20 years old as in those stands succeeding to spruce-fir. Those stands are not counted as mature/older forest habitat or within mature/older upland patches. Succession rules may help to accurately reflect a change in harvestable timber volume, however old stands of early successional tree species such as aspen continue to provide many of the attributes of mature or older forest habitat and would practicably contribute to contiguous upland patches and interior forest for one, two, or more decades. Successional transitions are not as immediate as the model might indicate. These forest stands do not constitute a hard edge between different habitat types but continue to offer many of the habitat attributes of mature or older habitat. In this way the loss of mature/older forest habitat or patches that contain this habitat is over-estimated. This effect appears to be greater in alternatives with lower harvest intensity such as Alternatives B,D,F, and G. However, this effect is present in Alternative E. Management Indicator Habitats are discussed in Section 3.3, Wildlife Habitat, of the FEIS.

Direct and Indirect Effects

Indicator 1: Size and Amount of Large Mature and Older Forest Patches

Alternative A

This alternative reflects management direction of the current forest plan for the Chippewa and Superior NFs. Management direction affecting forest spatial patterns includes a 40 acre limit on even-aged regeneration harvests on the Chippewa and a 200 acre limit on the Superior; a harvest adjacency requirement that promotes small patches; and vegetation objectives that emphasize young aspen forest.

This alternative causes short-term and long-term decrease in large mature upland patches on both the Superior and Chippewa Forests (Tables FSP-1 and FSP-2). This alternative maintains the least amount in large mature patches within the forest's capability among all alternatives. This alternative causes a loss of spatial diversity from current condition with a loss of large mature patches and a further shift towards a finer grained landscape. The decrease of spatial diversity through all decades examined limits the ability of an ecosystem coarse filter to effectively function compared to alternatives that maintain or increase spatial diversity. Coarse filter ecosystem processes (e.g. gap dynamics in forest stands) would be limited by the amount and intensity of forest management. This alternative would require fine filter, site level protection for maintaining rare elements or mitigating impacts. .

For both forests, patch configurations that may represent some desired condition consistent with this alternative's multiple use objectives were estimated for modeling purposes. Management direction would likely be developed to reflect these objectives and would be less than that proposed in the Plan.

On the Chippewa the number and amount of large upland mature forest patches would be fewer in all decades than the amount existing today. In the short term, during the implementation period of the management plan, there would be a 42% decline in this indicator from existing condition. In the long term this decline is maintained over the planning horizon at a 45% decline in the fifth decade and a 38% decline in the tenth decade. There is a corresponding loss of more than 50% of large patches. In the tenth decade, 13% of the uplands would be within large mature forest patches versus 21% currently or 80% at a maximum. Forest-wide, inclusive of all federal land, large forest patches would decline from 14% of the land base to as low as 8% in the second and fifth decades, or compared to 55% at a maximum.

On the Superior the number and amount of large upland mature forest patches would be fewer in all decades than the amount existing today. In the short term, during the implementation period of the management plan, there would be a 43% decline in this indicator from existing condition. In the long term this decline is maintained over the planning horizon a 51% decrease in the fifth decade and a 44% decrease in the tenth decade. In the tenth decade, 45% of the uplands would be within large mature forest patches versus 53% currently or 90% at a maximum.

Forest-wide, inclusive of all federal land, large forest patches would decline from 41% of the land base to as low as 34% in the fifth decade, compared to 69% at a maximum.

Alternative B

On the Chippewa, compared to other alternatives this alternative most quickly increases the spatial diversity of the landscape during implementation of the management plan. It begins to implement an effective coarse filter in this time through an increase in large mature patch numbers. In the long term it implements an effective coarse filter by more than doubling the acres in this indicator. This alternative would maintain 50% of the upland acres and 35% of all lands in large mature upland patches (Table FSP-1). In the context

Table FSP-1. Indicator 1: Area and Number of Large Mature/Older Upland Forest Patches within the Chippewa National Forest for existing condition and decades 1, 2, 5, and 10 for each alternative.

	Alt. A No Action	Alt. B	Alt. C	Alt. D	Mod. E	Alt. F	Alt. G
Acres of Large Patches	Ac	Ac	Ac	Ac	Ac	Ac	Ac
Indicator Max. Potential	365400	365400	365400	365400	365400	365400	365400
Existing 2002	95600	95600	95600	95600		95600	95600
Existing 2004					89700		
Decade 1	58200	91700	59700	86100	82700	90200	81200
2	55300	115900	62900	110200	95200	110800	92900
5	52900	235000	76500	231700	122700	213000	160600
10	58800	230000	85700	288600	142200	205800	162000
Numbers of Large Patches	#	#	#	#	#	#	#
Indicator Max. Potential	210	210	210	210	210	210	210
Existing 2002	100	100	100	100		100	100
Existing 2004					92		
Decade 1	59	94	54	48	85	91	79
2	65	120	59	123	104	111	95
5	47	180	58	199	130	172	151
10	46	185	62	205	136	170	155

Source: Patch analysis based on existing data and harvest model output for decades 1,2,5,10 for Federal ownership only.
Definitions: A patch is defined as a contiguous grouping of similar vegetative conditions. Large patches are those 300 acres or larger. Mature or older forest is based on forest type groupings for the mature, old growth, and old growth/multi-aged habitat groupings. Potential large upland patches are defined as areas of contiguous forested upland Federal ownership regardless of age (fragmented by lowlands, non-forest, water, and non-federal ownership).
‡Notes: Chippewa NF: Total upland acres: 455,880 ac, Total federal ownership: 666,471 ac.

Table FSP-2. Indicator 1: Area and Number of Large Mature/Older Upland Forest Patches within the Superior National Forest for existing condition and decades 1, 2, 5, and 10 for each alternative.							
	Alt. A No Action	**Alt. B**	**Alt. C**	**Alt. D**	**Modified Alt. E**	**Alt. F**	**Alt. G**
Acres of Large Patches	Ac	Ac	Ac	Ac	Ac	Ac	Ac
Indicator Max. Potential	800900	800900	800900	800900	800900	800900	800900
Forest-wide Max. Potential	1493100	1493100	1493100	1493100	1493100	1493100	1493100
Existing 2002	305900	305900	305900	305900		305900	305900
Existing 2004					297300		
Forest-wide Existing	885500	885500	885500	885500	876900	885500	885500
Indicator Dec. 1	199500	275800	164200	260500	246500	255000	241900
Forest-wide 1	779100	855400	743800	840100	826100	834600	821500
Indicator Dec. 2	173900	303100	132200	286600	240100	250100	239500
Forest-wide 2	753500	882700	711800	866200	819700	829700	819100
Indicator Dec. 5	149000	490000	137400	514100	263000	350000	319400
Forest-wide 5	728600	1069600	717000	1093700	842600	929600	899000
Indicator Dec.10	172500	525800	178000	628100	341900	386900	338200
Forest-wide 10	752100	1105300	757600	1207700	921500	966500	917800
Numbers of Patches	#	#	#	#	#	#	#
Indicator Max. Potential	320	320	320	320	320	320	320
Forest-wide Max. Potential	344	344	344	344	344	344	344
Existing 2002	294	294	294	294		294	294
Existing 2004					298		
Forest-wide Existing	465	465	465	465	469	465	465
Indicator Dec. 1	207	267	179	273	248	259	255
Forest-wide 1	378	438	350	444	419	430	426
Indicator Dec. 2	186	271	153	276	249	253	251
Forest-wide 2	357	442	324	447	420	424	422
Indicator Dec. 5	179	337	170	353	279	307	274
Forest-wide 5	350	508	341	524	450	478	445
Indicator Dec.10	160	306	173	351	273	306	250
Forest-wide 10	331	477	344	522	444	477	421

Source: Patch analysis based on existing data and harvest model output for decades 1,2,5,10 for Federal ownership only. Indicator total is for the area outside the wilderness; Forest-wide totals include contribution of BWCAW.

Definitions: A patch is defined as a contiguous grouping of similar vegetative conditions. Large patches are those 300 acres or larger. Mature or older forest is based on forest type groupings for the mature, old growth, and old growth/multi-aged habitat groupings. Potential large upland patches are defined as areas of contiguous forested upland Federal ownership regardless of age (fragmented by lowlands, non-forest, water, and non-federal ownership).

‡Notes: Forest-wide total include wilderness and area outside the wilderness. Superior NF: Total upland acres: 1,666,569 (outside the wilderness 960,270 ac. 706,299 ac. within the wilderness) Total federal ownership: 2,171,660 acres. The contributions of the BWCAW are considered a constant. Future potential increases for this indicator are not projected for the wilderness. Consequently, forest wide totals may understate this indicator for future decades.

of a landscape highly interspersed with other ownerships, this alternative would compensate for high levels of fragmentation on other ownerships.

On the Superior, compared to other alternatives this alternative shows the smallest short-term decreases in the spatial diversity of the landscape during implementation of the management plan (Table FSP-2). It has the least short-term impact to the forest level coarse filter in this time by marginally decreasing indicator patch numbers. In the long term it implements an effective coarse filter through a 72% increase the indicator acres. This alternative would maintain 66% of the upland acres forest-wide in large mature upland patches. When examined as a whole, management area allocations adjacent to the BWCAW along with the BWCAW creates an extensive large patch matrix on the Superior in this alternative.

On the Chippewa the number and amount of this indicator would be greater in all decades than the amount existing today. In the short term, during the implementation period of the management plan, there would be a 21% increase in the indicator acres from existing condition. This is the largest short-term increase among all alternatives. Over the planning horizon this increases to as much as 146% in the fifth decade, to 141% in the tenth decade. In the tenth decade, 50% of the uplands would be within large mature forest patches versus 21% currently or 80% at a maximum. Forest-wide, inclusive of all federal land, large forest patches would increase from 14% of the land base to 35% in the fifth decade, compared to 55% at a maximum..

On the Superior, the number and amount of large upland mature forest patches would be marginally less in the short-term and significantly greater in the long-term than the amount existing today. During the implementation period of the management plan, there would be a 10% decrease in indicator acres from existing condition. Given that all alternatives project decreases in large mature forest patches during plan implementation, this alternative represents the smallest decrease among all alternatives. Over the planning horizon this increases 60% above existing in the fifth decade, to 72% above existing in the tenth decade. Forest-wide in the tenth decade, 66% of the uplands would be within large mature forest patches versus 53% currently or 90% at a maximum. Forest-wide, inclusive of all federal land, large forest patches would increase from 41% of the land base to 49% in the tenth decade, compared to 69% at a maximum.

Alternative C

On the Chippewa, this alternative causes a short-term and long-term decrease in this indicator. It maintains 40% fewer indicator patches than existing, and is among the lowest at representing large patches within the forest's capability among all alternatives. On the Superior, this alternative causes the greatest short-term decrease in indicator acres and patch numbers among all alternatives.

For both forests, this alternative decreases spatial diversity from current condition with a loss of large mature patches (Host and White, 2002) and a further shift towards a finer grained landscape. The decrease of spatial diversity through all decades examined limits the ability of an ecosystem coarse filter to effectively function compared to alternatives that maintain or increase spatial diversity. Coarse filter ecosystem processes (e.g. gap dynamics in forest stands) would be limited by the amount and intensity of forest management. This management scenario would require fine filter, site level protection for maintaining rare elements or mitigating impacts.

For both forests, patch configurations that may represent some desired condition consistent with this alternative's multiple use objectives were estimated for modeling purposes. Management direction would likely be developed to reflect these objectives and would be less than that proposed in the Plan.

On the Chippewa, this alternative causes a 34% decrease from current condition in indicator acres during the implementation period of the management plan (Table FSP-1). In the long term, this decrease is lessened but large mature patch acres are projected to remain below existing condition. Numbers of large mature forest patches decline, on average, 40% for all decades from existing condition. By the tenth decade about 19% of the upland area would be maintained in large mature patches versus 21% currently or 80% at a maximum. Forest-wide, inclusive of all federal land, large forest patches would decline from 14% of the land base to as low as 9% in the second decade, or compared to 55% at a maximum.

On the Superior, there is a 57% reduction in indicator acres in during the implementation period of the management plan and a 42% reduction from existing over the entire planning horizon. Forest-wide in the tenth decade, 45% of the uplands would be within large mature forest patches versus 53% currently or 90% at a maximum. Forest-wide, inclusive of all federal land, large forest patches would decline from 41% of the land base to as low as 33% in the fifth decade, compared to 69% at a maximum.

Alternative D

On the Chippewa, this alternative causes the greatest long-term increase in the number of indicator patches (105%) and indicator acres (200%). On the Superior, the number and amount of indicator patches would be less in the short-term and significantly greater in the long-term than the amount existing today. On both forests this alternative would maintain the largest percentage of upland acres in large mature patches of all alternatives in the long-term. In the context of a landscape highly interspersed with other ownerships, this alternative could compensate for fragmentation on other ownerships. When the Superior is examined as a whole, management area allocations adjacent to the BWCAW along with the BWCAW creates an extensive large patch matrix on the Superior in this alternative.

On the Chippewa, there would be more large mature forest patches and patch acres for all decades projected in this alternative. It begins to implement an effective coarse filter in the short term through an increase in large mature patch numbers. In the long term it implements an effective coarse filter by more than tripling the acres in large mature patches. By the tenth decade about 63% of the upland area would be maintained in large mature patches versus 21% currently or 80% at a maximum. Forest-wide, inclusive of all federal land, large forest patches would increase from 14% of the land base to 35% in the fifth decade, to 43% in the tenth decade, compared to 55% at a maximum.

On the Superior, during the implementation period of the management plan, there would be a 6% decrease in the acres in large mature forest patches from existing condition. This alternative shows a relatively small decrease compared to most other alternatives. Over the planning horizon this indicator increases to 68% over existing in the fifth decade, to 105% in the tenth decade. Forest-wide in the tenth decade, 66% of the uplands would be within large mature forest patches versus 53% currently or 90% at a maximum. Forest-wide, inclusive of all federal land, large forest patches would increase from 41% of the land base to 56% in the tenth decade, compared to 69% at a maximum.

Modified Alternative E

On the Chippewa, this alternative causes a decrease in indicator numbers and acres during the first decade of the plan. By the end of the second decade indicator numbers and acres are projected to exceed existing amounts. Extrapolation to the end of the implementation period (about 15 years) shows that it is likely that this indicator will be at or above existing conditions at that time. Standards and guides prevent decreases from going below set limits and by maintaining the largest spatial elements. The decrease of spatial diversity through the first decade limits the ability of an ecosystem coarse filter to effectively function compared to alternatives that maintain or increase spatial diversity. Coarse filter ecosystem processes (e.g. gap dynamics in forest stands) would be limited by the amount and intensity of forest management. In the long-term, spatial diversity would be marginally greater than exists today.

For the Superior, the assumption that standards and guides for vegetation spatial patterns would stem potential decreases in patch area and numbers projected by the harvest model has changed for Modified Alternative E in the Final EIS and Forest Plan with the changes to objective language from increasing large patch numbers, large patch acres, and interior forest condition forest-wide to apply only to Spatial Zones 1 and 2. Harvest modeling predicts that these indicators will decrease in Spatial Zone 3 when forest composition and age objectives are met in this area of the Superior National Forest. Since there are no spatial zone-specific standards and guides for this area and an objective to strive to minimize decreases in this indicator, it is likely that these decreases will be realized on the landscape. In the zone concept this effect is viewed in the context of what the BWCAW provides in proximity to Zone 3. The BWCAW will continue to influence forest spatial patterns in Spatial Zone 3, however it is likely that there will be less connectivity of habitats (Mladenoff et al. 1993) between those found in the BWCAW and those found in Spatial Zones 1 and 2 as a result of meeting forest vegetation composition and age objectives in Spatial Zone 3. Large mature or older upland forest patches can be viewed as an indicator of landscape connectivity. Site specific analysis could consider the issue of connectivity and, through thoughtful management, could mitigate impacts to connectivity in Zone 3.

Overall, the area within Spatial Zones 1 and 2 compared to the total Forest acreage (both outside and within the BWCAW) on the Superior decreased from 36% of the forest to 30% of the forest with the adjustments of Spatial Zone boundaries from the draft EIS to the final EIS. Correspondingly, the area of existing 300 acre or larger patches covered by objectives to increase these spatial elements or standards and guides that limit decreases in these spatial elements would be decreased.

On the Superior with spatial modeling, this alternative maintains fewer large mature patch acres than existing in the short-term and through at least the 5th decade forest-wide. By the 10th decade amounts are predicted to exceed existing amounts. Until the 10th decade spatial diversity outside the BWCAW would be less than exists today. While the restated objectives for Spatial Zones 1 and 2 are to maintain or increase large mature/older upland patches, this indicator is predicted to decrease in decades 1 and 2. Project level management decisions would need to effectively cluster harvests and look for efficiencies in meeting multiple coarse filter objectives including those that that compel disturbance in forest cover, those for forest type composition, and those for forest spatial patterns. A decrease of spatial diversity would cause a shift towards a finer grained landscape outside the wilderness.

Management direction to meet LE based vegetation objectives for forest composition and age for the Chippewa in the Forest Plan would cause a decrease in large mature upland forest patches in the first decade. The full amount of this decrease would be stemmed by the spatial management guideline maintain at least 85,000 acres in this indicator. By the mid-point of the second decade, this indicator is projected to be at or above current existing amounts. Spatial arrangement of harvests (projected by spatial modeling) and emphasizing retaining existing large mature/older upland forest patches appears to be a successful strategy for increasing spatial diversity on the Chippewa while also meeting other objectives. Management direction for the Superior would not eliminate the projected decreases outside the wilderness, but it works towards maintaining the ecosystem representation and distribution of large mature upland forest patches not proximate to the BWCAW. During the first 2 decades of the Plan, fine filter, site level protections are needed in addition to this coarse filter matrix for maintaining rare ecosystem elements or mitigating impacts.

On the Chippewa, there is a 6% increase in indicator acres during the first 2 decades of the management plan. Patch numbers increase by 13% in the short-term. In the long-term there is an increase in indicator acres (59%) and patch number (48%). By the tenth decade about 31% of the upland area would be maintained in large mature patches versus 20% currently or 80% at a maximum. Forest-wide, inclusive of all federal land, large forest patches would decline from 13.5% of the land base to as low as 12% in the first decade. A forest-wide standard would prevent the decrease from exceeding 13% (85,000 acres) of the land base. By the fifth decade18% of the land base would be in large patches.

On the Superior, there is a 19% decrease in acres within large mature forest patches during the first 2 decades of the management plan. Patch numbers decrease by 16% in the short-term and in the long-term there would be 8% fewer acres in large mature forest patches than existing. In the tenth decade, 55% of the uplands forest-wide would be within large mature forest patches versus 53% currently or 90% at a maximum. Standards and guides for Spatial Zones 1 and 2 would limit, but not eliminate, the decreases predicted in first and second decades of implementation for those spatial zones. Despite objectives to maintain or increase acres in large mature/older upland patches, there would be as much as a 29% decrease in patch acres in Spatial Zone 1 in Decade 1 and a 4% decrease in Spatial Zone 2 in Decade 1. In Spatial Zone 3 by the end of the second decade there would be 27% fewer acres within large mature/older upland forest patches. Modeling rules for succession cause these potential decreases to be somewhat overestimated. Decisions made during implementation have the potential to eliminate or limit projected decreases by clustering of harvests or other management efficiencies. Conditions will be monitored to determine if spatial objectives along with other multiple use objectives can be met during implementation of the plan.

Alternative F

On the Chippewa, this alternative increases the amount and number of large mature forest patches during the first 2 decades of the management plan. There is a corresponding increase in spatial diversity of the landscape during this time. It begins to implement an effective coarse filter in this time through an increase in large mature patch numbers. In the long term it implements an effective coarse filter by more than doubling the acres in large mature patches. This alternative would maintain 45% of the upland acres and 31% of all lands in large mature upland patches. In the context of a landscape highly interspersed with other ownerships, this alternative would compensate to some degree for high levels of fragmentation on other ownerships.

On the Superior, this alternative causes decreases in the spatial diversity of the landscape by decreasing indicator acres during the implementation period of the management plan. In the long-term, this alternative increases spatial diversity over what exists today. This alternative would maintain 40% of the upland acres in large mature upland patches.

For the Chippewa, minimum standards for forest patches proposed in the Plan would be exceeded in all decades. For the Superior minimum standards may be approached in some zones and, because of projected decreases, fine filter site level protections are needed during the implementation period of the Plan in addition to this coarse filter matrix for maintaining rare ecosystem elements or mitigating impacts.

On the Chippewa the number and amount of indicator patches would be greater in the second decade and beyond than the amount existing today. Projected decreases in the first decade are due, in part, to succession rules in the harvest model. Effects are likely not as great as projected by the model. The vegetation composition and age objectives for this alternative closely mimic the range of natural variation for landscape ecosystems in the Drift and Lake Plains Ecological Section. In the short term, during the second decade of the management plan, there would be a 15% increase in the acres in large mature forest patches from existing condition. This short-term increase is the same as Alternative D. Over the planning horizon this increases to as much as 123% in the fifth decade, to 115% in the tenth decade from existing indicator levels. In the tenth decade, 45% of the uplands would be within large mature forest patches versus 21% currently or 80% at a maximum. Forest-wide, inclusive of all federal land, large forest patches would increase from 14% of the land base to 17% in the second decade, to 32% in the fifth decade, compared to 55% at a maximum.

On the Superior, during the implementation period of the management plan, there would be an 18% decrease in indicator acres from existing condition. Most of this decrease would occur in the first decade. Over the planning horizon this alternative increases this indicator to 14% over existing in the fifth decade, to 26% over existing in the tenth decade. In the tenth decade, 58% of the uplands forest-wide would be within large mature forest patches versus 53% currently or 90% at a maximum. In the long term it implements a coarse filter that is marginally better than exists today. Forest-wide, inclusive of all federal land, large forest patches would increase from 41% of the land base to 43% in the fifth decade and 45 % in the tenth decade, compared to 69% at a maximum.

Alternative G

On the Chippewa, this alternative causes a short-term decrease in numbers and acres in this indicator, mostly occurring during the first decade. The projected decrease of spatial diversity during the first 2 decades of the plan limits the ability of an ecosystem coarse filter to effectively function compared to alternatives that maintain or increase spatial diversity. Coarse filter ecosystem processes (e.g. gap dynamics in forest stands) would be limited to a degree by the amount and intensity of forest management. This is mitigated to a degree with minimum standards and guides. In the long term it implements an effective coarse filter by significantly increasing spatial diversity. This alternative would maintain 36% of the upland acres and 24% of all lands in large mature upland patches.

On the Superior, in the short-term, this alternative significantly decreases numbers and acres in large mature forest patches. The decrease of spatial diversity through all decades examined limits the ability of an ecosystem coarse filter to effectively function compared to alternatives that maintain or increase spatial diversity. Coarse filter ecosystem processes (e.g. gap dynamics in forest stands) would be limited to a degree by the amount and intensity of forest management. This is mitigated to a degree by standards and guides within spatial zones and relies on the contribution of the BWCAW to spatial patterns on the forest adjacent to the wilderness to mitigate harvest effects. In the long term it implements a coarse filter that is about equivalent to what exists today. This alternative would eventually maintain 35% of the upland acres in large mature upland patches.

For both forests, minimum standards for forest patches proposed in the Plan would be exceeded in all decades. But, because of projected decreases during the implementation period of the Plan, fine filter site level protections are needed in addition to this coarse filter matrix for maintaining rare ecosystem elements or mitigating impacts.

On the Chippewa, there is a 15% decrease in indicator acres during the implementation of the management plan. Patch numbers could decrease by 21% in the first decade. Projected decreases in the first decade would be stemmed by minimum standards and guides to maintain at least 85,000 acres in large mature upland patches and to maintain all patches greater than 1000 acres. In the long-term there is a significant increase (69%) from existing condition in indicator acres and a 55% increase in indicator numbers by the tenth decade. By the tenth decade about 36% of the upland area would be maintained in large mature patches versus 21% currently or 80% at a maximum. Forest-wide, inclusive of all federal land, large forest patches would increase from 14% of the land base to 24% in the fifth decade and tenth decades, compared to 55% at a maximum.

On the Superior, during the implementation period of the management plan, there would be a 22% decrease in indicator acres from existing condition. Decreases in spatial zones 1 and 2 would be limited by minimum standards and guides. Over the planning horizon this alternative increases this indicator to 4% over existing in the fifth decade, to 11% over existing condition in the tenth decade. In the tenth decade, 54% of the uplands forest-wide would be within large mature forest patches versus 53% currently or 90% at a maximum. Forest-wide, inclusive of all federal land, large forest patches would be maintained at existing levels (41%) in the fifth decade and slightly increase to 42 % in the tenth decade, compared to 69% at a maximum.

Indicator 2: Size, Amount, and Distribution of Large Young Forest Patches

Alternative A and C

On both the Chippewa and Superior, these alternatives produce the highest number of large young forest patches (Table FSP-3) compared to all other alternatives.

On the Chippewa, these alternatives are similar in the number and amount of large young patches they produce, largely reflecting the relatively high harvest intensity per decade projected by vegetation age and composition objectives. Young forest patches are not spatially aggregated on the landscape and, with high harvest levels, produce a fine grained less spatially diverse landscape.

On the Superior, in the short-term, Alternative C produces large young upland patches at about the rate as is currently being produced while Alternative A produces large young upland patches at about half the rate of Alternative C and the current rate. In the long term, Alternatives A and C are similar in the number and amount of large young patches they produce, reflecting the relatively high harvest intensity per decade projected by vegetation age and composition objectives.

For Alternative A, model projections may provide an estimate of amounts of young forest but standards and guides would limit young patch size to 40 acres on the Chippewa and 200 acres on the Superior.

For Alternative C, for both forests, management direction for forest spatial patterns has the potential to aggregate harvest activity to increase acres and number of patches of temporary openings up to and including 1,000 acres. This would help to maintain or increase spatial diversity but in the context of a forest matrix that is less diverse with regard to age and trees species composition due to short rotations and emphasis on early successional species.

These alternatives produce as many as six to seven large young patches per decade each and as many as

3600 acres on the Chippewa and as many as 63 large young patches and 27,500 acres on the Superior (Table FSP-3). Potentially, these alternatives could begin to produce large mature forest patches over time through the production of aggregated large young patches. This is especially true on the Superior for Alternative C in the first 2 decades (Table FSP-3). Alternative A would be limited by size limits on harvest size. Base rates of disturbance within the wilderness on the Superior would produce over 14,000 acres of young forest though patch sizes are not predicted.

However, analysis of large mature forest patches (Forest Spatial Patterns indicator 1) shows these alternatives to maintain the fewest acres and number of large mature forest patches of all alternatives in the short term and the long term. Therefore, there is an overall loss of spatial diversity and an increase of fragmentation from current levels.

Alternatives B, Modified E, F, and G

With the exception of Modified Alternative E on the Superior, generally few large young forest patches are produced in these alternatives over the planning horizon (Table FSP-3). On the Superior, Modified Alternative E produces large young forest patches at a rate at least twice that of Alternatives B,F, or G. For both forests, objectives for forest spatial patterns have the potential to aggregate harvest activity to increase acres and number of patches of temporary openings up to 1,000 acres. This is variable among these alternatives and Forests, and would need to fit within the context of the amount young forest projected in a given decade for that alternative and other multiple use objectives. Indicator levels between decades should be considered relative to rates of disturbance in each alternative, though through aggregation of harvest greater numbers of large patches could result.

On the Chippewa, these alternatives produce large young patches at a similar rate over the first 2 decades of the management plan. Alternatives B, F, and G predict that only one large young patch will be produced in the second decade, while Alternative E predicts that 3 will be produced. Over the 10 decade planning horizon Alternatives E and G produce 7 and 6 large young patches respectively. On the Superior, Alternatives E,F, and G produce between 4 and 28 large young patches per decades presented.
Alternative E produces more than two times the acres in large young patches over the planning horizon (Table FSP-3) than Alternatives F or G. The rate at which large young patches are produced is tied closely to the rate of forest harvest that each alternative attempts to achieve and the age and composition objectives they attempt to meet. Base rates of disturbance within the wilderness would produce over 14,000 acres of young forest, though patch sizes are not predicted.

Alternative D

On the Chippewa, Alternative D produces no large young forest patches over the 10 decade planning horizon (Table FSP-3) as a result of vegetation age and composition objectives that emphasize older and later successional forest. Management disturbance is generally at a scale that would not generate large temporary openings.

On the Superior, over all decades, this alternative produces large young forest patches at the lowest rate among all alternatives. Over the first 2 decades of the management plan, large young forest patches are produced at a similar rate as Alternative B. This is largely due to restoration activities that change the age of forest stands. Base rates of disturbance within the wilderness would produce over 14,000 acres of young forest, though patch sizes are not predicted.

Indicator 3 - Amount of Forest Interior Habitat

Alternative A

On the Chippewa, this alternative, on average, causes over a 30% loss of interior forest habitat over the short-term and the long-term (Table FSP-4). It maintains the least amount of interior forest of any alternative. This reduction in patch quality indicates a shift towards a more fragmented landscape with fewer patches that contain interior mature forest habitat. This alternative maintains 17% of the potential interior forest habitat compared to 25% under existing conditions.

Table FSP-3. Indicator 2: Area (Number) of Large Young Upland Forest Patches within the Chippewa and Superior National Forests for existing condition and decades 1, 2, 5, and 10 for each alternative.

National Forest	Alt. A No Action	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G
	Ac (#)	Ac (#)	Ac (#)	Ac (#)	Ac (#)	Ac (#)	Ac (#)
Chippewa							
Existing 2002	1300 (1)	1300 (1)	1300 (1)	1300 (1)		1300 (1)	1300 (1)
Existing 2004					2760 (4)		
Decade 1	3,100 (7)	0	9,500 (21)	400 (1)	390 (1)	400 (1)	800 (2)
2	2,800 (6)	300 (1)	3,600 (7)	0	1200 (3)	300 (1)	300 (1)
5	800 (2)	300 (1)	600 (1)	0	1200 (3)	0	400 (1)
10	2,400 (5)	0	1,700 (3)	0	0	0	900 (2)
Superior							
Existing 2002	30000 (43)	30000 (43)	30000 (43)	30000 (43)		30000 (43)	30000 (43)
Existing 2004					26900 (38)		
Forest-wide Existing	95500	95500	95500	95500	92400	95500	95500
Decade 1	13800 (33)	1000 (3)	27500 (63)	2800 (6)	6900 (17)	2300 (6)	1400 (4)
2	14300 (35)	2800 (6)	21800 (49)	1500 (3)	11700 (28)	5000 (12)	4800 (11)
5	15200 (27)	1700 (4)	14600 (26)	0	11800 (26)	5200 (7)	7800 (15)
10	17400 (33)	1600 (4)	16500 (31)	600 (1)	7700 (18)	6400 (11)	4700 (11)

Source: Patch analysis based on existing data and harvest model output for decades 1,2,5,10 for Federal ownership only. Superior forest-wide existing total includes BWCAW.
Definitions: A patch is defined as a contiguous grouping of similar vegetative conditions. Large patches are combinations of contiguous forest stands 300 acres or larger. Young forest is defined as forest cover aged 0-9 yrs.
‡Notes: Chippewa NF:Total upland acres: 455,880 ac, Total federal ownership: 666,471 ac, Superior NF: Total upland acres: 1,666,569 (outside the wilderness 960,270 ac. 706,299 ac. within the wilderness) Total federal ownership: 2,171,660 acres.

On the Superior, this alternative is among the lowest at maintaining interior forest over the short-term and the long-term. There is as much as a 41% decrease from existing conditions. This alternative maintains 22% of the potential interior forest habitat compared to 34% under existing conditions. This reduction in patch quality indicates a shift towards a more fragmented landscape with fewer patches that contain interior mature forest habitat.

On both forests the projected decrease of interior forest during the planning horizon limits the ability of an ecosystem coarse filter to effectively function compared to alternatives that maintain or increase spatial diversity by increasing interior forest. These effects may be further demonstrated by additional declines in populations of some ground nesting birds in northern Minnesota (Hanowski et al.) or other edge effects including increased tree mortality due to wind throw, reduced recruitment of moisture-limited species, or limitations on dispersal of insects or herpetofauna (Chen et al. 1999, Matlack 1993). These effects are likely to be among the highest in this alternative compared to other management scenarios. It is unlikely that the management objective to increase interior forest can be met while achieving age and composition objectives of this alternative.

Alternative B

On the Chippewa, this alternative results in a net short-term and a long-term increase, with 124 % more of this indicator than currently exists and 57% of the potential interior forest habitat (Table FSP-4). This alternative is among the highest at producing interior forest. In the context of a landscape highly interspersed with other ownerships, this alternative could compensate for losses of interior forest habitat on other ownerships.

On the Superior, this alternative is among the highest at maintaining interior forest over the short-term and the long-term. In the short-term there is a slight net increase from existing conditions and a 78% increase over the long-term. This alternative maintains 61% of the potential interior forest habitat compared to 34% under existing conditions. This alternative could compensate for losses of interior forest habitat on other ownerships and, where large forest patches join with the BWCAW, would form an extensive coarse filter.

The management objective to increase interior forest would be met along with the age and composition objectives of this alternative on both forests.

On the Chippewa, this alternative causes a 2% decrease in interior forest in the first decade of the management plan (FSP-4). However, by the end of the second decade there would be 17% more interior forest than exists currently. It begins a trend towards implementing an effective coarse filter by the end of the second decade through an increase in interior forest. This alternative maintains 57% of the potential interior forest habitat compared to 25% under existing conditions. The 124% increase in interior forest by the 10^{th} decade indicates that this alternative implements a more effective coarse filter than currently exists.

On the Superior, this alternative causes an 8% decrease in the first decade (FSP-4) but increases interior forest by 1% by the end of the implementation period. This alternative maintains 34% of the potential interior forest or about the same as existing condition. The 78% increase in interior forest by the 10^{th} decade is among the highest of all alternatives.

Alternative C

On the Chippewa, this alternative causes a 30% decrease in this indicator during the first 2 decades for the management plan (Table FSP-4). Losses of interior forest habitat are not recouped to current levels until the tenth decade of the planning horizon. This alternative maintains 26% of the potential interior forest habitat compared to 25% under existing conditions.

On the Superior, this alternative is the lowest at maintaining interior forest over the short-term and the long-term. There is a 50% reduction from existing in this indicator and a 34% reduction in the long-term. This alternative maintains 17% of the potential interior forest habitat compared to 34% under existing conditions. This loss of patch quality indicates a shift towards a more highly fragmented landscape with fewer patches that contain interior mature forest habitat.

On both forests the projected decrease of interior forest during the planning horizon limits the ability of an ecosystem coarse filter to effectively function compared to alternatives that maintain or increase spatial diversity by increasing interior forest. These effects may be further demonstrated by additional declines in populations of some ground nesting birds in northern Minnesota (Hanowski et al.) or other edge effects including increased tree mortality due to wind throw, reduced recruitment of moisture-limited species, or limitations on dispersal of insects or herpetofauna (Chen et al. 1999, Matlack 1993). These effects are likely to be among the highest in this alternative compared to other management scenarios. It is unlikely that the management objective to increase interior forest can be met while achieving age and composition objectives of this alternative.

Alternative D

On the Chippewa, this alternative results in a net short-term and a long-term increase to 184% more interior forest than currently exists (Table FSP-4). There would be more interior forest under this alternative than any other alternative. In the context of a landscape highly interspersed with other ownerships, this alternative would compensate for losses of interior forest habitat on other ownerships. This alternative maintains 72% of the potential interior forest habitat compared to 25% under existing conditions.

On the Superior, this alternative results in a slight short-term decrease in interior forest than exists currently. The decrease in this indicator may be due partially to the effect of succession modeling rules that may over-predict a change to a younger forest condition and, therefore, to patches that contain interior forest. In the long-term this alternative causes the greatest increase (117%) in interior forest among all alternatives. This alternative maintains 74% of the potential interior forest habitat compared to 25% under existing conditions.

Through an increase in interior forest this alternative begins a trend towards implementing a more effective coarse filter than existing by the end of the second decade on the Superior. The management objective to increase interior forest would be met with the age and composition objectives of this alternative on both forests.

Modified Alternative E

On the Chippewa, this alternative causes an increase of interior forest habitat in the first 2 decades and in the long term. (Table FSP-4). This alternative would have a slight increase (less than 1%) and a 14% increase in interior forest in the first and second decades, respectively, than currently exists. There is a gradual increasing trend of interior forest through Decade 10. At that point there would be about 74% more interior forest than currently exists. In the long-term there is a 36% increase of interior forest over current conditions. This alternative maintains 42% of the potential interior forest habitat in the long-term compared to 25% under existing conditions. The management objective to maintain or increase interior forest would require a specific effort at the project level in order to be met along with the vegetation age and composition objectives of this alternative during the implementation period of the Plan. Spatial modeling projects that it is <u>likely</u> that the combination of interior forest, vegetation age, and vegetation composition objectives could be met.

On the Superior, this alternative causes a decline of 9% in the first and second decades in interior forest from existing condition. A 27% increase in interior forest habitat would be realized in the long-term. The projected decrease of interior forest during the first and second decades would be most pronounced in Spatial Zone 3 where there would be as much as a 17% decrease in interior forest by decade 2. Despite management direction to maintain or increase interior forest in Spatial Zones 1 and 2, there is projected to be a 6% decrease in interior forest in these zones in decade 1. Limitations on the ability of an ecosystem coarse filter to effectively function are likely to be differential by Spatial Zone. The greatest impacts to spatial diversity would be observed in Spatial Zone 3. These effects may be further demonstrated by additional declines in populations of some ground nesting birds in northern Minnesota (Hanowski et al.) or other edge effects (Chen et al. 1999, Matlack 1993) primarily in Spatial Zone 3. By Decade 10 this alternative maintains 41% of the potential interior forest habitat compared to 33% under existing conditions. The management objective to maintain or increase interior forest in Spatial Zones 1 and 2 would require a specific effort at the project level in order to be met along with the vegetation age and composition objectives of this alternative during the implementation period of the Plan.

Alternative F

On the Chippewa, this alternative results in a net short-term and a long-term increase to 108 % more interior forest than currently exists (Table FSP-4). This alternative causes a 3% decrease in interior forest in the first decade of the management plan. However, by the end of the second decade there would be 14% more interior forest than exists currently. This alternative is among the highest at producing interior forest than currently exists. This alternative maintains 53% of the potential interior forest habitat compared to 25% under existing conditions. The management objective to increase interior forest would require a specific effort at the project level in order to be met along with the vegetation age and composition objectives of this alternative during the implementation period of the Plan

On the Superior, this alternative causes a decline of 13% in the short-term and a 31% increase in the long-term of interior forest habitat. In the long-term this alternative significantly improves interior forest habitat. This alternative would maintain 45% of the potential interior forest habitat in the long-term compared to 34% under existing conditions. The management objective to increase interior forest would require a specific effort at the project level in order to be met along with the vegetation age and composition objectives of this alternative during the implementation period of the Plan.

Alternative G

On the Chippewa, this alternative results in a 10% decrease in interior forest in the first decade and a marginal (2%) net short-term increase in interior forest habitat during implementation of the management plan than exists currently (Table FSP-4). In the long-term, there would be 65% more interior forest than currently exists. This alternative makes long-term improvements in the effectiveness of the coarse filter over current conditions. This alternative maintains 42% of the potential interior forest habitat compared to 25% under existing conditions. The management objective to increase interior forest would require a specific effort at the project level in order to be met along with the vegetation age and composition objectives of this alternative during the implementation period of the Plan

On the Superior, this alternative causes a decline of 19% in the short-term and a 9% increase in the long-term of interior forest habitat. In the long-term this alternative marginally improves interior forest habitat. This alternative would maintain 37% of the potential interior forest habitat in the long-term compared to 34% under existing conditions. The management objective to increase interior forest would require a specific effort at the project level in order to be met along with the vegetation age and composition objectives of this alternative during the implementation period of the Plan.

Indicator 4:Management Induced Edge Density

Alternative A and C

On the Chippewa, these alternatives increase management induced edge density on the uplands and the lowlands in the short-term and in the long-term (Table FSP- 5). This reflects the increased harvest levels projected in these alternatives, decrease in large mature forest patches, and decrease in interior forest. In the short-term Upland Young edge density increases 11% under Alternative A and 18% in Alternative C. In the long-term, Alternative A increases to 33% more than exists today while Alternative C increase to 23% more. On the lowland forest (lowland conifer), in the short-term there is a 440% increase in Lowland Young edge density in Alternative A and a 521% increase in Lowland Young edge density in Alternative C. In the long-term Alternative A eventually has 30% less edge than exists today. Alternative C reduces management intensity in lowlands through time but still results in 203% more edge than exists today.

On the Superior uplands, these alternatives increase edge in the short-term and the long-term at a similar rate. Alternative C has greater increases in the short-term (25%), while Alternative A increases edge 29% over existing. On lowland forest (lowland conifer), Alternative C increase young forest edge 651% in the short-term.. Alternative A shows a 214% increase in the short-term.

The increases in upland edge reflect a further shift similar to recent trends (Wolter and White 2002) to a finer grained landscape with increased fragmentation, a decrease of spatial diversity, a loss of larger forest stands, and high rates of disturbance through forest harvest.

The increases in lowland edge on both forests under these alternatives are indicative of greatly increased edge effects including physical changes of forested sites adjacent to edges, hydrological changes of sites that may influence reforestation, and vegetative changes that may affect rare species (Planning Record, Biological Evaluation, Chen et al. 1999, Matlack 1993).

Alternatives B, D , and F

On the Chippewa, these alternatives project similar

Table FSP-4 Indicator 3: Total Area of Interior Forest within Mature or Older Upland Forest Patches within the Chippewa and Superior National Forests for existing condition and decades 1, 2, 5, and 10 for each alternative.

National Forest	Alt. A No Action	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G
	Ac	Ac	Ac	Ac	Ac	Ac	Ac
Chippewa							
Existing 2002	43,900	43,900	43,900	43,900		43,900	43,900
Existing 2004					42500		
Decade 1	30,400	43,100	29,200	40,700	42700	42,600	39,600
2	29,200	51,400	30,800	49,500	48700	50,200	44,600
5	28,500	102,300	40,000	100,500	63000	95,900	70,800
10	32,000	98,300	45,400	124,500	73900	91,300	72,300
Indicator Max. Potential	172700	172700	172700	172700	172700	172700	172700
Superior							
Existing 2002	147,700	147,700	147,700	147,700		147,700	147,700
Existing 2004					141400		
Decade 1	103,500	136,100	88,100	130,800	128800	129,200	121,200
2	93,100	149,600	74,500	144,200	128400	128,700	120,300
5	87,200	245,900	79,900	260,800	140900	177,300	159,000
10	94,400	263,600	97,900	321,000	179200	194,000	160,300
Indicator Max. Potential	434600	434600	434600	434600	434600	434600	434600

Source: Based on buffering patches of Mature/older upland forest patches 100 m. in from the patch edge for existing condition and patches predicted for future decades 1,2,5,10 for Federal ownership only. For Superior NF interior forest was calculated for upland mature or older forest patches outside of wilderness.
Definitions: Interior forest area is measured by determining the amount of forest that is beyond a certain distance (in this case 100 m. inward) from the forest patch edge. Potential interior forest is calculated by buffering inherent upland patches (Appendix B: Spatial Analysis) 100 m. inward.
‡Notes:

decreases in Upland Young management induced edge from existing condition in the short-term (Table FSP-5). In the long-term Alternatives F,B, and D, in this order, produce decreasing amounts of edge. At most, Alternative F produces 50% of the Upland Young edge density than currently exists. This indicates a decrease in the effects related to management induced edge, an increase in spatial diversity, and an increase forest stand size.

In Alternatives B and F Lowland Young edge density increases from 160% to 300% from existing, depending on the decade. Alternative D produces less than half the Lowland Young edge density than exists for all decades. Alternative D is the only alternative that produces less Lowland Young edge density than currently exists.

On the Superior, Alternatives B and D project similar short-term decreases in Upland Young edge density from existing condition. Edge density is reduced 56% during the implementation period of the management plan. Over the long-term Alternative D shows a greater decrease in edge density than Alternative B at 79% and 46% respectively. Alternative F reduces edge density 27% in the short-term and 17% in the long-term. This indicates a decrease in the effects related to management induced edge, an increase in spatial diversity, and an increase forest stand size.

Edge density of Lowland Young forest on the Superior shows similar increases as on the Chippewa. Edge density of Lowland Young is greater in all decades than currently exists. Alternative F projects as much as 112% more Lowland Young edge density than exists. Alternative B projects as much as 82% more Lowland Young edge density than exists. Alternative D produces no Lowland Young edge in the long-term. This alternative is the only one that produces less Lowland Young edge density than currently exists for all decades.

The increases in lowland edge on both forests under Alternatives B and F are indicative of greatly increased edge effects including physical changes of forested sites adjacent to edges, hydrological changes of sites that may influence reforestation, and vegetative changes that may affect rare species (Planning Record, Biological Evaluation, Chen et al. 1999, Matlack 1993).

Modified Alternative E

On the Chippewa, Young Upland edge is maintained at 77% to 82% of current levels in the short and long-term (Table FSP-5). Edge effects would be reduced from existing condition on Upland Forest.

On the Superior, Young Upland edge is maintained at 86% of current levels in the short and long-term. Aggregation of harvests and efforts at maintaining or increasing large mature/older upland patches or interior forest in Spatial Zones 1 and 2 would reduce edge density and edge effects from existing conditions (reflected in this indicator for the Superior). In Spatial Zone 3 edge effects are likely to be maintained or to increase over existing levels due to different objectives for this area.

In Lowland Forest on the Chippewa Lowland Young edge density increases 308% in the short-term and 166% in the long-term.

In Lowland Forest on the Superior, this alternative increases edge 200% in the short-term and 150% in the long-term over existing condition.

The increases in lowland edge on both forests under Alternative E is indicative of greatly increased edge effects including physical changes of forested sites adjacent to edges, hydrological changes of sites that may influence reforestation, and vegetative changes that may affect rare species (Planning Record, Biological Evaluation, Chen et al. 1999, Matlack 1993).

Alternative G

On the Chippewa, Young Upland edge is maintained at about 63% of current levels in the short and long-term (Table FSP-5). Edge effects would be significantly reduced from existing condition on Upland Forest.

On the Superior, Young Upland edge decreases to 84% of current levels in the short term, to 78% and 94% of current levels in the long-term. Over the long term upland edge amounts appear to fluctuate below that of current levels.

Reductions of Young Upland edge on both forests in this alternative reflect the reduced amount of even-aged harvest projected.

In Lowland Forest on the Chippewa Lowland Young edge density increases 233% in the short-term and 144% in the long-term from existing condition. In Lowland Forest on the Superior, this alternative increases edge 38% in the short-term and 46% in the long-term over existing condition.

The increases in lowland edge on both forests under this alternative are indicative of greatly increased edge effects including physical changes of forested sites adjacent to edges, hydrological changes of sites that may influence reforestation, and vegetative changes that may affect rare species (Planning Record, Biological Evaluation, Chen et al. 1999, Matlack 1993).

Cumulative Effects

The discussion of cumulative effects to forest spatial patterns is closely tied to the cumulative effects to Forest Vegetation (section 3.2.1d). Each of the alternatives implements differing coarse filter strategies that produce varying spatial patterns and qualities of forest patches over time. The cumulative effects to forest spatial patterns are conducted within the relevant ecological Section. This is the Northern Minnesota Drift and Lake Plains (DLP) Section for the Chippewa, and the Northern Superior Uplands (NSU) Section for the Superior. The ecological Section is an appropriate scale for characterizing and considering the forest spatial patterns that occurred on landscape ecosystems operating within the range of natural variability (RNV). Considering disturbance processes and resulting spatial patterns at this scale provides important insights for evaluating the effectiveness of coarse filter strategies to ensure long-term ecological sustainability and inherent biological diversity.

Landscape Assessment committees for both the North Central Landscape (DLP Ecological Section) and the Northeast Landscape (NSU Ecological Section) established desired conditions that will affect forest vegetation and spatial patterns in the near future and beyond. These desired conditions include spatial patterns that are consistent with the ecology of NE Minnesota for the NSU and patch sizes that more closely resemble natural patterns and functions within [the] landscape for the DLP. These are outlined in more detail in Appendix H.

Landowners may adjust their management to account for, compliment and/or compensate for management by other landowners in order for all to work toward the overall vision.

Host and White (2002, 2003) and Wolter and White (2002) examined changes over different time periods in forest landscape structure using Landsat TM data and other information (i.e. aerial photos). Host and White (2003) examined recent historic trends (1930's, 1970's, 1990's) in forest spatial patterns with the DLP and NSU sections. Wolter and White (2002) examined changes during a five-year period from 1990-1995 for an area that encompasses the Superior NF including the BWCAW. These works provide trend information during those time periods and define current spatial patterns for the landscape inclusive of all ownerships. The percent ownership of the DLP Section and the NSU Section, by Landscape Ecosystem, is provided in Appendix G.

For purposes of this analysis, the effect of National Forest-wide vegetation management strategies (e.g. alternatives) on forest spatial patterns are compared to the existing conditions and trends on all forested lands within the appropriate ecological Section. The information can be used to evaluate how individual alternatives for National Forest lands contribute to the overall conditions across the ecological Section.

Northern Minnesota Drift and Lake Plains (DLP) Section

The Chippewa National Forest manages approximately 8% of the forested lands in this ecological Section. This percentage varies among the Landscape Ecosystems (LE), and ranges from a low of 3% of the Dry Pine LE to a high of 30% of the Mesic Northern Hardwoods LE. Refer to Appendix B for a complete breakdown of land ownership by landscape ecosystem within the DLP.

Table FSP-5. Indicator 4: Management Induced Edge Density (mi/mi^2) of Young Upland (UY) and Lowland Young (LY) Forest within the Chippewa and Superior National Forests for existing condition and decades 2, 5, and 10 for each alternative.

National Forest	Alt. A No Action		Alt. B		Alt. C		Alt. D		Modified Alt. E		Alt. F		Alt. G	
	UY	LY	UY	LY	UY	LY	UY	LY	UY	LY	UY	LY	UY	LY
Chippewa														
Existing 2002	2.4	.14	2.4	.14	2.4	.14	2.4	.14			2.4	.14	2.4	.14
Existing 2004									2.2	.12				
Decade 2	2.7	.77	.85	.30	2.9	.87	.87	.03	1.7	.37	1.0	.42	1.5	.33
5	3.2	.20	.78	.25	2.5	.11	.48	.06	1.8	.28	.89	.33	1.4	.28
10	3.2	.10	.87	.23	3.0	.42	.47	.03	1.7	.20	1.2	.29	1.6	.20
Superior														
Existing 2002	2.1	0.2	2.1	0.2	2.1	0.2	2.1	0.2			2.1	0.2	2.1	0.2
Existing 2004									2.1	0.2				
Decade 2	2.4	0.6	0.9	0.3	2.6	1.4	0.9	.01	1.8	0.4	1.5	0.4	1.7	0.3
5	2.7	0.4	0.9	0.4	2.7	0.3	0.5	0	1.8	0.3	1.3	0.4	1.6	0.3
10	2.7	.08	1.1	0.3	2.6	0.3	0.4	0	1.8	0.3	1.7	0.4	2.0	0.3

Source: Determined by calculating the amount of edge contributed by Upland and Lowland Young Forest per square mile between the generalized cover types of Non-forest, Non-Federal, Upland and Lowland mature/older Forest, Upland and Lowland sapling/pole Forest, and Young Upland and Young Lowland Forest for existing data and harvest model output for decades 2,5,10 for Federal ownership only. For the Superior NF management induced edge was calculated for outside the wilderness only.

Definitions: The amount (length) of edge per unit area in a given landscape.

‡Notes:

Wolter and White (2002) showed that management as affected by ownership (e.g. private industrial vs. federal, etc.) strongly influences landscape patterns in the NSU in northeastern MN. With even greater interspersion of ownerships within the DLP, these effects are greater in this section. Existing and predicted amounts of forest types and age classes are displayed and analyzed by alternatives in Chapter 3.2.1. Table FAC-1 in Chapter 3.2.1. displays a comparison of the existing amounts of forest types and age classes on the Chippewa National Forest and on all lands within the ecological Section to the RNV values. Ownership patterns, current and predicted disturbance rates on forested lands and the relationship to RNV, recent trends, and desired conditions of landscapes helps to place into context foreseeable effects to landscape patterns.

Alternative A

This alternative continues recent trends in changes to forest spatial patterns. High rates of disturbance along with a 40 acres limit on harvest size perpetuate trends in forest fragmentation (Host and White 2002, Wolter and White 2002) of small patches, decreasing interior forest, and high amounts of edge. There is a corresponding decrease in mature or older upland forest and large patches of forest in these age classes. A high degree of ownership interspersion, especially non-industrial private land, will limit opportunities to increase the patch size or increase interior forest within the DLP section. Opportunities to maintain or increase patch size are greatest within a given ownership for public forest and private industrial ownerships. In relation to RNV (Chapter 3.2.1), this alternative continues trends in forest composition and age structure away from this reference point section-wide. This management intensity will be reflected in forest patterns. When considered along with the existing condition of other ownerships and the likely management of other lands, it is unlikely that this alternative would contribute to meeting all of the desired conditions within the DLP section with regard to spatial condition of the landscape.

Alternatives B, D, and F

These alternatives make the greatest short-term and long-term changes in the spatial diversity within the forest and work towards the desired conditions for DLP section to a greater degree than other alternatives. These alternatives would compensate for higher amounts of fragmentation and smaller patch sizes due to interspersed ownership patterns. In relation to RNV (Chapter 3.2.1), these alternatives begin to move forest composition and age structure toward this reference point. Combined with any similar efforts on other ownerships, this would result in greater representation section-wide of ecosystem structure, processes, and functions that were once more common. Reductions in disturbance rates (Wolter and White 2002, p.149) would begin to change recent past effects on forest spatial patterns more quickly than other alternatives.

Alternative C

This alternative is similar to Alternative A in its management intensity and trend away from RNV with regard to forest composition and age. This alternative has a greater potential than Alternative A to increase the grain of the landscape by increasing the size of young forest patches up to 1000 acres. Rates of disturbance predicted combined with landscape trends would limit the ability of an ecosystem coarse filter to effectively function with regard to ecosystem structure, processes, and functions. When considered with the existing condition of other lands and the likely management of other ownerships, it is unlikely that this alternative would contribute to meeting all of the desired conditions within the DLP section with regard to spatial condition of the landscape.

Alternative G

This alternative makes significant long-term increases in the spatial diversity within the forest. During the implementation period of the plan, projected drops in large patches and interior forest would be limited by management standards and guidelines.. These, along with management objectives to increase patch sizes and interior forest, would allow this alternative to work towards the desired conditions for DLP section. This alternative compensates for interspersed ownership patterns by using management area (MAs) allocations that would result in larger patches of mature or older forest. In relation to RNV (Chapter 3.2.1), this alternative begins to move forest composition and age structure toward this reference point but at a slower rate than Alternatives B,D, or F. This would result in an increased representation section-wide of ecosystem structure, processes, and functions that were once more common. Reductions in disturbance rates (Wolter and White, 2002, p.149) combined with other factors listed above would, in the long term, reverse recent past effects on forest spatial patterns.

Modified Alternative E

This alternative would make some short-term decreases in some spatial elements. These decreases are projected to be recouped within the implementation period of the Chippewa Forest Plan marginally improving conditions within the proclamation boundary of the forest . Overall, there would be long-term increases in the spatial diversity within the forest. Spatial standards and guide lines, along with management objectives to increase patch sizes and interior forest, would allow this alternative to work towards the desired conditions for DLP section. This alternative has fewer management area allocations that would result in larger forest patches of mature or older forest. As a result, it has a lower ability to compensate for interspersed ownership patterns. In relation to RNV (Chapter 3.2.1), this alternative begins to move some aspects of forest composition and age structure toward this reference point but moves other aspects further away. Maintenance of disturbance rates similar to recent levels, combined with other factors listed above including rates of disturbance and fragmentation on other ownerships (especially private non-industrial lands), would still result in perpetuation of recent downward trends to forest spatial patterns in the region (Host and White, 2002). National Forest lands comprise only 8% of DLP section. Even within the proclamation boundary, any decreases in fragmentation as a result of federal actions would likely be greatly outweighed by the probable increases in fragmentation on private non-industrial lands within the implementation period of the Forest Plan.

Northern Superior Uplands (NSU) Section

The Superior National Forest manages approximately 42% of the forested lands in this ecological Section. This percentage varies among the Landscape Ecosystems (LE), and ranges from a low of 17% of the Rich Swamp LE to a high of 83% of the Jack Pine-Black Spruce LE. Refer to Appendix B for a complete breakdown of land ownership by landscape ecosystem within the NSU. Table FAC-2 in Chapter 3.2.1., displays a comparison of the existing amounts of forest types and age classes on the Superior National Forest and on all lands within the ecological Section to the RNV values.

Cumulative effects to forest spatial patterns for the Superior and NSU are somewhat confusing among the array of planning alternatives because: 1) the BWCAW provides a very large forested matrix that is primarily influenced by natural processes; 2) boundaries to spatial management zones vary among alternatives; 3) ownership patterns are different among spatial zones, and 4) management direction (i.e. objectives, standards, guides) would vary between Modified Alternative E and other alternatives.

Wolter and White (2002) showed that management as affected by ownership (e.g. private industrial vs. federal, etc.) strongly influences landscape patterns in the NSU in northeastern MN. This work shows an overall trend toward less interior forest area and decreased connectivity (increased fragmentation) across the managed forest landscape in northeastern MN. By contrast the Boundary Waters Canoe Area Wilderness, considered unmanaged forest in this study, remained relatively constant with regard to these same measures of spatial patterns. The wilderness is a dominant feature in the NSU and some LEs are well represented in the wilderness. Ownership patterns, current and predicted disturbance rates on forested lands and the relationship to RNV, recent trends, and desired conditions of landscapes helps to place into context foreseeable effects to landscape patterns.

The alternatives proposed for revising the Superior Forest Plan respond to these conditions and goals to varying degrees.

Alternative A

This alternative continues recent trends in changes to forest spatial patterns. High rates of disturbance along with a 200-acre limit on harvest size perpetuate trends in forest fragmentation (Wolter and White 2002) to small patches, decreasing interior forest, and high amounts of edge. There is a corresponding decrease in mature or older upland forest and large patches of forest in these age classes. Ownership interspersion, especially non-industrial private land, will limit opportunities to increase the patch size or increase interior forest within some sub-sections of the NSU section. In relation to RNV (Chapter 3.2.1), this alternative continues trends in forest composition and age structure away from this reference point section-wide. This management intensity will be reflected in forest patterns. The BWCAW would continue to contribute significantly to spatial patterns in that portion of the forest.. Areas outside of the wilderness would continue in the downward trend in spatial diversity. Rates of disturbance predicted combined with landscape trends would limit the ability of an ecosystem coarse filter to effectively function with regard to ecosystem structure, processes, and functions. When considered with the existing condition of other lands and the likely management of other ownerships, it is unlikely that this alternative would contribute to meeting a majority of the desired conditions within the NSU section with regard to spatial condition of the landscape.

Alternatives B, D, F, and G

These alternatives make the greatest long-term changes in the spatial diversity within the forest and work towards the desired conditions for NSU section to a greater degree than other alternatives. All of these alternatives would contribute in the short-term to recent trends in the NSU section of increased forest fragmentation, but at a lower rate than current levels. Management area (MAs) allocations that would help to maintain larger forest patches help to moderate these predicted short-term trends. This effect would be greatest in Alternatives D,B, and G, in this order. All of these alternatives would compensate for higher amounts of fragmentation and smaller patch sizes due to interspersed ownership patterns. In relation to RNV (Chapter 3.2.1), these alternatives, similarly but to varying degrees, begin to move forest composition and age structure toward this reference point. Combined with any similar efforts on other ownerships, this would result in greater representation section-wide of ecosystem structure, processes, and functions that were once more common. Reductions in disturbance rates (Wolter and White 2002, p.149) would begin to change recent past effects on forest spatial patterns more quickly than the other alternatives. Increasing the size of temporary openings in the context of landscape ecosystem vegetation objectives would contribute somewhat to this end. With the BWCAW, these alternatives implement an effective coarse filter that is at least as effective as currently exists (Alternative G) to greatly increased over existing (Alternative B).

Alternative C

This alternative is similar to Alternative A in its management intensity and trend away from RNV with regard to forest composition and age. Trends in fragmentation would be increased over current levels. This alternative has a greater potential than Alternative A to increase the grain of the landscape by increasing the size of young forest patches up to 1000 acres. In relation to RNV (Chapter 3.2.1), this alternative continues trends in forest composition and age structure away from this reference point section-wide. This management intensity will be reflected in forest patterns. The BWCAW would continue to contribute significantly to spatial patterns in that portion of the forest.. Areas not proximate to the wilderness would continue in the downward trend in spatial diversity. Rates of disturbance predicted combined with landscape trends would limit the ability of an ecosystem coarse filter to effectively function with regard to ecosystem structure, processes, and functions. When considered with the existing condition of other lands and the likely management of other ownerships, it is unlikely that this alternative would contribute to meeting a majority of the desired conditions within the NSU section.

Modified Alternative E

During the first and second decades of the plan, projected drops in large patches and interior forest would be limited by management standards and guide lines in Spatial Zones 1 and 2. These, along with management objectives to maintain or increase patch sizes and interior forest in Spatial Zones 1 and 2 may allow this alternative to work towards the desired conditions for the NSU section in those spatial zones. Landscape changes inferred by rates of disturbance in mature or older forest (also indicated by trends in patches, interior forest, and edge density) in this alternative combined with similar or greater recent rates on other ownerships (Wolter and White 2002) would create large gaps in connectivity and spatial diversity. This would likely run counter to the desired conditions for the NSU in this area. Rates of disturbance predicted combined with landscape trends may limit the ability of an ecosystem coarse filter to effectively function with regard to ecosystem structure, processes, and functions. This alternative has fewer management area allocations that would result in larger forest patches of mature or older forest and may result in a lower ability to compensate for interspersed ownership patterns. In relation to RNV (Chapter 3.2.1), this alternative begins to move some aspects of forest composition and age structure toward this reference point but moves other aspects further away. The effect of the BWCAW in this alternative would be two-fold on the NSU landscape: 1) it will maintain a very large patch matrix that will dominate the Border Lakes subsection 2) because of representation within the BWCAW, spatial patterns would be disrupted to a greater degree on forest adjacent to the wilderness in Spatial Zone 3 to achieve overall rates of disturbance of landscape ecosystems objectives or to meet other objectives. This would influence habitat connectivity and distribution of habitats. Spatial Zone 3 contains a higher proportion of federal land ownership compared to Spatial Zones 1 and 2 that have more interspersed ownership patterns. Cumulative spatial changes in Spatial Zone 3 of the Superior National Forest and NSU would be primarily due to federal management actions. Increases in disturbance rates (Wolter and White 2002, p.149) would perpetuate or increase recent past effects on forest spatial patterns in this area of the NSU during the first 2 decades of the plan and beyond.

3.2.3 Forest Insect and Disease

Issue Statement

Various forces affect the health of the forest. These include many things related to biodiversity that are addressed by the vegetation objectives and forest spatial patterns objectives. Some of the influences include, but are not limited to, fire, weather, down woody debris, human activities and insects and diseases. Many of these are addressed in other sections of the document. This section is limited to the insect and diseases that affect our forests.

Some of the important insects and diseases common to both Forests include, but are not limited to white trunk rot and hypoxlyn canker in aspen, butt and heart rots in balsam fir, weevil and blister rust in white pine, aspen tortrix, forest tent caterpillar, eastern spruce budworm, various saw flies, shoot blights and in the future gypsy moth.

We identified three indicators that will vary by the alternatives. These are addressed in this section.

Indicator 1 – Acres capable of sustaining Eastern Spruce Budworm Epidemic

Eastern spruce budworm feeds on balsam fir and white spruce in northern Minnesota. Mature and older balsam fir (generally greater than 40 years) is the species that has the highest mortality and sustains epidemic populations, though white spruce is also affected. During the late 1990s, the Superior National Forest (including the Boundary Waters Canoe Area Wilderness) contained approximately 222,000 acres of balsam fir over 40 years of age. An epidemic was ongoing on the majority of these acres at that time. Additional mature balsam fir forest present on other ownerships was also sustaining epidemic populations.

This indicator does a good job of highlighting the difference between alternatives because each alternative projects different acreages of mature spruce/fir forest types.

Indicator 2 – Acres of multiple aged red and jack pine capable of sustaining Shoot Blight Epidemics

The two major shoot blights occurring on the Superior and Chippewa NF are *Sphaeropsis* (formerly *Diplodia*) and *Sirococcus*. Both are pathogens and affect red and jack pine stands. White pine is not significantly affected by shoot blight. These pathogens are both a shoot blight and collar rot, may exist on older trees, and then infect and or kill reproduction in the understory. Red pine and jack pine stands managed in multiple canopy levels are the most susceptible to these pathogens. *Sphaeropsis* is known to have killed entire red pine stands in Upper Michigan. Presently, these pathogens have not reached epidemic proportions on the Superior or Chippewa NF. This indicator examines acres in multi-aged condition that result from certain management prescriptions. It does not examine those resulting from other processes such as prescribed fire, wild fire, wind, or succession.

This indicator does a good job of highlighting the difference between alternatives because each alternative projects different acreages of two storied red and jack pine stands.

Indicator 3 – Landscape conditions (upland edge density) that affects the duration of Forest Tent Caterpillar outbreaks

The forest tent caterpillar (Malacosoma disstria) periodically causes wide-spread defoliation of deciduous tree species in Minnesota, with aspen (Populus tremuloides) being the principle host species

(Roland 1993). Outbreaks move across a region at intervals varying from 6 to 16 years and are widespread. Roland (1993) found the duration of outbreaks increased in landscapes with increasing edge density. This is explained in part by a reduced rate of transmission of the virus that affects tent caterpillars at forest edges versus within forest interior (Roland and Kaupp, 1995).

Upland young forest edge density (miles of edge per square mile) does a good job of highlighting the difference between alternatives because each alternative affects forest spatial patterns uniquely and is a good predictor of duration of impact due to the forest tent caterpillar.

Scope of Analysis

The analysis area for Eastern Spruce Budworm is the forested land on the Superior National Forest. Although the insect has also achieved high populations on the Chippewa National Forest, mortality in balsam fir or white spruce has historically been very light.

The analysis area for Shoot Blights and the Forest Tent Caterpillar is the forested lands on the Superior and Chippewa NF.

3.2.3a Affected Environment

Indicator 1

Historically, three major outbreaks of the spruce budworm have occurred in North America in the 20^{th} century, with the first starting about 1910 (MacLean 1882). Minnesota had a major outbreak of spruce budworm from 1912-1926. The Eastern Spruce Budworm has reportedly been defoliating trees in the northern 1/3 of Minnesota since 1954 (Katovich 1998). Normal outbreaks last 8 to 15 years. The most recent epidemic on the Superior NF began in 1983 and has continued, although populations are currently low. Approximately 39,000 acres of mature balsam fir type were defoliated to the point where the Superior National Forest adjusted its silvicultural inventory to show these stands as seedling size/age stands prior to analyzing the alternatives considered in this document. Many acres of spruce/fir type have been harvested prior to this time to salvage trees defoliated by the insect. Since dead trees decay very rapidly and become un-merchantable, salvage normally occurs prior to mortality.

Indicator 2

Shoot blights have been known to be present on both the Superior and Chippewa NF since the 1960's. One of the shoot blights of concern, *Sirococcus,* is found on both the Superior and Chippewa NF, while *Sphaeropsis* is mainly confined to the Chippewa NF. Small isolated pockets of red pine reproduction have been affected/killed by these Shoot Blights on both Forests. In no cases have either reached epidemic proportions, but based on what has happened in Upper Michigan, the potential for an epidemic outbreak exists.

Indicator 3

Historical and recent trends in forest spatial patterns show decreases in average patch size, a decrease of interior forest, and an increase in edge density in the landscapes that include the Chippewa and Superior National Forests (Wolter and White 2002; Host and White 2002, 2003). The duration of forest tent caterpillar outbreaks are affected by these changes in forest spatial patterns.

3.2.3.b Environmental Consequences

Effects Comment to All Alternatives

Resource Protection Methods

Management for insects and disease is guided by various laws, regulations, and policies. Some of those relating to this issue are mentioned here.

The Forest and Rangeland Renewable Planning Act of 1977 directs that the Forest Service shall “provide for methods to identify special conditions or situations involving hazards to the various resources and their relationship to alternative activities.

The National Forest Management Act allows/directs the salvage of dead and dying trees caused by natural forces including insects and disease. The size of harvest blocks and type of harvest are not restricted when salvaging is necessary, nor is it limited to suitable timber lands.

The 1986 Superior Forest Plan has Standards and Guidelines directing that silvicultural treatments be applied to reduce the impacts of insects and diseases on forest trees (Forest Plan, p2-14). These further state that integrated pest management methods will emphasize techniques that are least conducive to pest outbreaks.

Spatial management direction (outlined in the Final EIS section 3.2.2) would have the effect of lowering edge density on the uplands on the Chippewa and portions of the Superior. This coarse filter management direction would have the greatest effect on conditions that affect the forest tent caterpillar.

Trees killed by the spruce budworm set the stage for large fires that have been difficult to control. The dead standing trees, with lichen, which seems to proliferate after defoliation, are extremely flammable. Extreme fire behavior has been reported in spruce budworm killed stands on the Superior and elsewhere in the boreal forest.

Spraying of mortality inducing agents has occurred in areas of the northeast United States and portions of Canada. Such treatments do not stop the epidemic, but do slow the mortality to allow salvage logging to remove the trees prior to loss of merchantability. Spraying has not been used in Northern Minnesota since the late 1980’s.

Direct and Indirect Effects

Indicator - 1

Defoliation of spruce/fir by the Eastern Spruce Budworm results in reduced growth of the affected trees, and a loss of wood production. Repeated defoliations over a 3-4 year period generally result in mortality. Unless a salvage operation takes place within a year or two following mortality, the majority

Table FID-1: Acres of Mature Spruce/Fir On Superior NF (Including BWCAW) for Decade 0, Decade1, and Decade 10

Alternatives	Decade 0	Decade 1	Decade 5	Decade 10
A	221,943	272,156	499,065	583,308
B	221,943	276,294	600,844	820,550
C	221,943	264,666	423,115	555,461
D	221,943	273,174	565,897	776,979
Mod. E	221,943	270901	503012	643350
F	221,943	273,947	554,451	729,607
G	221,943	270,106	509,625	647,205

Source: Acres outside BWCAW from computer model runs. Acres in BWCAW from FEIS, BWCAW Fuel Treatment, 5/01, p3.7-19, Table 3.7-4.
Definitions: Mature Spruce/Fir includes all acreages 40 years old or greater.

of the trees will no longer be merchantable.

Following an outbreak that causes mortality, the trees rot and fall. As a result the ground becomes a tangled jackstraw of stems and tops, greatly increasing the fire hazard. As affected areas and fuel loads increase, the risk of a catastrophic (larger and hotter) wildfire increases. Under extreme conditions fire of these magnitudes are very difficult, if not nearly impossible to control.

Human safety throughout these areas will be of greater concern and rural interface structure protection will become more difficult. A large catastrophic fire may also destroy other live trees, alter wildlife habitat, affect soils and associated watersheds, and be very expensive to suppress.

Wind throw may become a problem in mixed stands such as spruce/fir/aspen. As the spruce/fir is killed and the stand is opened up, the remaining trees become more susceptible to wind throw. This in turn results in more fuel accumulation on the ground, along with loss of harvestable timber and associated revenues.

Wildlife habitat is also altered by budworm epidemics. Some species benefit from these out breaks while others may be adversely affected. Good habitat is created for species that require dead trees for cavity nesting or feeding, but is lost for those that require conifer cover.

Budworm epidemics may lessen the recreational experience of the general forest user and reduce the scenic integrity of the forested landscape.

Acres capable of sustaining Eastern Spruce Budworm Epidemic

Table FID 1 depicts the projected acres of mature spruce/fir on the Superior National Forest by alternative for decades 1, 5 and 10. Acreages for other decades outside of the BWCAW are available in the project files, but only 1, 5 and 10 were available for inside the BWCAW. These acreages are for the Superior NF only, and do not include other ownership timbered lands within the Forest boundary. Acreages for all alternatives increase well above those presently capable of supporting a budworm epidemic.

Alternative A & C

Alternative A and C produce the lowest amount of mature spruce/fir capable of sustaining a budworm epidemic over 10 decades than any of the other alternatives. Compared to existing condition, the acreages of mature spruce/fir increases by approximately 263% and 250% respectively. By decade 10, approximately 34-37% of the total mature spruce/fir types will occur outside the BWCAW. The main reason for this is that Alternative A (The present Forest Plan) and Alternative C both emphasize early successional and young forests.

Alternative B

This alternative produces the highest amount of mature spruce/fir acreages capable of sustaining a budworm epidemic over 10 decades than any of the other alternatives. Compared to existing condition, the increase amounts to approximately 370%, with 55% of the total acreage located outside of the BWCAW. The main reason for the large increase is that Alternative B includes most of the proposed SMC's and emphasizes older forests and conifer stands.

Alternative D and F

Alternative D & F fall near the middle when compared with the rest of the alternatives capable of sustaining a budworm epidemic. Based on existing condition, by the end of decade 10 acres of mature spruce/fir increase by approximately 350% and 329% respectively. Approximately 50-53% of total mature spruce/fir types will occur on lands outside of the BWCAW. Alternative D emphasizes old forests, while Alternative F include all proposed RNA's and emphasizes RNV.

Modified Alternative E and G

Alternatives E and G falls between the mid and lower limits of all the alternatives capable of sustaining a budworm epidemic. Based on existing condition, the acres of mature spruce/fir increase by approximately 277% and 291% respectively. Of the total amount of spruce/fir acres, 41- 44% will occur on lands outside of the BWCAW. Management emphasizes for these Alternatives is a mix of both young and old forests.

Table FID-2: Acres of Two-storied Red and Jack Pine on Superior and Chippewa NF by Alternative for Decades 1, 2, and 3.

National Forest		Alt. A No Action	Alt. B	Alt. C	Alt. D	Mod. Alt. E	Alt. F	Alt. G
		Ac (#)	Ac (#)	Ac (#)	Ac (#)	Ac (#)	Ac (#)	Ac (#)
Chippewa	Decade 1	3,741	7,306	2,472	2,782	5069	4,534	8,272
	Decade 2	5,035	8,535	2,854	2,579	3991	6,246	10,308
	Decade 3	2,230	4,367	11,393	216	4427	14,599	7,577
Totals		11,006	20,208	16,719	5,577	13487	25,379	26,157
Superior	Decade 1	9,461	12,329	9,983	9,296	5464	9,649	11,873
	Decade 2	3,586	6,147	4,932	6,040	2057	6,012	8,842
	Decade 3	7,253	8,019	8,506	3,376	4098	6,873	7,516
Totals		20,300	26,495	23,421	18,712	11,619	22,534	28,231

Source: Data from computer model runs.

Direct and Indirect Effects

Indicator - 2

The killing of the new foliage of red and jack pine by shoot blight (*Sphaeropsis*) results in reduced growth of the affected trees, and a loss of wood production. Repeated killing of the new foliage over a 3-4 year period generally results in mortality. *Sphaeropsis* also affects/kills red and jack pine by initiating girdling stem cankers on stressed trees. Unless a salvage operation takes place within a year or two following mortality, the majority of the trees will no longer be harvestable.

Often shoot blight will exist on larger red and jack pine trees without killing them. In these cases, it becomes very difficult to establish new pine in the understory.

Following an outbreak that causes mortality, the trees rot and fall. This causes pockets of fuel accumulations. As a result, and depending on area affected, the hazard of wildfire increases.

Wildlife habitat is also altered by shoot blights epidemics. Some species benefit from these out breaks while others may be adversely affected. Good habitat is created for species that require dead trees for cavity nesting or feeding, but is lost for those that require conifer cover.

Shoot blight epidemics may lessen the recreational experience of the general forest user and reduce the scenic integrity of the forested landscape.

Acres of multiple aged red and jack pine capable of sustaining Shoot Blight Epidemics

The following table FSH-2 depicts the model results, by acres, of projected multiple aged red and jack pine stands for decades 1, 2 and 3 within the Superior and Chippewa NF. This table does not include lands within the BWCAW, or other timbered lands within the boundaries of these two forests.

Alternative A

This alternative produces the second lowest amount of acres susceptible to shoot blights on both forests. The main reason for this is that the existing forest plans do not emphasize two storied stands.

Alternative B

Alternative B is medium in the amount of susceptible acres to shoot blight on the Chippewa, while on the Superior it is second only to Alternative G in acreage of two-storied pine. This alternative minimizes the amount of even-aged management and relies more on harvest methods that establish and maintain two-age and multi-aged stands.

Alternative C

This alternative ranks medium/low in the amount of acres susceptible to shoot blight on the Chippewa, while it is medium in ranking on the Superior. Harvest methods for this alternative relies heavily on even-aged management with the dominant regeneration method being clear-cut.

Alternative D

This alternative produces the lowest amount of acres susceptible to shoot blights on both forests during the first three decades. Although all harvesting under this alternative is partial cutting that retains 30 square feet of basal area, this alternative does the least amount of harvesting.

Modified Alternative E

The amount of acres susceptible to shoot blight between forests is similar under this alternative. On the Chippewa this alternative ranks medium compared to other for the forest. On the Superior this alternative ranks among the lowest compared to other alternatives for the forest. On the Superior, even-aged harvest methods (i.e. clear cutting) predominate. On the Chippewa, clear-cutting is projected to be used less than the Superior to accomplish vegetation objectives.

Alternative F

On the Chippewa, this alternative produces the second highest number of acres susceptible to shoot blight, while on the Superior it produces the third lowest. This alternative utilizes a mixture of both even-aged and uneven-aged management. Although harvest methods are utilized on a considerable amount of area to establish and maintain two-aged and multi- aged stands, less acres are harvested under this method than alternative G.

Alternative G

Alternative G consistently produces the highest acreage of stands susceptible to shoot blight on both forests. The reason for this is that this alternative on both forests utilizes harvest methods on a considerable amount of area to establish and maintain two-aged and multi-aged stands.

Direct and Indirect Effects

Indicator 3

The primary impact of the forest tent caterpillar is defoliation of deciduous forest tree species. Outbreaks of forest tent caterpillar occur at regular intervals, but are stemmed by factors such as a lack of food and natural pathogens. The duration of outbreaks is lengthened in landscapes that have higher edge density (Roland 1993). Thus, forest with more fragmented, edge dense conditions will have greater adverse effects related to defoliation. Defoliation resulting from caterpillar outbreaks can depress growth and stress trees (Bather and Morris 1981). Repeated defoliation for five or more years can cause tree mortality (Batzer and Morris 1981). Moderate defoliation combined with other stressors such as drought can also cause tree mortality. Economic effects include a cumulative loss of timber growth, timber losses resulting from secondary disease infections, reduced sugar maple sap production, reduced nectar collection by honey bees, and may temporarily alter recreational use patterns during outbreaks (Batzer and Morris 1981),

The analysis of upland young forest edge density is a summary of what is already covered in Forest Spatial Patterns (section 3.2.2) indicator 4: management induced edge density. Also in section 3.2.2, Table FSP-5. Indicator 4: Management Induced Edge Density contains data by Planning Alternative for this indicator.

Alternative A and C

On the Chippewa, these alternatives increase management induced edge density on the uplands in the short-term and in the long-term (Table FSP- 5). This reflects the increased harvest levels projected in these alternatives, decrease in large mature forest patches, and decrease in interior forest. In the short-term Upland Young edge density increases 11% under Alternative A and 18% in Alternative C. In the long-term, Alternative A increases to 33% more than exists today while Alternative C increase to 23% more.

On the Superior uplands, these alternatives increase edge in the short-term and the long-term at a similar rate. Alternative C has greater increases in the short-term (25%), while Alternative A increases edge 29% over existing.

The durational effects of forest tent caterpillar outbreaks would likely be greatest in these alternatives as the National Forests further shift to a finer grained landscape with increased fragmentation, a decrease of spatial diversity, a loss of larger forest stands, and high rates of disturbance through forest harvest.

Alternatives B, D , and F

On the Chippewa, these alternatives project similar decreases in Upland Young management induced edge from existing condition in the short-term (Table FSP-5). In the long-term Alternatives F,B, and D, in this order, produce decreasing amounts of edge. At most, Alternative F produces 50% of the Upland Young edge density than currently exists. This indicates a decrease in the effects related to management induced edge, an increase in spatial diversity, and an increase forest stand size.

On the Superior, Alternatives B and D project similar short-term decreases in Upland Young edge density from existing condition. Edge density is reduced 56% during the implementation period of the management plan. Over the long-term Alternative D shows a greater decrease in edge density than Alternative B at 79% and 46% respectively. Alternative F reduces edge density 27% in the short-term and 17% in the long-term. This indicates a decrease in the effects related to management induced edge, an increase in spatial diversity, and an increase forest stand size.

The durational effects of forest tent caterpillar outbreaks in these alternatives would likely be the least among alternatives examined and are most likely to eventually reflect those of the natural range for the forest tent caterpillar.

Modified Alternative E

On the Chippewa, Young Upland edge is maintained at 77% to 82% of current levels in the short and long-term (Table FSP-5). Edge effects would be reduced from existing condition on Upland Forest.

On the Superior, Young Upland edge is maintained at 86% of current levels in the short and long-term. Aggregation of harvests and efforts at maintaining or increasing large mature/older upland patches or interior forest in Spatial Zones 1 and 2 would reduce edge density and edge effects from existing conditions (reflected in this indicator for the Superior). In Spatial Zone 3 edge effects are likely to be maintained or to increase over existing levels due to different objectives for this area.

Reductions of this indicator on both forests in this alternative through managing for larger forest patches and more interior forest would likely result in conditions that favor longer durations between forest tent caterpillar outbreaks.

Alternative G

On the Chippewa, Young Upland edge is maintained at about 63% of current levels in the short and long-term (Table FSP-5). Edge effects would be significantly reduced from existing condition on Upland Forest.

On the Superior, Young Upland edge decreases to 84% of current levels in the short term, to 78% and 94% of current levels in the long-term. Over the long term upland edge amounts appear to fluctuate below that of current levels.

Reductions of this indicator on both forests in this alternative through managing for larger forest patches, more interior forest, and a reduced amount of even-aged harvest would likely result in conditions that favor longer durations between forest tent caterpillar outbreaks.

Cumulative Effects

Analysis Area

The analysis area for the eastern spruce bud worm, shoot blight, forest tent caterpillar is northern Minnesota.

Indicator 1

All alternatives increase the acreages of mature spruce/fir. In the 1990's approximately 222,000 acres of federal lands on the Superior with mature spruce/fir supported an epidemic. Over the next 100 year period the acres of mature spruce/fir on the Superior is projected to increase by a low of approximately 333,500 acres under Alternative C, to a high of approximately 599,000 acres under Alternative B. This large increase of mature spruce/fir on federal lands along with the acreages on state, county and private holdings will increase the risk of an eastern spruce budworm epidemic. Forest Plan management direction, including objectives, standards, and guidelines, would compel the Forest Service to manage outbreaks to within historic levels.

Indicator 2

All alternatives increase the present acreages of two-storied jack and red pine stands resulting from forest management activities. Acreage increases on the two forests combined over the next 30 years range from approximately 24,000 (Alternative D) to 54,000 (Alternative G) acres. There have been no epidemics of shoot blight in northern Minnesota, and it is unknown how many acres of two-storied jack and red pine stands are needed to support an epidemic. Since other acreages on state, county and private holdings are not generally managed as two-storied stands, the cumulative risk of an epidemic is low for all decades.

Indicator 3

The forest tent caterpillar will continue to be present on the landscapes that contain the National Forests in Minnesota. Cumulatively, landscape patterns contributed by other ownerships (Wolter and White 2002, Host and White 2002, 2003) are likely to affect the duration of forest tent caterpillar outbreaks as interspersed ownerships continue to be fragmented by decreasing the time between outbreaks and increasing the duration when they do occur. These effects would be the least in Alternatives B, D, and F. Alternatives Modified E and G are likely to affect outbreaks similarly when considered in the cumulative effects analysis area. Alternatives A and C would result in the greatest impacts due to caterpillar outbreaks. The Chippewa and Superior in Alternatives A and C would resemble other portions of the cumulative effects area (i.e. higher amounts for forest edge than existing condition) and greater effects due to the forest tent caterpillar.

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