# Wisconsin Voluntary Site-level Forest Management Guidelines

PUB-FR-226 2002 Preliminary, First Edition



# Wisconsin Department of Natural Resources Division of Forestry

P.O. Box 7921 Madison, Wisconsin 53707

For additional information, call **608-267-7494** or visit our web site at: www.dnr.state.wi.us/org/land/forestry/

July 31, 2002

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## **FOREWORD**

### Dear Wisconsin Woodland Owner, Forestry Enthusiast, or Resource Professional:

Wisconsin is fortunate to have more than 15,000,000 acres of forestland. Over the last century, we learned the phenomenal value of our forests after nearly losing them to agricultural conversion and fires. Future social, economic and environmental pressures will be different, but we have a duty as a society to find ways to meet our needs without imperiling the productivity of forests for future generations. That is the goal of sustainable forestry, outlined in the chapters to follow.

Agreeing on measures to protect forest ecosystems while addressing our many values and needs is complex. The Department of Natural Resources welcomes broad discussion of the principles of sustainable forestry. To that end, this draft first edition of *Wisconsin's Voluntary, Site-level Forest Management Guidelines (FMG)* is designed for public review. It's being made available in print and on the DNR Internet site (where written comments will be accepted). Five public input sessions are also being planned between October 1, 2002 and March 31, 2003.

Keep in mind that the FMG is not meant to be an exhaustive textbook. Our goal is to establish basic concepts that outline responsible resource management. Other technical publications and references should be used to learn the details. The FMG is written for resource managers and enthusiasts. As a result, it might be somewhat difficult for a general reader, but our hope is that it's simple and attractive enough to be understood with a little effort.

Wisconsin DNR owes a debt of gratitude to the Minnesota Forest Resources Council for their permission to base the Wisconsin FMG on a similar project completed in Minnesota a few years ago. That was a Herculean effort involving more than 60 partner organizations meeting hundreds of times over two years. We are pleased to be able to build on Minnesota's process. Perhaps they will find something new in our efforts that will be useful for them.

As I mentioned before, your comments are valued. Please send them by March 31, 2003 to DNR Division of Forestry – FMG Project, P.O. Box 7921, Madison, WI 53707. From them we will build a final color edition of the FMG by fall of 2003. It will be a milestone for resource management in the decades to come.

Sincerely,

Gene L. Francisco Chief State Forester

May 29, 2002

# MASTER INDEX Master Index ......a The Purpose of Integrated Guidelines .....i The Forest .....i A Framework of Balance and Stewardship......j A Diversity of Needs......j The Concept of Integrated Guidelines......j Who Will Use the Guidelines? .....i Factors That May Affect Implementation.....k Recognizing the Need for Flexibility......l What the Guidelines Are How this Guidebook is Organized.....n CHAPTER 1 — WISCONSIN'S FORESTS: A QUICK OVERVIEW A Statewide Snapshot of Wisconsin's Forests......2 Number of Trees ......4 Timber Volume.......4 Biodiversity .......6 Ownership ......6 A Brief History of Wisconsin's Forests ......7 Forests Before European/American Settlement......7 Forests Since European/American Settlement ......9 CHAPTER 2 - GENERALLY ACCEPTED SILVICULTURAL PRINCIPLES Sustainable Forestry ......15 Landowner Goals and Objectives......16 Site Evaluation and Stand Delineation......17

Forest Cover Types and Silvicultural Alternatives ......19

| CHAPTER 2 (CONTINUED)  |                |
|--|----------------|
| Silvicultural Systems  Even-aged Silvicultural Systems  Uneven-aged Silvicultural Systems  Silvicultural Systems Summary | 24<br>33<br>38 |
| Table 2-1: Generally Accepted Regeneration Methods   |                |
| Passive or Non Management Options  |                |
| Salvage Harvests   |                |
| Unsustainable Cutting Methods  |                |
| Management Prescriptions   | 43             |
| CHAPTER 3 — WILDLIFE HABITAT   |                |
| Specific Wildlife Habitat Guidelines   |                |
| Leave Trees and Snags  |                |
| Coarse Woody Debris and Slash  |                |
| Conifer Retention and Regeneration   |                |
| Patterns of Cutting  |                |
| Endangered, Threatened and Special Concern Species.  |                |
| Natural Areas and Sensitive Communities  |                |
| Affected Natural Communities   | 60             |
| Field Survey Consultants and Other Resources   | 60             |
| Wetland Inclusions and Seasonal Ponds  |                |
| Riparian Wildlife Habitat  | 62             |
| Resources for Additional Information.  | 65             |
| CHAPTER 4 — VISUAL QUALITY   |                |
| The Value of Visual Quality  | 68             |
| A Concern for Aesthetic Quality  |                |
| Benefits of Visual Quality Management  | 69             |
| Visual Sensitivity   | 71             |
| Recognizing Different Levels of Visual Sensitivity   |                |
| Visual Sensitivity Levels  |                |
| The Value of Recognizing Different Levels of Visual Sen  | sitivity72     |
| CHAPTER 5 — RIPARIAN AREAS A   | ND WETLANDS    |
| The Value of Riparian Areas  | 7 4            |
| A Transition from Aquatic to Terrestrial Ecosystems  |                |
| Potential Threats to Riparian Areas: Pollutants and Impa   |                |
| Protecting Riparian Functions and Values   | 17             |

| CHA         | APTER 5 (CONTINUED)  |          |     |
|-------------|--|----------|-----|
| Ripa        | Background: What is a RMZ?   | 80<br>81 | .80 |
| Best<br>Mar | t Management Practices for Riparian agement Zones                                  |          | .82 |
|             | BMPs: Riparian Management Zones  |          |     |
|             | BMPs: Lakes & Navigable Perennial Streams BMPs: Navigable Intermittent Streams     |          |     |
|             | BMPs: Non-Navigable Streams  |          |     |
| Wet         | lands  |          | .84 |
|             | BMPs: General  |          |     |
| CH          | APTER 6 — CULTURAL RESOURCES   |          |     |
|             | ural Resources   |          | 86  |
| Curt        | Forest Management for the Protection of Cultural Resources                         |          | .00 |
|             | What Cultural Resources Are  |          |     |
|             | Economics of Cultural Resource Management  |          |     |
|             | Potential Impacts  | 88       |     |
|             | Cultural Resource Management and the Law   |          |     |
|             | Cultural Resource Inventories  |          |     |
|             | Assessing Cultural Resource Potential  |          |     |
|             | Field Identification of Cultural Resources   |          |     |
|             | Assessing Management Alternatives  |          |     |
|             | When Accidental discovery occurs   | 90       |     |
| СНА         | APTER 7 — FOREST SOIL PRODUCTIVITY   |          |     |
| The         | Value of Forest Soil Productivity  Sustainable Soil Productivity                   |          | .92 |
| Soil        | Characteristics and Potential Impacts Three Related Groups of Soil Characteristics |          | .92 |
| Арр         | lying Guidelines to Varying Site Conditions  |          | .98 |
| CHA         | APTER 8 — FOREST MANAGEMENT PLANI  | VING     |     |
|             | est Management Planning  |          | 100 |
|             | Incorporating Sustainability into Forest Management Plans                          |          |     |
|             | Forest Management Plan Elements  |          |     |

| CHAPTER 9 — GENERAL OPERATIONAL GUIDELII              | NES |
|---|-----|
| Operational Considerations                            | 110 |
| Protecting Cultural Resources                         | 112 |
| Fuels, Lubricants, Waste, and Spills                  | 113 |
| Post-Operational Activities and Follow-up Visits      | 114 |
| CHAPTER 10 — FOREST ROAD CONSTRUCTION AND MAINTENANCE |     |
| Considerations116                                     |     |
| Upland Forest Roads                                   | 118 |
| Stream Crossing Design and Construction               | 119 |
| Road Construction and Drainage                        | 123 |
| Drainage Structures                                   | 125 |
| Soil Stabilization                                    | 128 |
| Wetland Forest Roads                                  | 130 |
| BMPs: Wetland Roads, Skid Trails & Landings130        |     |

| CHAPTER 10 (CONTINUED)                                 |          |
|--|----------|
| 15 Federal Requirements  BMPs: Forest Roads in Wetland |          |
| Road MaintenanceBMPs: Road Maintenance                 | 132      |
| CHAPTER 11 — TIMBER HARVESTING                         |          |
| Considerations   | 134      |
| Protecting Soil and Water Resources                    |          |
| Visual Impacts   |          |
| Managing Slash   |          |
| Landings   | 136      |
| Snags  | 136      |
| Planning and Design                                    | 137      |
| BMP: Planning and Design                               |          |
| Operational Considerations                             | 140      |
| BMPs: Protecting Sensitive Areas                       | 140      |
| BMPs: Landings   | 140      |
| BMPs: Skid Trails                                      |          |
| BMPs: Stream Crossings for Skidding                    |          |
| Minimizing Rutting                                     |          |
| BMP: Rutting   |          |
| Managing Slash   |          |
| BMP: Slash   |          |
| Water Quality and Wetlands                             |          |
| Snags (Standing Dead Trees)                            |          |
| Leave Trees (Live Trees)                               |          |
| · ·  |          |
| The Timber Sale Contract                               |          |
| Understanding the Sample Timber Sale Contract          |          |
| Post-operational Activities                            | 148      |
| CHAPTER 12 — MECHANICAL SITE PREPAR                    | OA TIONI |
| Considerations   |          |
| Planning   |          |
| Planning and Design Considerations                     |          |
| Timing and Intensity of Activities                     |          |
| Selecting Application Methods                          |          |
| BMP: Selecting Application Methods                     |          |

| CHAPTER 12 (CONTINUED)   |                                      |
|--|--------------------------------------|
| Operational Considerations  Managing Slash and Windrows  Protecting Resources  BMPs: Protecting Resources  | .154<br>.154                         |
| Post-Operational Activities  | 154                                  |
| CHAPTER 13 — PESTICIDE USE  Considerations   | .156                                 |
| Incorporating Integrated Pest Management Strategies Characteristics Affecting Ground and Surface Water Contamination Potential Selecting Pesticides Selecting Application Methods Emergency Planning and Community Right-to-Know Spill Response BMP: Spill Response  | .156<br>.157<br>.158<br>.159<br>.160 |
| Operational Considerations Transportation of Pesticides Storage of Pesticides Mixing and Loading Operations BMP: Mixing and Loading Operations Pre-Application Activities Timing and Weather Considerations BMP: Timing & Weather Considerations Applying Pesticides BMPs: Applying Pesticides Protecting Water Resources BMPs: Protecting Water Resources |                                      |
| Post-Operational Considerations  Equipment Clean-up  BMP: Equipment Clean-up  Container and Waste Disposal  BMPs: Container and Waste Disposal   |                                      |
| CHAPTER 14 — REFORESTATION  Considerations   |                                      |
| Species Selection  | .169                                 |
| Operational Considerations   | 1 / 0                                |

| CHAPTER 15 — TIMBER STAND IMPROVEMENT ( Considerations                            | ΓSI) |
|---|------|
| Planning  | 173  |
| Operational Considerations  | 173  |
| Specific TSI GuidelinesRelease of Crop Trees in Pre-commercial Hardwood Stands174 | 174  |
| CHAPTER 16 — FIRE MANAGEMENT  |      |
| Considerations176   |      |
| Planning  | 177  |
| Burn Plan Development   |      |
| Operational Considerations  | 178  |
| Pre-Ignition Activities   |      |
| Managing Fuel Breaks and Accesses178  |      |
| BMP: Managing Fuel Breaks and Accesses178   |      |
| Protecting Water Quality and Wetlands   |      |
| Post-Operational Activities   | 180  |
| BMP: Post-Operational Activities180   |      |
| CHAPTER 17 — FOREST RECREATION MANAGEM Considerations                             | IENT |
| Construction of Recreation Areas  | 183  |
| Protecting Cultural Resources   |      |
| Protecting Water Quality and Soil Productivity184                                 |      |
| Public Use Considerations   | 184  |
| Recreational Traffic  |      |
| Public Education Opportunities  |      |
| GLOSSA RY   | 185  |

# APPENDICES

| Appendix A: Marking Guidelines  |  | 198 |
|---|--|-----|
| Appendix B: Sample Timber Sale Contract   |  | 200 |
| Appendix C: MFL Entry Review Checklist  |  | 209 |
| Appendix D: Pesticide Laws and Rules  |  | 212 |
| Appendix E: Regulations Relating to Forest<br>Management and Water Quality  |  | 213 |
| Appendix F: Permits   |  | 218 |
| Appendix G: References Cited  |  | 220 |
| Appendix H: Resource Directory Forest Management Guidance and Education Sources of Maps and Planning Tools Financial Incentive Programs Cultural Resource Assistance Fish and Wildlife Habitat, Wetland Protection Integrated Pest Management and Pesticide Use Petroleum Spills Prescribed Burning Endangered, Threatened or Special Concern Species Water Crossings | 221<br>225<br>226<br>227<br>228<br>229<br>230<br>230 | 221 |
| Appendix I: Acknowledgments and Credits   |  | 231 |

# THE PURPOSE OF INTEGRATED GUIDELINES

#### The Forest

The forest is a diverse and complex community that includes plants, animals, microorganisms and people – along with the surrounding physical environment they inhabit, in which trees are the dominant life form.

Sustaining forest resources for future generations depends on balancing a diversity of social, economic and environmental objectives, including:

- · Production of timber for wood and paper products
- · Providing recreational opportunities
- · Protection of cultural resources
- · Enhancement of scenic beauty
- · Improvement of wildlife habitat
- · Conservation of water and soil resources
- Maintaining the viability of rural communities



Figure A: Springtime in the Baraboo Hills showcases the diversity found in a mixed pine and hardwood forested landscape.





Figure B and Figure C: Sustaining forest resources for future generations depends on balancing a diversity of social, economic and environmental objectives, including production of timber for wood and paper products.

# A Framework of Balance and Stewardship

Forest management can contribute to the long-term sustainability of forested lands in Wisconsin. Harvesting timber stands, prescribed burning, the use of pesticides, and the ongoing regeneration of forests contribute to the long-term health, productivity and sustainability of valuable forest resources.

Like many other human activities, from building houses to growing crops to living on a lake, forest management activities also have the potential to adversely affect site-level forest functions and values. As the needs and desires of society impose ever-increasing demands on forest resources, the responsibility to meet those increased demands without compromising the overall sustainability of forest resources becomes more challenging. Within a sound stewardship framework, however, forest management can occur at the site level with no adverse effects on the sustainability of the entire forest ecosystem.

# A Diversity of Needs

Sustainability means meeting the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable forestry is a proactive form of management that provides for the multiple uses of the forest by balancing a diversity of both present and future needs. It's a process of informed decision-making that takes into account resource needs, landowner objectives, site capabilities, existing regulations, economics and the best information available at any given time.

Those concerned about forest management have long recognized the challenge of balancing social, economic and environmental objectives and implications. They also recognize the complex relationship between forest management practices and the long-term sustainability of our forests.

# The Concept of Integrated Guidelines

Integrated resource management approaches, comprehensive planning, and recommended practices and guidelines are not new ideas. So what's new? Three things:

- The concept of one set of integrated guidelines to support the sustainability of many different resources within forest communities.
- The recognition that guidelines should be designed to accommodate a wide range of resource needs, landowner objectives and site conditions.
- The idea of a broad-based, collaborative approach to developing user-friendly guidelines applicable to forests throughout Wisconsin.

This concept of integrated guidelines recognizes the forest as a community of related resources, rather than a collection of separate resources. Integrated guidelines reflect the forest ecosystem that they are designed to help sustain.

Integrated guidelines recognize the forest as a community of related resources, rather than a collection of separate resources.

## Who Will Use the Guidelines?

These forest management guidelines have been developed for use by forest landowners, resource managers, loggers, contractors and equipment operators, who share a concern for balancing forest management activities and the long-term sustainability of forest resources. Although many individuals may participate in managing a particular site, final decisions regarding guideline implementation lie with the landowner.

These guidelines were designed to help landowners, resource managers and loggers determine how to protect the functions and values of forest resources during forest management activities. They do not provide advice on whether to manage or which management activities are needed.

# Factors That May Affect Implementation

Generally speaking, these guidelines are informational and voluntary. They are designed to help landowners and resource managers meet today's needs while maintaining ecosystem integrity and productivity for future generations. Any federal, state and local regulations, however, whether or not referenced by the guidelines (such as endangered species laws, pesticide rules, permitting requirements, zoning ordinances, etc.), take precedence and must be observed. Landowners voluntarily participating in formal incentive programs such as Wisconsin Forest Landowner Grant Program or the Managed Forest Law are obliged to comply with the statutes and rules that apply, some of which may be reflected in these guidelines.

Parts of these guidelines also have special significance to private consulting foresters and industrial forest products companies that voluntarily participate in Wisconsin's Cooperating Forester Program. Section NR 1.213 (3)b, Wisconsin Administrative Code, provides that a Cooperating Forester "shall manage private lands where the cooperator provides service in a manner which maintains the long-term capacity of the land to provide forest products, uses and values desired by landowners in accordance with the silvicultural quidelines in department handbooks and directives or a written, science-based forest management commitment submitted to and approved by the department in advance." For purposes of administering the Cooperating Forester Program, compliance with the following sections of these guidelines is considered mandatory:

- Generally Accepted Regeneration Methods by Cover Type found in Table 2-1, Chapter 2, page 39, unless the Department has approved an exception described in a science-based forest management commitment submitted by the Cooperator. The regeneration methods designated in the table have been substantiated by forestry research and have been found to be reliable techniques for manipulating forest vegetation with predictable results. Since our understanding of forest ecology and silvics is constantly evolving, the management commitment option allows the adoption of new techniques as they are proven.
- Wisconsin's Forestry Best Management Practices for Water Quality (BMPs), designated by the symbol "✓" found throughout these guidelines. Wisconsin BMPs identify and explain guidelines for landowners, loggers and land managers to protect water quality. They were prepared in response to federal legislation. Section 208 of the 1977 Clean Water Act required each state to develop plans and procedures to control "silviculturally related nonpoint sources of pollution ... to the extent feasible." Section 319 of the 1987 Water Quality Act requires each state to develop and implement a program to reduce nonpoint source pollution to the "maximum extent practicable." Compliance with Wisconsin BMPs will help meet our federal obligations.

Cooperating Foresters must also abide by federal, state and local regulations, including those related to forest incentive programs administered by the Department. Implementation of other information presented in these guidelines is encouraged, but not mandatory.

# Recognizing the Need for Flexibility

Because no single set of guidelines can effectively address the concerns of all situations and all areas, guidelines need to be flexible enough to address site-specific conditions. This flexibility also allows guidelines to be modified to balance resource needs, landowner objectives and site capabilities – as long as modified approaches still achieve the same management goals.

Besides being flexible, these guidelines will evolve and change over time. Guideline revisions will occur in the future to reflect new information, new perspectives or new priorities.

## What The Guidelines Are

- The guidelines are designed to be flexible, recognizing that both site conditions and landowner objectives vary. Determining the most appropriate guidelines for implementation on a particular site depends on the informed judgment of the landowner, resource manager or logger responsible for that site.
- It may be possible to implement several guidelines simultaneously in some instances. For example, trees left to protect cultural resources may also satisfy mast guidelines for wildlife, as well as apparent harvest size guidelines for visual quality.
- Implementation of the guidelines is voluntary, except as noted above.

- The guidelines are designed to help forest landowners, resource managers and loggers meet two goals:
  - Conduct forest management activities while addressing continued long-term sustainability of diverse forest resources.
  - Promote or enhance the functions and values of water and soil resources, riparian areas, wildlife habitat, visual quality and cultural resources.
- The guidelines represent practical, sound, and generally accepted practices based on the best available scientific information.
- The guidelines are designed to assist with site level forest management. They are not designed to provide broad-based landscape direction.



Figure D: Harvesting timber stands can contribute to the long-term health, productivity and sustainability of valuable forest resources.

#### What the Guidelines Are Not

- The guidelines are not a substitute for a resource management plan. They are intended to support implementation of a plan once it is in place.
- The guidelines are not intended to replace any existing rules or regulations.
- The guidelines are not intended as a substitute for obtaining professional assistance as needed to achieve management objectives or meet appropriate engineering standards. They are guidelines, not construction standards or engineering specifications.
- The guidelines are not designed to help determine whether a particular forest management activity should or should not occur. They are designed instead to provide guidance in how to implement a particular forest management activity.
- The guidelines are not intended to address all forest management activities and all forest resources. They address major forest management activities as they relate to selected components of a healthy forest.
- The guidelines do not cover all management options related to a particular forest resource.
   Wildlife guidelines, for example, provide the essentials to address site-level habitat issues, but they do not list all possible techniques for improving forest habitats or for managing particular species.



Figure E: Integrated guidelines recognize the forest as a community of related resources, rather than a collection of separate resources.

# How this Guidebook is Organized

Because this guidebook has been designed for a variety of audiences, some landowners may find it to be more technical than they need and some resource managers may find it to be more basic than they might prefer. Some readers will be more interested in an overall understanding of "why" a particular resource (forests, wildlife, water, soils, visual quality, or cultural resources) is important relative to overall sustainability and "why" particular strategies are employed in their management. Other readers will be more interested in "how to" implement a particular activity or practice needed to carry out a management strategy. They would like to know, for example, "how to" construct a forest road, or develop a forest management plan, or design and administer a timber harvest.

Part one of the guide (Chapters 1 through 7) is designed to address the "whys" of each of a number of important resource components. Why do the forests of Wisconsin look like they do – how are they changing? Why are various timber stands harvested differently? What are the key issues related to wildlife management and the protection of water resources, riparian areas, soils and cultural resources? Why is visual quality an important resource consideration and what are the trade-offs that need to be considered?

Part two of the guide (Chapters 8 through 17) focuses on specific activities that are normally carried out in the management of a forest.

Starting with the development of a well considered, ecologically based forest management plan, and followed by guidelines related to a number of "on-the-ground" activities necessary to carry out such a plan.

Obviously there is linkage between "why" and "how" a resource is managed. The management of any one resource also impacts others. The implementation of any one specific management activity must be considered from many perspectives. Readers are encouraged to "explore" the entire guide in order to gain a more complete understanding of any particular plan of action before proceeding.

Finally, a glossary of terms and, because no single guide can be complete, a list of additional resources and sources of assistance have been included.

• Important Note •

# The WISCONSIN'S FORESTRY BEST MANAGEMENT PRACTICES FOR WATER QUALITY FIELD MANUAL

has been incorporated into this guide.

BMPs are found throughout the guide and are identified by the "

" symbol.

# CHAPTER 1 — WISCONSIN'S FORESTS: A QUICK OVERVIEW

| Α | Statewide Snapshot of Wisconsin's Forests   |   | . 2 |
|---|---|---|-----|
|   | Wisconsin's Forests                         | 2 |     |
|   | Forest Area                                 | 2 |     |
|   | Forest Types                                | 3 |     |
|   | Number of Trees                             |   |     |
|   | Timber Volume                               | 4 |     |
|   | Growth and Removals                         | 5 |     |
|   | Economic Importance                         | 6 |     |
|   | Biodiversity                                |   |     |
|   | Ownership                                   | 6 |     |
|   | Urban Forests                               |   |     |
| Α | Brief History of Wisconsin's Forests        |   | . 7 |
|   | Forests Before European/American Settlement | 7 |     |
|   | Forests Since European/American Settlement  | 9 |     |

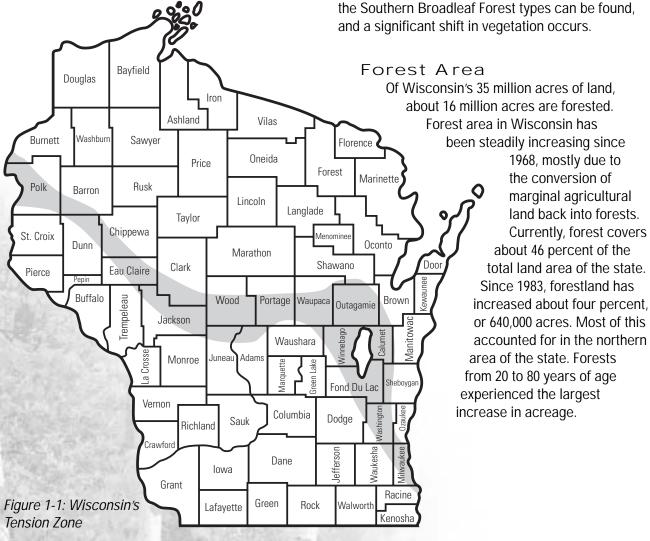
# A STATEWIDE SNAPSHOT OF WISCONSIN'S FORESTS\*

#### Wisconsin's Forests

Wisconsin's forest resources can be divided into two broad categories, the Northern Mixed Forest and the Southern Broadleaf Forest. These two forest types exist in Wisconsin because they have adapted to the different soil types and climates that have supported them over thousands of years.

These two regions meet in an area called the tension zone. The tension zone stretches across Wisconsin from northwest to southeast in an S-shape. The tension zone forms the northern

boundary of many species' ranges, both plant and animal. From Polk and St. Croix counties southeast to Milwaukee, the tension zone divides the state into the two major ecological regions. The northern region, the Northern Mixed Forest, is more closely related to the forest of northeastern Minnesota, northern Michigan, southern Ontario, and New England. The southern region, the Southern Broadleaf Forest, is warmer and is generally considered closer, ecologically, to the forests of Ohio and Indiana. The tension zone is a diverse area, where representative plant and animal species from both the Northern Mixed Forest and the Southern Broadleaf Forest types can be found, and a significant shift in vegetation occurs.



<sup>\*</sup> Note: The information in this chapter was taken from Wisconsin Forests at the Millennium: An Assessment. November 2000. Wisconsin Department of Natural Resources Division of Forestry, publication PUB-FR-161 2000.

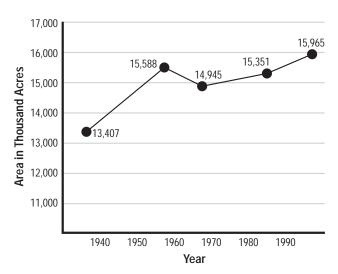


Figure 1-2: Wisconsin forest acreage over time.

# Forest Types

The most abundant forest types in Wisconsin are hardwood forest types. Maple-basswood, aspen-birch and oak-hickory are the most common. Maple-basswood accounts for 5.3 million acres, followed by aspen-birch forest type with almost 3.4 million acres, and oak-hickory with about 2.9 million acres. While 84 percent of Wisconsin's forests are hardwood types, there are also significant softwood types occupying large areas, especially in the north. Red pine, jack pine, black spruce, northern white cedar, and tamarack are the most common types.

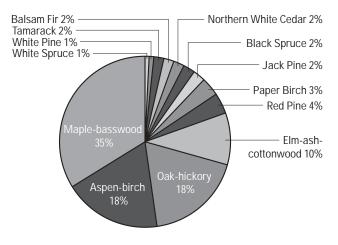


Figure 1-3: Wisconsin forest types, 1996.

Areas and relative proportion of various forest types have changed significantly over the last 70 years. Hardwood succession is very apparent. Since the first official statewide forest inventory in 1936, aspen-birch forest area has decreased steadily, although it is still much more common than at the beginning of the Cutover. The Cutover was the period of intense timber harvest in the Lake States, lasting about 40 years, from 1880 to 1920. Since 1936, maple-basswood, soft maple-ash, and oak-hickory forests have increased just as steadily. Conifer forest area has remained roughly constant over the last 70 years.

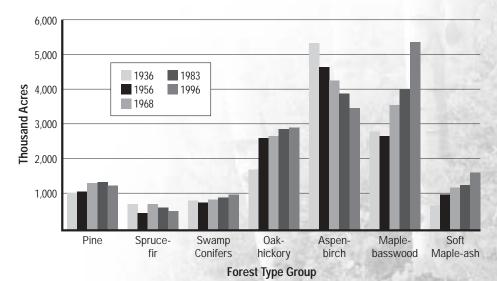


Figure 1-4: Wisconsin forest types over time.



Figure 1-5: The area of aspen-birch and other "pioneer types" has declined over the last 70 years. These sun-loving species require the open conditions created by a windstorm, fire or an even-aged harvest to regenerate and grow.

#### Number of Trees

Predictably, along with an increase in forest area, there has been a corresponding increase in number of trees. Between 1983 and 1996, trees more than 10 feet tall increased by 1.4 billion individual trees. In 1996, there were 9.8 billion trees in Wisconsin.

#### Timber Volume

Between the 1983 forest inventory and the 1996 forest inventory, overall growing stock volume in Wisconsin's forests has increased by almost 12 percent – about two billion cubic feet. In 1996, there were 18.5 billion cubic feet of growing stock volume, of which 4.4 billion were conifer, and 14.1 were hardwood. Along with this overall increase, the state's maples, oaks, basswood, ashes, white and red pines, white and black spruces, and balsam fir are some of the commercially important species whose growing stock volume increased. Aspen, paper birch, and jack pine volumes decreased between inventories.

#### **PLANTATIONS**

More than 95 percent of Wisconsin's standing forests are a result of natural regeneration. The remaining 4.5 percent of Wisconsin's forests are plantations. In this context, plantations refer to areas reforested through planting that are sufficiently productive to qualify as timberland. The planted species is not necessarily dominant. The majority of plantations are conifer types and located in the central and northern parts of the state.



Figure 1-6: Most of Wisconsin's plantations are pine, however, they constitute only 4.5 percent of the state's total forestland.

During the same period, sawtimber volume increased dramatically – by more than 30 percent or 11 billion board feet. Sawtimber is the largest timber size class. These trees tend to be older, more economically valuable, mature seed-producers, and are important to the forest's structure. As Wisconsin's forests age, continued growth of sawtimber volume is likely.

#### Growth and Removals

In Wisconsin, our forests are growing at a rate that significantly exceeds harvest. Between 1983 and 1996, average net annual growth exceeded harvests and other removals by almost 158 million cubic feet. During the period between inventories, average net annual growth was 490 million cubic feet. Average annual removals were 332 million cubic feet, about 68 percent of average net annual growth. Between 1968 and 1983, average annual removals were 45 percent of average net annual growth. Average net annual growth of sawtimber in particular also exceeded average annual removals, resulting in a net increase in sawtimber volume between 1983 and 1996. Each year, on average, sawtimber volume



Figure 1-7: Continued lakeshore development is influencing Wisconsin forests.

increased 1.68 billion board feet. About 59 percent of that growth was offset by removals – 986 million board feet each year. One important measure of sustainability is that the Wisconsin timber net growth versus removals ratio is greater than one, statewide.

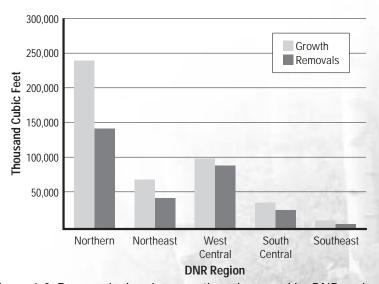


Figure 1-8: Bar graph showing growth and removal by DNR regions.

# **Economic Importance**

Wisconsin's forests provide the raw materials for homes, offices, furniture, paper, medicines, paints, plastics, and many products people may not realize come from trees. In Wisconsin, more than 1,850 wood-using companies produce nearly 20 billion dollars of forest products every year. More than 300,000 Wisconsin jobs rely on the forest products industry.

# Biodiversity

Wisconsin is blessed with abundant biodiversity. Located at the junction of three of North America's six biotic provinces – the eastern deciduous forest, the northern boreal forest and the temperate grasslands – we have a wealth of species and natural communities. Approximately 1,800 species of native plants and 657 species of native vertebrates have been identified in Wisconsin. In addition, there are thousands of species of nonvascular plants and invertebrates. The challenge is to manage this diversity to conserve Wisconsin's heritage and preserve future management options (*Wisconsin DNR Biodiversity as a Management Issue 3*).

# Ownership

Individual, private owners own the majority of Wisconsin forests – 57 percent. The state owns just five percent, and the federal government, 10 percent. In the public sector, counties and municipalities own the largest – 15 percent, followed by the forest industry (seven percent), private corporations (four percent), and tribal lands (two percent).

Ownership is increasingly important to Wisconsin forests. The demographics of Wisconsin forestland owners are changing, as are their values and goals for their land. The increase in second homes and non-resident landowners has resulted in more forest owners of smaller parcels. Lakeshore development is another trend related to this phenomenon.

This increase in second homes and non-resident landowners results in a significant increase in the number of individual private owners. Increased human presence in the forest has significant impact

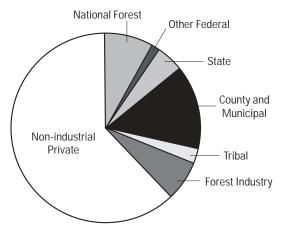


Figure 1-9: Forest acres by ownership category.

on the integrity of forest communities. Between 1984 and 1997, the number of Wisconsin's non-industrial private owners increased 20 percent to 262,000. Every year, an average of 3,385 new parcels are carved from Wisconsin's forestlands. As a result, ownership size is decreasing and development is increasing.

#### **Urban Forests**

Many Wisconsin residents associate with urban forests. Urban forests surround people every day. The trees, lawns, landscape plantings, gardens, urban wildlife, and people of the cities compose the urban forest ecosystem. Wisconsin has about 1.7 million acres of urban forest, about 4.7 percent of the state's total land area. Statewide, the average urban canopy cover is 29 percent of the urban area. In the northern region, urban canopy cover is closer to 38 percent, in the south it's about 26 percent.



Figure 1-10: A lot for sale in Wisconsin's forestland.

# A BRIEF HISTORY OF WISCONSIN'S FORESTS

Wisconsin's forests are reservoirs of vast ecological, economic and social wealth. Throughout Wisconsin's history, forests have played a primary role in supporting the people who lived here. The forests of Wisconsin are dynamic, living systems that change with the human demands placed on them as well as through natural occurrences such as succession, severe weather events, fire, insect infestations, and disease.

# Forests Before European/ American Settlement

At the time of European/American settlement (1825 to 1880), forests stretched over most of the area that would become the state of Wisconsin. Between 22 and 30 million acres – between 63 percent and 86 percent of the total land area of the state – were covered with forests. A complex array of habitats supported wildlife, plants and humans.

The last glaciers receded from northern Wisconsin between 10,000 and 12,000 years ago. Their departure opened the area for colonization by plants, animals and humans.

There are two major forest divisions in Wisconsin – the Northern Mixed Forest and the Southern Broadleaf Forest, with several ecosystems represented in each.

The native vegetation of the northern region is more cold tolerant. Pine, spruce and tamarack are more abundant. Before European settlement, sugar maple, hemlock and yellow birch dominated the mesic forests of northern Wisconsin. Various pine species were also important. Aspen and white birch were



Figure 1-11: This old growth forest of pine, hemlock and northern hardwoods west of Minocqua is typical of the native vegetation that was found in northern Wisconsin before European/American settlement.

important successional species that followed natural disturbance across northern Wisconsin. Acid bogs were a significant ecosystem in the northern Wisconsin forest. Pine forests and barrens were important on the sandy soils of central and northwestern Wisconsin. In the southern part of the state, oak-hickory and maple-basswood forests were especially prevalent. The southern and western parts of the state also supported oak savanna and prairie habitats. Forested and non-forested wetlands were found throughout the state.



Figure 1-12: Prairies and savannahs were common native habitat in the southern and western parts of Wisconsin, which were often maintained by Native American use of fire.

#### **EARLY HUMAN INFLUENCE**

There is evidence of human presence in Wisconsin as early as 11,000 years ago. The post-glacial ecology of Wisconsin was influenced by humans from its very beginning. The extent of that influence in times before European settlement is remarkable.

New research indicates that before European contact beginning in 1492, there were about two million people living in North America. In Wisconsin, 15th-century population is estimated at 60,000 to 70,000. Between 1492 and 1634, the population was reduced to as few as 4,000 individuals, primarily as a result of introduced European diseases and war.

Especially prior to this population collapse, native people profoundly influenced the land and ecology of Wisconsin in areas where they lived. Perhaps most significant was their use of fire. It is thought that native people used fire throughout the state to varying degrees to encourage the establishment of favored plant and animal communities. Prairie and savanna were likely maintained by these fires.

Hunting and trapping also influenced the ecological communities of the area that later became Wisconsin. Native people hunted a broad spectrum of animals. Deer, fish and black bear were the cornerstone of the Woodland Indians' diet, but mussels, birds, fish, and more than 25 other mammal species were utilized as well. Many animal populations may have been limited by human hunting rather than by other carnivores or food supply.

Nuts and fruits were also important to native people, and there is evidence that they planted orchards to ensure a supply. There are accounts from early European explorers describing the "planted tree groves" of chestnuts, locusts, oaks, ashes, basswoods, beeches, cottonwoods, maples, pecans, medlars, mulberries, and plums. These "orchards" may have resulted in the forest islands seen on the prairies by early European explorers.

Foraging also influenced the ecology of Wisconsin. Collected plants may have become over-represented in biotic communities because of Indian dispersal. It was said of wild rice by the Menominee, "Whenever the Menomini enter a region the wild rice spreads ahead, whenever they leave it the wild rice passes." Mining, trails, agriculture and placement of settlements in pre-contact times had a large impact on the landscape. Many of our major highways began as roads between native people's settlements hundreds of years ago.

When early explorers arrived in Wisconsin in the 1630s, they found a greatly reduced population. Because of this, until recent archeological research contested the belief, it was assumed that there were very few people living in Wisconsin before European settlement. The forest early European explorers saw likely changed as a result of the decrease in human population. Because there was no longer the need or capacity to burn or clear the land, many areas maintained by fire as grassland or early successional forest soon became mature forests.

The tribes living in Wisconsin in the mid-1600s included the Winnebago, Ojibwe, Menominee, Dakota, Potawatomi, Heron, Sauk, and Fox. However, some of these groups have stories of migrating from other areas to Wisconsin. For example, the Ojibwe tell of their migration from the eastern ocean in the 1400s. This era corresponds to the "Little Ice Age," a period of significant cooling of the North American continent. Temperatures between 1450 and 1850 averaged 1.5 degrees Fahrenheit cooler than today.

# Forests Since European/ American Settlement

Today, Wisconsin's forests are significantly different than those before European/American settlement. A variety of historical reasons can account for this.

### **EXPLORATION AND SETTLEMENT**

In 1634, Frenchman Jean Nicolet landed on the southern shore of Green Bay to arrange a truce between the Winnebago and their enemies so that the French fur trade would be protected, a task at which he succeeded. This was the first direct European influence felt on the land that would become the state of Wisconsin. However, for two hundred years, the forests remained sparsely settled while providing for the lucrative fur trade and continuing to support native people.



Figure 1-13: Eight million acres of forest were cut by 1898, the height of the Wisconsin Cutover (photo courtesy of the Wisconsin DNR).

Various treaties in the early 1800s, which either removed or confined native populations, opened up Wisconsin to intensive European/American settlement. With the dramatic increase in human population came increasing demands on resources. Much of the southern part of the state was converted to agriculture. The fertile soil in this area, including much that was previously forested, became the base for some of the most productive farms in the growing nation. During this process, southern forests were cut and burned to aid in clearing the land and create nutrient-rich ash to fertilize crops. Timber was not a major economic contributor until the 1870s.

#### THE CUTOVER

In the late 1860s following the Civil War, logging became an important component of Wisconsin's economy. By 1893, Wisconsin had reached its logging zenith and was a world leader in lumber production with more than 3.5 billion board feet produced annually. Pulpwood consumption was about 211,000 cords. Sawmills sprang up everywhere along Wisconsin's many rivers, which transported logs to the mill and finished products to burgeoning cities to the south and west.

In 1898, the federal government conducted and published a survey of Wisconsin's northern forests. By this time, a first wave of cutting was well underway, and a second beginning. In the survey's introduction, B. E. Fernow estimates the 1850s pine (red and white pine) volume at 130 billion board feet. By 1898, all but 17 billion had been removed, and cutting was continuing at a rate of two billion board feet per year. Fernow wrote, "In almost every town in this region, logging has been carried on and 8,000,000 of the 17,000,000 acres of forest are 'cut over' lands largely burned over and waste brush lands, and one-half of it as nearly desert as it can become in the climate of Wisconsin."

By the 1930s, most of the valuable timber in the northern area of the state had been removed or destroyed by fire. The harvest occurred in two waves; the pines were harvested first and floated down the rivers to cities to the south. When railroad shipping became available, valuable hardwoods were cut and taken by train to the south. Then the other, less economically desirable trees were cut.

Harvest techniques varied in cutover lands. Some lands were clearcut, but most were high-graded. The largest and most valuable trees were removed, many times leaving species and individuals less dominant to re-seed an area. At the time of the first statewide inventory in 1936, the approximately 16 million acres of forestland in the state was primarily young, early succession second growth.



Figure 1-14: Logjam on a river. Rivers transported much of the timber cut from Wisconsin forests in the late 1800s (photo courtesy of the Wisconsin DNR).

The Cutover led to a variety of problems for contemporary and future residents. Not least among the challenges was the wave of forest fires that cinched the destruction of millions of acres of trees, and took thousands of human lives. Slash (wood residue from logging operations) burned easily and quickly. Fires spread over large areas, leaving ashes in their path.

Another result of the Cutover was the land boom of the early 1900s. In northern Wisconsin, logging companies sold sizable tracts of cutover land to speculators who then sold smaller farms to the immigrant population arriving in Wisconsin, enticed by the promise of land. Farmers diligently removed stumps left from the Cutover, sometimes disposing of them through fire, which further contributed to the frequent and intense forest fires of the era.

#### CONSERVATION

This degradation of Wisconsin's forests did not go unnoticed. An era of forest conservation was about to begin. One of the most persistent advocates of conservation was E. M. Griffith, appointed the first state forester in 1904. With the help of people as disparate as Senator Robert LaFollette, Sr., lumber baron Frederick Weyerhaeuser, and University of Wisconsin President Charles R. Van Hise, Griffith pieced together land into state-owned forest preserves. He also oversaw construction of the first state nursery at Trout Lake near Minoqua, implemented new fire control strategies and was influential in locating the U.S. Forest Products Laboratory in Madison.

Unfortunately, neither the public nor the Wisconsin Supreme Court was ready for such innovations. County governments were concerned about the loss of land from the tax rolls, and contended that Griffith and his cohorts were trying to turn northern Wisconsin into a "playground for the rich" at the expense of the farmers becoming established in the area.

The Supreme Court found that the land was purchased for the forest preserves under the authority of an improper amendment to the state constitution. Griffith resigned in 1915, and the reforms that he tried to promote were not implemented for another decade.

Finally, in the late 1920s and 1930s, some of Griffith's goals were realized. A new concern for conservation and an understanding that the forest resource is indeed finite formed new decisions regarding Wisconsin's forests. Farmers in the north realized the land and climate were not well suited to agriculture. Many of them abandoned the land, bankrupt. This land reverted to forest.

The State Constitution was amended in 1924 to allow state funds to go to acquisition, development and preservation of forest resources. The Northern Highland State Forest, still the largest state forest, was the first created under the new amendment. The Forest Crop Law, a precursor to the current Managed Forest Law, was passed in 1927, making it easier for private landowners and counties to conserve forest resources for future use. County forests were created from much of the tax delinquent land of failed farms. In 1928, the first national forest land was purchased in Wisconsin, creating what is now known as the Chequamegon-Nicolet National Forest.

After 50 years of pervasive forest fires, made worse because of the ready availability of fast-burning slash from the extensive harvesting, the public began to value fire control. Human life, farms, buildings, and forests were protected with new fire prevention and control measures. With Smokey Bear's advent in 1944, the public embraced a commitment to fire prevention and forest conservation in Wisconsin.



Figure 1-15: The Civilian Conservation Corps fought fires, planted trees and contributed in substantial ways to Wisconsin's growing conservation ethic (photo courtesy of the Wisconsin DNR).

In the 1930s and early 1940s, a notable influence on Wisconsin's forests was the Civilian Conservation Corps (CCC). As in other areas, the "CCC boys" fought fires, planted trees, built park buildings, and worked on other conservation projects. Reforestation efforts commenced across the state, with the goal to renew the forests. Many of Wisconsin's older pine plantations originated with CCC efforts.

The Cutover era had dramatically changed the composition, structure and function of Wisconsin's forests. The extensive logging and large fires allowed species like quaking aspen and paper birch to become prevalent, encouraging large populations of whitetail deer and other wildlife that thrive in early successional habitat.

A forest inventory of Wisconsin was conducted in 1936. It revealed a very young forest, with aspen-birch by far the most prevalent forest type. Many years passed before the cutover forests recovered sufficiently for harvest. Fortunately, by this time there was a better understanding of the need to conserve forest resources and employ sound forest management. In many instances, professional foresters from forest products companies and government agencies worked together to bolster the growing forests.

Since the Cutover era, Wisconsin's forests have recovered dramatically. The state now supports a wide array of healthy forest ecosystems. Ecological, economic and social benefits have grown with the growing forest. There are also challenges that face Wisconsin's forests including environmental issues, economic demands and changing expectations among people who use and own the forests.

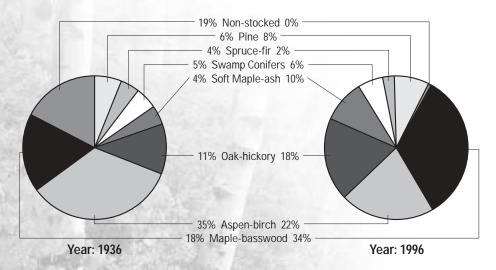


Figure 1-16: Wisconsin forest area by type in 1936 and 1996.

# CHAPTER 2 — GENERALLY ACCEPTED SILVICULTURAL PRINCIPLES

| Sustainable Forestry   | 15     |
|--|--------|
| Landowner Goals and Objectives   | 16     |
| Site Evaluation and Stand Delineation  Forest Cover Types and Silvicultural Alternatives   |        |
| Silvicultural Systems  Even-aged Silvicultural Systems  Uneven-aged Silvicultural Systems  Silvicultural Systems Summary  Table 2-1: Generally Accepted Regeneration Methods | 243338 |
| Passive or Non Management Options  | 41     |
| Salvage Harvests   | 41     |
| Unsustainable Cutting Methods  | 42     |
| Management Prescriptions   | 43     |

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**NOTE:** Figures 2-9 through 2-11, 2-13 through 2-18, and 2-23 and 2-24 use computer-generated simulations to depict various harvest methods listed in Table 2-1 (see page 39). The images were produced by Andrew M. Stoltman as part of the *Forest Visualization at Multiple Scales for Management* project at the University of Wisconsin Department of Forest Ecology and Management, Madison.

The purpose of this part of the guide is to focus on growing stands of trees and the generally accepted silvicultural practices used in Wisconsin.

#### This chapter will:

- Provide an overview on the interdependence of compatible landowner objectives, a careful evaluation of site capability and the selection of an appropriate silvicultural system – the three essential elements of sustainable forestry practices.
- Expand upon each of the preceding three essential elements of sustainable forestry practices.
- Identify, define and explain various silvicultural systems and their application to the common forest cover types in Wisconsin.

- Address other types of harvesting, unsustainable cutting methods and passive management strategies.
- Provide examples of how to distill all the sustainable forestry considerations into an effective management prescription at the stand level.

For more detailed silvicultural information related to a specific forest cover type or forest management treatment, readers are referred to the *Wisconsin DNR Silviculture and Forest Aesthetics Handbook*, 2431.5.

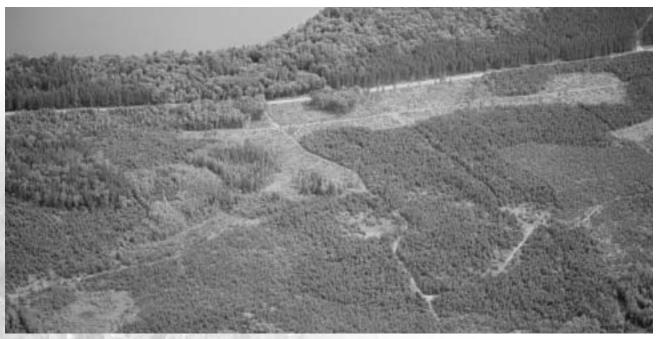


Figure 2-1: The goal of sustainable forest management is to meet the needs of humankind for commercial products and amenities through silvicultural practices that work within and safeguard the processes that form natural communities.

# SUSTAINABLE FORESTRY

Sustainable forestry practices must be based on compatible landowner objectives, the capabilities of each particular site and sound silviculture. Each of these factors is equally important.

Landowners' goals and objectives might encompass a wide range of values and benefits such as commercial products, recreation, aesthetics, wildlife habitat, endangered and threatened resources, and clean water. Understanding landowners' goals and objectives is essential to ensure that prescribed forestry practices are relevant and will endure over time. Landowners' goals and objectives must also be compatible with sustainable forestry defined as the management of dynamic forest ecosystems to provide ecological, social and cultural benefits for present and future generations. The silvicultural principles discussed in this guide assume that landowners are committed to sustainable forestry.

Site capabilities help define sustainable forestry practices. Each particular growing space has its own set of environmental conditions affecting tree growth. Factors like soil type, aspect and climate that influence moisture, and nutrients needed by individual tree species must be considered if long-term health and vigor forests are to be achieved. The section of this chapter dealing with Site Evaluations and Delineation of Stands will help clarify site capabilities.

Silviculture is based on both forest ecology (relations between organisms) and the silvics (behavior or response) of individual tree species. Silvicultural systems are applied to stands of trees (rather than to individual trees) composed of species that commonly grow together. By definition, silviculture is the practice of controlling forest composition, structure and growth to maintain and enhance the forest's utility for any purpose. Silviculture is applied to accomplish specific landowner objectives.

The following sections of this guide will cover a number of silvicultural systems and harvest methods separately to facilitate the discussion of sound

silviculture. Keep in mind that the techniques are often most effective when used in combination to best accommodate differences between and even within stands. Table 2-1 (see page 39) further shows the array of regeneration harvest methods generally considered acceptable for the forest cover types in Wisconsin. The ability to adapt silvicultural systems to address multiple objectives is limited only by ones own imagination and creativity, making the practice of sustainable forestry both an art and a science.

#### SUSTAINABLE FORESTRY

The practice of managing dynamic forest ecosystems to provide ecological, economic, social, and cultural benefits for present and future generations (from Ch.28.04(1)e, Wisconsin Statutes).

#### **SILVICULTURE**

The practice of controlling forest composition, structure and growth to maintain and enhance the forest's utility for any purpose.

#### **FOREST ECOLOGY**

The science concerned with 1) the forest as a biological community dominated by trees and other woody vegetation; 2) the interrelationships between the various trees and other organisms constituting the community; and 3) the interrelationships between the organisms and physical environment in which they exist.

#### **SILVICS**

The study of the life history, characteristics and ecology of forest trees. It involves understanding how trees grow, reproduce and respond to environmental variations. The silvics of a particular tree species would describe the climatic range, temperature and light requirements, thermoperiodicity, moisture needs, soil conditions and topography, life history and development, commonly associated trees and shrubs, and any insect, disease and environmental factors that affect its growth and survival.

## LANDOWNER GOALS AND OBJECTIVES

Silviculture and forestry practices are not ends within themselves, but rather a means of achieving specific objectives in a landowner's overall goal to manage a forest on a sustainable basis. The test of a silvicultural prescription or recommended forestry practice is how well it meets the landowner's sustainable forestry goals and objectives.

As noted previously, landowner goals may be varied, reflecting a wide variety of forest values and benefits. Some goals may have a higher priority than others, but it's important to remember they are often interrelated, and generally depend on sound forestry practices to be realized.

Goals can be achieved by accomplishing specific objectives. For example, a goal of periodic income or maintenance of wild turkey habitat might be achieved through an objective to regenerate an oak timber type through small shelterwood harvests spread over time. Think of a silvicultural prescription as a site-specific "action plan" to accomplish objectives.

In developing goals, landowners should realize that although specific site characteristics of their land could make some objectives unsustainable, there might be other viable courses of action to choose from. It's up to the forester and other resource professionals to identify all options open to the landowner, and to use as much flexibility as possible in designing a silvicultural prescription that best addresses the full range of landowner goals.

#### **GOAL**

A concise statement that describes a future desired condition normally expressed in broad, general terms that are timeless with no specific date by which the goal is to be achieved.

#### **OBJECTIVE**

Concise, time-specific statements of measurable, planned results that relate to overall goals.

Note: Generally, "goals" apply to an entire property and "objectives" to individual stands.

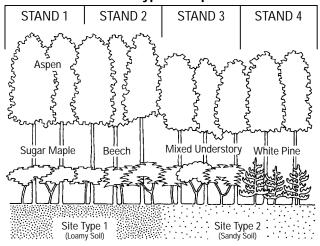


Figure 2-2: Landowners and resource managers should meet on-site prior to preparing a plan or conducting operations. Such meetings can help assure common understanding of landowner objectives, site characteristics and forestry prescriptions.

## SITE EVALUATION AND STAND DELINEATION

Site capability determines what types of forestry practices are sustainable. A site is defined by the sum total of environmental conditions surrounding and available to the plants. A site is also a portion of land characterized by specific physical properties that affect ecosystem functions and differ from other portions of the land (Kotar 9).

**Cover Type 1: Aspen** 



Cover Type 2: Red Oak

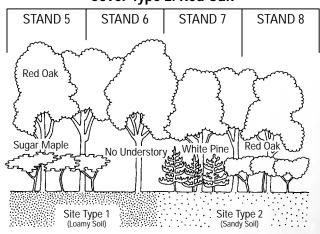


Figure 2-3: A schematic representation of two site types (loamy soil and sandy soil), two forest cover types (aspen and red oak), and eight stands. Each stand has unique composition and is defined by a specific combination of overstory and understory species. Each stand also can be considered as a unique ecological or silvicultural opportunity unit (Kotar 10).

Forestry practices are carried out on a stand basis which determines where practices will occur. A stand may loosely be defined as a contiguous group of trees sufficiently uniform in species composition, arrangement of age classes, and general condition to be considered a homogeneous and distinguishable unit.

A stand is usually treated as a basic silvicultural unit. The forest cover type that occupies stands (e.g., an "aspen" stand or a "jack pine" stand) normally identifies them. Cover types are discussed in more detail later in this chapter.

Forest stands are identified through the use of aerial photographs, forest reconnaissance, inventory, and cruising. Sites are generally delineated based on soils, topography, landforms, geology, vegetation associations, and site index.

It's important to note forest stands and sites often overlap each other. As illustrated in Figure 2-3, a single stand may occupy more than one site as well as a single site may support more than one stand.

Since a stand is the basic unit of silvicultural planning, care should be taken to ensure that it represents a uniform ecological opportunity unit. In other words, each specific site and stand combination has a unique set of silvicultural opportunities and constraints, which can be used to increase the number of outcomes available to the landowner. As shown in Figure 2-4 and Figure 2-5 (see page 18), defining stands by cover type and site type will facilitate the determination of management objectives.

Forest site quality is the sum total of all factors affecting the capacity to produce forests or other vegetation. Biotic and abiotic factors impact moisture and nutrient and energy (light and heat) gradients, which determine vegetation growth and dynamics. Site quality affects tree growth, species composition and succession (plant community development). As site quality varies, so do forest management potentials and alternatives.

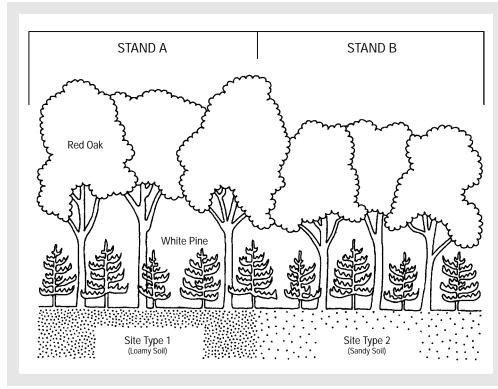


Figure 2-4: A single stand (red oak overstory with white pine regeneration) "straddles" two significantly different site types. Because ecological and silvicultural potentials differ for the two site types, the stand was split (A and B) to identify two ecological and silvicultural opportunity units (Kotar 12).

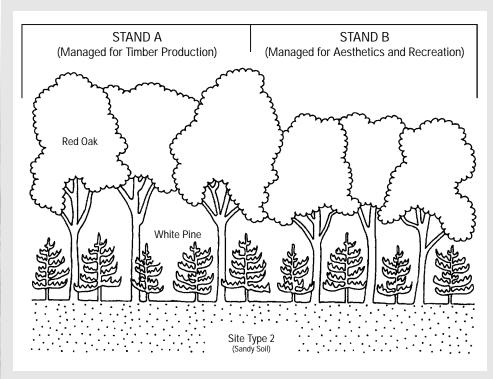


Figure 2-5: This stand is divided into two management units on the basis of different management objectives. E.g., in stand A, oak will be harvested and white pine released to form a new crop, while in stand B, oak overstory will be retained to provide a food source for wildlife and conditions for future old growth (Kotar 13).

Forest site productivity is a measure of the rate of tree growth and overall wood volumes that can be expected on a given site. Productivity for a given species will generally vary between different sites as will productivity for different species on the same site.

There are direct and indirect ways to evaluate forest site quality and productivity:

- Direct measures of forest productivity such as historical yields and mean annual increment. These measurements are influenced by stand characteristics and may not be available.
- 2) **Indirect measures** that relate environmental characteristics to tree growth and productivity are most commonly used. Indirect measures can be applied individually or in combination.
  - Site Index: Growth rates are measured and compared to tables that predict the height a particular species will attain at a given age.
  - Vegetation Associations: The number and relative density of key characteristic ground plants are measured, and a vegetative habitat type is identified. A great deal of inventory and other productivity date is available for each habitat type in Wisconsin.
  - Physical Site Characteristics: Examples of this include geology, landform, aspect, topography, and soil. These characteristics can be used to differentiate among types of sites that are significantly different with respect to their capabilities to support or produce different cover types or rate of tree growth. It's important to remember, however, that different combinations of individual site factors can result in functionally similar sites.

Regional site classification systems can provide tools to understand local site variability, impacts on site quality and productivity, and potential management alternatives.

# Forest Cover Types and Silvicultural Alternatives

The range of sustainable management alternatives on a given site is limited. In a forested situation, tree species tend to occur in associations known as forest cover types. These may range from a single species to several different species that commonly grow together on a particular site. The Department of Natural Resources recognizes roughly 19 forest cover types statewide. Of that number, only a small subset will naturally occur on any given site.

# COMMON FOREST COVER TYPES FOUND IN WISCONSIN

Oak
Scrub Oak
Aspen
White Birch
Red Pine
White Pine
Northern Hardwood
Hemlock Hardwood
Central Hardwoods
Bottomland Hardwoods
Swamp Hardwood
Swamp Conifer-balsam fir

Jack Pine Cedar

Red Maple Black Spruce Walnut Fir-spruce

Tamarack

Forest cover types on a given site tend to change over time through the natural process of forest succession. Following a major disturbance such as a fire or windstorm (or a silvicultural treatment designed to create similar conditions), a pioneer community normally invades a site. These communities (or forest cover types) are made up of sun-loving species able to rapidly establish themselves on an open, relatively competition-free, highly-disturbed site. Over time, the canopy begins to close and limit available sunlight, which results in other more shade-tolerant species becoming established.

As the original pioneer species are no longer able to compete, other successional communities better adapted to the changing microenvironment gradually replace them. A gradual transition to a number of different successional communities may occur as each gains a reproductive edge on the continually changing site conditions. At some point, after a long disturbance-free period, sites will transition to a potential climax community that is self-regenerating. This climax community will occupy the site until another disturbance creates conditions favoring re-establishment of a pioneer community (a major disturbance) or one of the earlier successional communities (a lesser disturbance).

In Wisconsin, these successional trends are fairly well understood for each ecological habitat type (site type). The pathways on some sites involve only a few stages; on others there may be several. Figure 2-6 is an example of the successional stages and trends on one particular site type.

Referring to Figure 2-6, an understanding of forest succession on a particular site can provide a great deal of useful information to a landowner evaluating potential management goals and a forester developing the silvicultural prescription needed to achieve those goals. On the site illustrated, one might deduce:

- Seven successional stages commonly occur naturally. Long-term management for quality northern hardwood or black walnut sawtimber, for example, would not be practical.
- Of the naturally occurring successional stages, some are currently more common at a landscape scale (as identified by the circles).
- Maintaining an existing climax association would normally require less effort to ensure regeneration. On this particular site for example, red maple, red oak, white pine, white spruce, and balsam fir are self-regenerating.

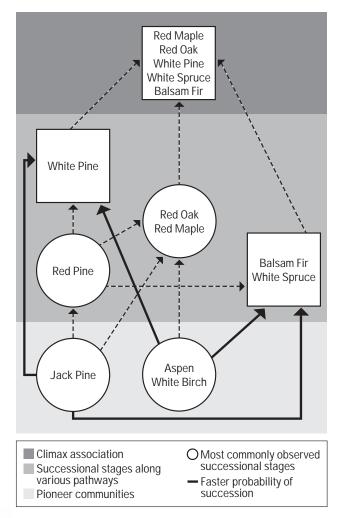


Figure 2-6: This figure represents the most commonly observed successional stages and probability of succession on this site type.

 Movement from one successional stage to another further along in the successional path will occur naturally over time. The process of succession could even be shortened with minimal effort. Careful selection of red pine for removal to release invading white pine, for example, would hasten the conversion from a red pine to a white pine timber type.



Figure 2-7: White pine was the first and most desirable tree species removed during the Cutover. Repeated fires after logging destroyed many regrowing pine forests. White pines are now returning through forest succession. The shade-tolerant seedlings regenerate under hardwood canopies where seed sources are available on sandy or loamy sand soils.

- Maintaining a pioneer or mid-successional stage would require a disturbance, such as active management, to overcome the natural tendency to convert to the next stage. Increasing light levels by maintaining a lower canopy density is needed to allow reseeding of the more light-demanding, earlier successional stages. Marking criteria would have to focus on releasing preferred species from more shade tolerant species to ensure survival.
- Reversing the trend and going back to a previous successional stage would generally require a significant disturbance. Even-aged management would normally be needed to create conditions favorable for re-invasion by pioneer successional stages like aspen and white birch. Prescribed fire or mechanical scarification may be required to favor jack pine. Site preparation and planting would probably be needed to re-establish red pine. In general, the further succession is set back the more disturbance and effort will be required.

### SILVICULTURAL SYSTEMS

A **silvicultural system** is a planned program of vegetative manipulation carried out over the entire life of a stand. All silvicultural systems include three basic components: **harvest**, **regeneration and tending**. These components are designed to mimic natural processes and conditions fostering healthy, vigorous stands of trees. Typically, silvicultural systems are named after the regeneration method employed to create the conditions favorable for the establishment of a new stand.

A harvest method differs from a simple harvest cut because it's specifically designed to accomplish two objectives – removal of trees from the existing stand, and the creation of conditions necessary to favor regeneration and establishment of a new stand. The method selected depends on the species to be regenerated or established in the new stand. Harvest methods vary from the complete removal of a stand in a single cut or in stages over several years, to the selection of individual trees or groups of trees on a periodic basis.

A regeneration method is a process by which a stand is established or renewed. The various methods include: 1) the removal of the old stand; 2) the establishment of a new one; and 3) any supplementary treatments of vegetation, logging residue or soil that are applied to create conditions favorable for the establishment of reproduction. There are two general regeneration techniques:

- Natural regeneration systems rely on natural seeding or root/stump sprouts and are generally carried on concurrently with the harvest process. In some cases, additional follow-up activities (e.g. scarification, understory competition control, slash treatment, or prescribed fire) may be necessary.
- Artificial regeneration systems depend on the planting of tree seedlings or seeds. Generally, planting occurs on non-forested land or following

complete removal and harvest of a forest overstory and results in an even-aged stand. Examples of artificial regeneration systems are:

- Afforestation: Establishing a forest on non-forested land.
- Reforestation and Conversion: Forest type conversion when the desired species is not present or is inadequately represented to provide sufficient seed or vegetative reproduction.
- Reforestation and Re-establishment: Forest type re-establishment when the desired species are difficult to regenerate, and it appears to be more efficient to utilize artificial regeneration than to depend on natural regeneration.

Table 2-1 (see page 38) shows the regeneration harvest methods described in this chapter as generally accepted for application to Wisconsin forest cover types.

Tending involves a number of intermediate treatments. Some are designed to ensure early survival through weeding and release activities. Others modify species composition or future tree quality through timber stand improvement, crop tree release and pruning. Periodic thinnings over the life of the stand are another type of tending activity. They maintain optimum stocking levels in order to maximize tree vigor, increase stand diameter growth and remove defective or poorly growing trees.

Separate discussion of each silvicultural system that follows is meant to aid understanding. The systems, however, are most effective when used in combination to best accommodate site differences between and within stands. Flexibility and imagination can be used to accommodate a host of forest values through silvicultural prescriptions.

Another important factor to keep in mind is that all harvests are not necessarily part of a regeneration system. In some cases, a harvest is specifically designed to capture the value of trees that might otherwise be lost. An example would be a situation where past cutting practices or natural events have left a number of mature trees scattered over an otherwise immature stand. Waiting for the scheduled regeneration harvest of the younger stand would likely result in loss of valuable forest products. As a result, a harvest might be carried out as part of an intermediate or salvage operation specifically to remove all or a portion of the older trees. Even though such harvests are not part of the overall regeneration system being applied to the primary stand, they should be compatible with overall long-term silvicultural objectives.

Remember, too, that silvicultural systems are developed based on the characteristics of forest cover types and a consideration of site factors. Specific treatments within a system should be modified to accommodate any special requirements.

Some of the key considerations in the selection of a silvicultural system include:

 Shade Tolerance: The term refers to the ability of a given tree species to survive or thrive in low light conditions under a forest canopy. Shade tolerance is one of the most critical considerations in the selection of a silvicultural system. Once established, most trees will maximize vigor and growth in near full sunlight. However, the amount of sunlight required for regeneration, early survival and different growth rates varies between tree species. Some species require full sunlight for their entire life cycle while others benefit from some protection in the regeneration and early establishment phases, only requiring full sunlight later to maintain growth and vigor. Still other species are able to regenerate and develop under very shady conditions, and use that ability to effectively compete with other more sun-loving species.

- Age Distribution and Stand Structure: The age difference between individual trees within a particular stand varies. Some cover types typically regenerate all at once following a major disturbance (fire, wind events, insect and disease activity, past cutting, etc.). Others regenerate as groups following smaller disturbances, while still others regenerate almost continuously as individual trees die and create openings. As a result, the trees in some stands are essentially all the same age, while in others age varies widely. These age differences within a stand are often reflected by differences in tree heights and diameters. Trees in an even-aged stand tend to mature at the same time, while trees in an uneven-aged stand tend to mature as groups at distinct intervals or as individual trees on a relatively continuous basis.
- Seed Production, Dissemination and Predation:
   Should seed to come from the residual overstory, or will a new stand result from vegetative sprouting or seed in the slash? Is sufficient seed generally available, or will the harvest need to be timed with the occurrence of a good seed crop?
- Seedbed Characteristics and Germination Requirements: Is a mineral soil seedbed and/or residual overstory shade needed to enhance germination and better stabilize moisture variations during the early survival phase?
- Seedling Establishment and Competition Control:
   Will overstory shade be needed to protect new
   seedlings from full sun during early development?
   Will overstory shade be needed to retard the
   growth of competing species, or is full sun needed
   to ensure the target species will be able to
   outgrow its competition?
- Quality Considerations: In stands managed for high-quality sawtimber, overstory shade levels must be carefully controlled to minimize sunscald and epicormic branching and forking, while at the same time maximizing tree form and merchantable height.

# Even-aged Silvicultural Systems

Even-aged management systems are normally used to harvest, regenerate and tend sun-loving forest cover types that grow poorly or will not regenerate in their own shade. The cover types adapted to these systems are generally those accustomed to regeneration and rapid domination of a site following a catastrophic disturbance, such as a fire or major windstorm. They are normally used in stands where all the trees are near the same age. Even-aged systems are also applied to cover types dominated by shade tolerant species when the intent is to focus on the less tolerant component of the stand. Portions of even-aged management systems, specifically the intermediate thinning regimes, may also be used in the early stages of young northern hardwood stands to facilitate a long-term conversion to the uneven-aged system.

# EVEN-AGED HARVEST AND REGENERATION METHODS

Light requirements, growth rates and reproductive characteristics of the species to be regenerated govern the degree of overstory removal at the time of harvest. Competing vegetation and site characteristics are additional factors. The following are the generally accepted even-aged regeneration methods used in Wisconsin.

Even-aged regeneration methods used to partially simulate the degree of stand mortality that would normally follow a major natural disturbance such as a fire.

These methods are primarily used with intolerant species such as aspen, red pine or jack pine that require full sunlight to ensure complete regeneration and optimum development.



Figure 2-8: This aspen stand was harvested one year ago using the coppice regeneration method and several red pine "standards" were retained per acre to enhance the visual impact. Abundant aspen, from vegetative reproduction, has now been established.

 Coppice: (Figures 2-8 through 2-11) A method designed to naturally regenerate a stand using vegetative reproduction. The overstory is completely removed.

Generally there is no residual stand left as the residual can interfere with the regeneration and is not necessary to shelter the regenerated stand.

This method differs from the other even-aged regeneration systems (clearcut, seed tree and shelterwood) in that the regenerated stand is derived from vegetative reproduction rather than a seed source.



Figure 2-9 (Coppice A): A 50-year-old aspen stand with smaller numbers of northern red oak, red maple and white pines mixed in (the understory has been reduced for image clarity), (A. Stoltman).



Figure 2-10 (Coppice B): An aspen stand immediately following a clearcut/coppice regeneration harvest showing tree stumps, coarse woody debris and scattered advanced natural regeneration, (A. Stoltman).



Figure 2-11 (Coppice C): A stand of dense coppice-origin aspen sprouts 10 to 15 years after the initial harvest, (A. Stoltman).

 Clearcut: (Figure 2-12) A method used to regenerate a stand by the removal of most or all woody vegetation during the harvest creating a completely open area leading to the establishment of an even-aged stand.
 Regeneration can be from natural seed produced by adjacent stands, trees cut in the harvesting operation, direct seeding, or replanting.

This method differs from the seed tree and shelterwood methods in that no trees are left in the cut area for seeding purposes. Rather, the seed source is from outside the cut area or from felled tops of harvested trees.

• Seed Tree: (Figures 2-13 and 2-14) A method designed to bring about natural reproduction on clearcut harvest areas by leaving enough trees singly or in groups to naturally seed the area with adequate stocking of desired species in a reasonable period of time before the site is captured by undesirable vegetation. In this method only a few trees (typically three to 10 per acre) are left and the residual stocking is not enough to sufficiently protect, modify or shelter the site in any significant way. Seed trees may be removed after establishment or left indefinitely.



Figure 2-12: This central Wisconsin stand of mixed jack pine and "scrub" oak was clearcut within the past year.

This method differs from the coppice method in that regeneration comes primarily from seed rather than sprouts. It differs from a clearcut in that the seed source for regeneration is from residual trees within the harvest area rather than outside the cut area or relying on seed existing on or in the ground. It differs from a shelterwood in that the residual stocking is too sparse to modify the understory environment for seedling protection.



Figure 2-13 (Seed Tree A): A mature forest of predominately white pines mixed with smaller amounts of northern red oak and red maple. Seed tree harvesting is one method used with even-aged species that require full sunlight for regeneration. All trees in such stands are generally ready for harvest at the same time, but sufficient advanced regeneration is not usually present, (A. Stoltman).



Figure 2-14 (Seed Tree B): White pine residual following a seed-tree regeneration harvest leaving about seven trees per hectare as a seed source to renew the stand, (A. Stoltman).

# Even-aged regeneration methods used to partially mimic natural deterioration of the overstory over time.

These methods are tailored to more tolerant species that require partial shade and/or a seed source for optimum regeneration, but need full sunlight for survival and full development (such as white pine and oak).

Shelterwood: (Figures 2-15 through 2-18)
 A method used to regenerate a stand by manipulating the overstory and understory to create conditions favorable for the establishment and survival of desirable tree species. This method normally involves gradual removal (usually in two or three cuts) of the overstory. The overstory serves to modify understory conditions to create a favorable environment for reproduction and provide a seed source.

 A secondary function of the overstory is to allow

further development of quality overstory stems during seedling establishment. The most vigorous trees are normally left as the overstory, and the less vigorous trees removed.

A successful shelterwood harvest often requires the removal of intermediate or suppressed saplings and poles (often of less desirable species such as elm, ironwood or red maple) because the smaller understory trees will suppress development of vigorous seedlings of the preferred species.

Initial shelterwood cuttings resemble heavy thinnings. Natural reproduction starts under the protection of the older stand and is finally released when it becomes desirable to give the new stand full use of the growing space. At that point, the remaining overstory is completely removed.



Figure 2-15 (Shelterwood A): A dense stand of mature oak sawtimber and associated hardwoods before harvest. Notice the uniformity in size and age in the overstory, and the lack of regeneration, (A. Stoltman).



Figure 2-16 (Shelterwood B): An oak forest soon after the first stage of a shelterwood harvest removing approximately 75 percent of the basal area. (Note: In some situations, post-harvest treatment of the understory with herbicides or mechanical scarification may be needed to control competition or to prepare a seed bed.), (A. Stoltman).



Figure 2-17 (Shelterwood C): The same stand after five years. Notice the regeneration developing as a result of the increased light penetration, (A. Stoltman).



Figure 2-18 (Shelterwood D): An oak forest after the second stage (overstory removal) of a shelterwood harvest. After approximately 10 years, established regeneration is adequate to replenish the stand. The overstory is removed so the established seedlings and saplings are free to grow, (A. Stoltman).



Figure 2-19: A red oak stand several months after the first shelterwood cut (seed cut). The logging slash was removed and the ground was scarified to provide improved conditions for the oak acorns to germinate.

This method differs from clearcutting and coppice methods in that the next stand is established on the site before overstory removal. It differs from a seed tree cutting in that the overstory serves to protect the understory as well as distribute seed. Finally, an even-aged shelterwood harvest differs from uneven-aged selection methods in that it promotes an even-aged stand structure.

 Overstory Removal: A method used to mimic the natural deterioration of the overstory but at an accelerated rate in situations where adequate regeneration is already established. The entire stand overstory is removed in one cut to provide the release of established seedlings and saplings. This method has been referred to as a natural shelterwood or a one-cut shelterwood.

Overstory removal results in an even-aged stand structure as opposed to uneven-aged structure. It differs from the clearcut and the coppice regeneration methods in that seedling and sapling



Figure 2-20: Regeneration 27 years after a two-cut shelterwood harvest in northern hardwoods. The seed cut was conducted in 1969, the overstory was removed in 1975. This even-aged sapling stand has the same structure a clearcut harvest would produce.

regeneration is established prior to the overstory removal. It differs from the shelterwood and seed tree methods in that no manipulation of the overstory is needed to establish regeneration.

Overstory removal can be applied to all forest stands being managed on an even-aged basis if desirable advance regeneration is well-established. Cover type specifics and applicability of overstory removal are addressed in appropriate cover type chapters of the *Wisconsin DNR Silviculture* and Forest Aesthetics Handbook. General considerations in the application of the overstory removal method are:

- Overstory health, condition and composition
- Potential risk of raising the water table on wet sites
- Adequate stocking, distribution, vigor and desirability of established, advanced regeneration
- Site capability
- Existing and potential competition, including exotic species

All the even-aged methods have variants with reserves involving scattered trees left throughout the harvest area or in groups or clumps. Individual trees or groups of trees left uncut on a long-term basis will hamper the growth of seedlings adjacent to them, but regeneration should be adequate as long as the reserves do not exceed 20 to 30 square feet of basal area per acre. With such reserves, even-aged systems can be managed as two-aged systems on a long-term basis.

In most cases, the goal of an even-aged silvicultural system is to naturally regenerate a species already present in the stand. Depending on the species involved, additional activities may be required to ensure its germination and growth requirements are met. These may involve the use of prescribed fire, disking and other forms of scarification to expose a mineral soil seedbed to enhance seed germination and survival. Where natural regeneration is insufficient or in cases where the desired species was not present in the harvested stand, tree planting may be required.

#### **EVEN-AGED TENDING METHODS**

Timber Stand Improvement (TSI) is a series of non-commercial activities designed to increase the survival, productivity and value of a stand. Specific activities include removal of competing vegetation to ensure tree survival, thinning overstocked areas, releasing crop trees, and/or pruning to increase the production of high-quality sawlogs. These operations are generally carried out early in the life of a stand before the trees become large enough to commercially thin. Specific needs are based on the species involved and specific site conditions.

Intermediate thinnings are used to maintain optimum stocking levels to maintain tree vigor, increase stand diameter growth, and to remove defective or poorly growing trees. Thinnings are generally carried out on a 10- to 15-year cycle until the final harvest, beginning when trees reach a merchantable size and stocking reaches a level high enough to allow removal of enough volume to be economically viable. Excessive stocking reduces diameter growth and vigor, and, in extreme cases, can reduce volume growth. Tree selection is primarily based on risk, vigor, quality, and spacing.





Figure 2-21 and 2-22: The importance of tending an even-aged stand is illustrated by comparing these two plots in the famous Star Lake thinning experiment started by Fred Wilson with red pine planted in 1913. Figure 2-21 (left) shows the poor growth and mortality in the plot that was never thinned. The adjoining plot, Figure 2-22 (right), shows the impact that periodic thinnings (every five to 10 years starting in 1943) can have on red pine growth and quality.

Optimal number of trees left varies with the species being managed and the site on which they occur. Optimal residual stand density can also change over time as the stand matures. Stocking charts provide guidelines for a range of residual stocking levels for optimum growth and yield. This flexibility offered within a range can be utilized to alter thinning schedules and residual levels to enhance other landowner goals over the life of the stand.

When using the even-aged system as a transition to long-term uneven-age management, initial thinnings in pole-sized northern hardwood stands are focused on crop tree release and development of more favorable stand structure. Later thinnings are based on uneven-aged individual tree selection criteria described in the activity-specific chapters of these guidelines.

# EVEN-AGED HARVEST ROTATION LENGTH CONSIDERATIONS

Under even-age silvicultural systems, entire stands are harvested all at once or over a relatively short period when they reach a given age. The term rotation is used for the period of years required to grow timber stands to a specified condition of maturity. The age of the stand at the end of the rotation period when it is normally harvested is called the rotation age.

Traditional rotation ages are set at a point in time when average annual growth reaches its maximum. Beyond that age, stands grow more slowly. Decay and tree mortality may begin to increase. This rotation age varies by species and site, and is normally established for each individual species reflecting prevailing regional or local conditions.

Eventually a stand will reach its pathological rotation age, at which time insect and disease activity result in such extensive decay and mortality that harvesting of the stand is no longer economically viable. At the stand level, natural mortality of the overstory becomes significant. Regeneration of the current overstory may also become difficult due to natural succession and loss of seed sources.

Rotation length will vary with a number of factors:

- The average growth rate and life span of the species involved. A typical rotation age for a stand of aspen, for example, is 45 to 60 years. A typical rotation age for an oak stand may be two to three times as long.
- The type and quality of product desired.
   Pulpwood takes a shorter time to produce than sawlogs, which must be larger in diameter. High quality sawlogs and veneer logs require more time since they are typically grown to larger diameters and at higher density levels.
- Economic considerations. Changes in supply and demand in general, specific customer requirements, market values, and internal infrastructure demands can all result in modified rotation ages.
- Site productivity. More productive sites support increased growth rates for a longer period of time. As a result, the period of positive mean annual growth is also extended, increasing the optimum rotation age. Different rotation lengths are typically employed across the range of site productivity.

- Insect and disease concerns. The level of mortality and decay caused by insects and disease is a prime factor in net growth. Insect and disease outbreaks can significantly reduce stand growth and in extreme cases, cause such extensive mortality that they determine rotations. As stands age, the risk of sudden, extensive mortality increases.
- Landowner goals. Rotation ages can be extended to enhance non-timber resources if the landowner is willing to accept reduced growth rates and potentially forgo some timber revenues. In some cases, these extended rotations can enhance the supply and value of some high-quality timber products such as sawtimber and veneer. Just as stands can be held for some time after the normal rotation age, they can also be harvested for a period prior to the normal rotation age. This harvest period can be used to space harvests over time, divide or combine stands to meet other landowner goals, manage the flow of timber income or deal with other supply and demand economic constraints.

### Uneven-aged Silvicultural Systems

Uneven-aged management systems are normally used to harvest, regenerate and tend forest cover types that will regenerate and grow under their own shade. Stands managed under uneven-aged systems are normally comprised of three or more age classes. These cover types are adapted to regenerate under partial canopies following minor disturbances like individual tree mortality, or a moderate disturbance such as a wind storm that would damage up to one third of the stand. Uneven-aged systems are designed to mimic such disturbances.

Even shade tolerant species grow most vigorously in relatively free-to-grow conditions with full

sunlight, assuming other growth requirements like soil moisture, are met. As a result, regeneration and most vigorous growth typically occur in small to medium-sized gaps (small openings). The number and size of the gaps created through uneven-aged management are dependent upon species composition, acreage regulation, and tree rotation age or size. Normally, these systems are used to manage stands containing mixed trees of all ages, from seedlings to mature trees. They are also used to convert even-aged stands to an uneven-aged structure.

# UNEVEN-AGED HARVEST AND REGENERATION METHODS

Stand regeneration is achieved by periodically manipulating the overstory and understory to create conditions favorable for the establishment and survival of desirable tree species. Thinning, regeneration and harvesting usually occurs simultaneously. The harvested trees are essentially replaced by growth on the younger trees left in the stand. These silvicultural systems are designed to maintain an uneven-aged stand condition, while manipulating the multi-age and multi-size structure of the overstory to facilitate continual recruitment and development of quality growing stock.

The following are generally accepted uneven-aged natural regeneration systems used in Wisconsin:

• Single-tree Selection: (Figures 2-23 and 2-24) Individual trees of various size and age classes are periodically removed to provide space for regeneration and promote the growth of remaining trees. Each regeneration opening (gap) covers an area equivalent to the crown spread of a single large tree that has been removed. Individual trees are selected for removal from all size classes (to achieve residual density levels) following recognized order of removal criteria based on tree risk, vigor, quality, and spacing.

The goal, particularly in the northern hardwood cover type, is to achieve an optimum distribution of size and age classes such that each contains a sufficient number of quality trees to replace those harvested in the next larger size class.

Specific selection criteria vary slightly with the particular species makeup of the stand involved (see the *Wisconsin DNR Silviculture and Forest Aesthetics Handbook* or an appropriate management guide).



Figure 2-23 (Single-tree Selection A): A second growth hemlock/hardwood stand dominated by hemlock, yellow birch and lesser amounts of sugar maple, paper birch, white pine, and balsam fir. The stand contains about 120 square feet of basal area per acre with excess in the 10-inch diameter class, (A. Stoltman).



Figure 2-24 (Single-tree Selection B): The stand after a selection harvest cut to about 70 square feet of basal area per acre, with trees removed across many size classes, (A. Stoltman).

• Group Selection: Trees are periodically removed in small groups to create conditions favorable for the regeneration and establishment of new age classes. In general, the openings created may range in size from fairly small 0.02 acre (30' diameter circle) up to one half acre (166' diameter circle or approximately two tree lengths). In northern hardwood management, gaps are generally less than one-tenth acre. Smaller openings favor the regeneration of more tolerant species, while larger openings favor mid-tolerant species.

In general, stands dominated by large crowned tolerant species (such as sugar maple, beech and hemlock) do not require the creation of large openings to provide sunlight for regeneration, and individual trees are harvested as they mature using the single-tree selection method. However, some of the less tolerant species commonly associated with sugar maple (such as basswood, yellow birch and ash) benefit from the use of the group selection method to enhance recruitment and growth of new seedlings. One-quarter to one-half acre gaps can also be used to facilitate the management of uneven-aged stands of mid-tolerants like red oak and white pine on some sites. Potentially, most tolerant to mid-tolerant species can be managed by applying variations of the selection regeneration method, if appropriate steps are taken to control competition.

In general, stands managed under uneven-aged systems regenerate as a result of manipulation of light levels during the harvest process. In some cases, non-commercial removal of additional cull trees or poorly formed saplings may be needed to further enhance regeneration in specific areas which are not opened up through the normal selection process.



Figure 2-25: Tree Quality

With the uneven-age silvicultural system, the tree selection decision (to cut or leave) considers a number of factors as illustrated in the following figures: tree quality (Figure 2-25); proper spacing of trees (Figure 2-26); and species desirability (e.g., the yellow birch or sugar maple in Figure 2-27).



Figure 2-26: Proper Spacing



Figure 2-27: Species Desirability

#### **UNEVEN-AGED TENDING METHODS**

- Timber Stand Improvement: In some cases, selected weeding and crop-tree release work may be needed in larger openings created in the group selection process to ensure survival of mid-tolerant target species. As crowns expand over time, previously created regeneration gaps may need to be reopened or expanded to maintain growth of young trees.
- Thinning Cuts: Under the uneven-aged silvicultural system, thinning cuts are usually carried out concurrently with periodic regeneration cuts. Stands are normally re-entered on an eight- to 20-year cutting cycle on a continuing basis as site quality, growth rates and removable volumes allow. Size and age class distribution are very important in the growth and quality development of trees managed with the uneven-aged system, and specific stocking levels are targeted for seedling/sapling, pole and sawtimber-sized trees.

Tree selection is based on a recognized order of removal that considers a number of factors including tree risk, vigor, crop tree selection, stocking levels by size class, spacing, tree grade, diameter, and species. Additional criteria can also be employed to enhance wildlife habitat, water quality and aesthetic values (see activity-specific chapters in this guideline).

### UNEVEN-AGED HARVEST CONSIDERATIONS: CUTTING CYCLES, STOCKING BY DIAMETER CLASS AND OPTIMUM MAXIMUM DIAMETER CLASS

Harvests in uneven-aged stands are carried out at regular intervals. Normally, cutting cycles range from eight to 20 years. The interval is based on site quality, growth rates, removable volumes, and landowner goals relative to each stand.

Individual trees are removed from each size (or age) class, as needed, to achieve the desired level of stocking. When selecting which trees to remove within each diameter class, the primary factors considered are risk, vigor, quality, and spacing. In addition, an optimum maximum diameter class is determined for each stand.

As is the case with rotation age determination in even-aged systems, the selection of an optimum maximum diameter class also depends on a number of considerations:

- Site Productivity: Higher quality sites will normally allow trees to be carried to a larger diameter before growth rates decline significantly and degrade/decay becomes a major factor in tree value.
- Average Growth Rates and Life Spans of the Species Involved: Stands managed under uneven-aged silvicultural systems normally contain a variety of different species, each of which may have a different optimum maximum diameter class.

- Type and Quality of Products Desired: A decision to focus on sawtimber, veneer or a mix of both will influence the selection of an optimum maximum diameter class.
- Balancing Risk and Economic Value: As a particular high-quality crop tree gets larger, it becomes more economically valuable. The value increase is due to more than just the additional volume accumulated as the tree grows. As a tree passes though a number of threshold diameters. it increases in grade and value dramatically. The values of sawlogs depend more on grade than volume. Larger diameters are required for the higher grades, which can bring two to three times the value of lower grade logs. Attaining veneer size can result in another major increase in tree value. The decision to leave a particular large valuable tree uncut must be weighed against the uncertainty of it still being alive and healthy 10 to 15 years later, when the next periodic harvest will be done. If it survives, it may increase significantly in timber value; if it's damaged or dies, that value could be lost. The evaluation of tree risk and vigor is critical to the determination of individual tree rotation.
- Landowner Goals: Maximum diameter classes can be increased or decreased depending on specific landowner goals. They can be extended to enhance non-timber resources (e.g. aesthetics, wildlife food and shelter, and old growth characteristics) if the landowner is willing to accept reduced growth rates and potentially forgo some timber revenues. In the case of low risk, vigorous, high-quality trees, these extended rotations can increase the supply of sawtimber and veneer, and therefore total value. Just as trees can be held longer, they can also be harvested earlier. This strategy can be used to respond to variable market conditions (supply and demand economics), manage the flow of specific timber products or income, or divide or combine stands to meet other landowner goals.

Reaching the optimum maximum diameter class is not an absolute criterion for tree selection. Other marking criteria (risk, vigor, spacing, quality, and basal area stocking levels) take precedence and may result in a particular tree being retained longer. Vigorous, low risk, high-quality trees may be retained well beyond the target diameter, for example, if stocking in the maximum diameter class is too low or other poorer quality trees are removed instead.

There is room for flexibility in the choice of an optimum maximum diameter class for a stand. The diameter class chosen, however, is a key factor in the determination of the optimum number of trees needed in each of the other various diameter classes – from the smallest to the largest – to ensure that quality trees are available to replace those harvested.

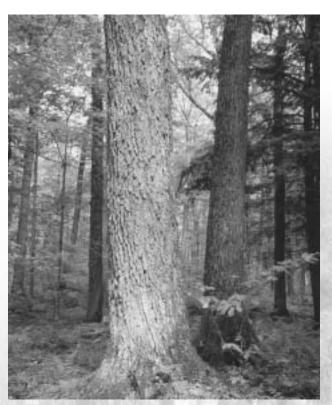


Figure 2-28: When the uneven-age system is used, an optimum maximum tree diameter class (the target diameter) is determined for each stand. With northern hardwoods, this is typically set at 20 or more inches dbh.

### Silvicultural Systems Summary

As discussed in previous sections of this chapter, each of the silvicultural systems and regeneration harvest methods have a number of variations that can be employed to tailor them to the specific species and sites involved. The choices can be confusing, and hopefully this summary will help sort things out.

# **EVEN-AGED SILVICULTURAL SYSTEMS** (normally used for sun-loving species)

- Coppice: A complete overstory removal (clearcut) designed to promote regeneration through sprouts and suckers.
- Clearcut: A complete overstory removal designed to facilitate regeneration by natural seeding, direct seeding or planting.
- Seed Tree: All overstory trees, except for approximately three to 10 seed trees per acre are removed to facilitate regeneration by natural seeding.
- Shelterwood: A complete overstory removal in two to three harvests spaced over a period of years. The residual trees from the first cut serve to modify understory conditions to create a more favorable environment for reproduction and provide a seed source. They are removed when the regeneration is established.
- Overstory Removal: A complete removal of the overstory in a single harvest, applied to any even-aged cover type if adequate regeneration is already established (used to accelerate release of the new stand).

# UNEVEN-AGED SILVICULTURAL SYSTEMS (normally used for shade-tolerant species)

- Single-tree Selection: Individual trees are harvested from all size classes on a recurring cycle. Regeneration occurs naturally in the openings created (favors shade-tolerant species).
- Group Selection: Trees are removed in small groups on a recurring cycle. Regeneration occurs naturally in the openings created (favors species that require more light for regeneration).

Table 2-1 (see page 39) summarizes the regeneration harvest systems that are generally recognized as acceptable in Wisconsin. The designations are substantiated in forestry research literature. All forest management and timber harvesting assistance provided by DNR and Cooperating Foresters must be consistent with the sideboards established in Table 2-1, unless a science-based management commitment describing an alternative method has been submitted to and approved by the Department of Natural Resources in advance.

|                                    | NATURAL REGENERATION HARVEST METHOD |                |              |                 |                          |                    | ARTIFICIAL<br>REGENERATION<br>METHOD <sup>5</sup> |
|------------------------------------|-------------------------------------|----------------|--------------|-----------------|--------------------------|--------------------|---|
|                                    | EVEN-AGED SYSTEMS <sup>6</sup>      |                |              |                 | UNEVEN-AGED<br>SYSTEMS   |                    | PLANTING/   |
| FOREST<br>COVER TYPES <sup>1</sup> | Coppice                             | Clearcut       | Seed<br>Tree | Shelter<br>Wood | Single-tree<br>Selection | Group<br>Selection | DIRECT<br>SEEDING                                 |
| Jack Pine                          |                                     | Х              | Х            |                 |                          |                    | Х   |
| Red Pine                           |                                     |                |              |                 |                          |                    | Х   |
| White Pine                         |                                     |                | Х            | Х               |                          |                    | Х   |
| Aspen                              | Х                                   |                |              |                 |                          |                    |   |
| White Birch                        |                                     | X <sup>2</sup> |              | Х               |                          |                    |   |
| Scrub Oak                          | Х                                   | Х              |              | Х               |                          |                    |   |
| Oak                                |                                     | Х              |              | Х               |                          |                    | Х   |
| Black Walnut                       |                                     |                |              |                 |                          |                    | Х   |
| Red Maple                          | Х                                   |                |              | Х               |                          | Х                  |   |
| Central Hardwoods                  |                                     |                |              | Х               |                          | Х                  |   |
| Northern Hardwoods                 |                                     |                |              | Х               | Х                        | Х                  |   |
| Hemlock Hardwoods <sup>4</sup>     |                                     |                |              | Х               | Х                        |                    |   |
| Fir-spruce                         |                                     | X <sup>2</sup> |              | Х               |                          |                    | Х   |
| Swamp Conifer-fir                  |                                     | X <sup>2</sup> |              | Х               |                          |                    |   |
| Black Spruce                       |                                     | X <sup>2</sup> |              | Х               |                          |                    |   |
| Tamarack                           |                                     | X <sup>2</sup> |              |                 |                          |                    |   |
| Cedar <sup>4</sup>                 |                                     | X <sup>2</sup> |              | Х               |                          |                    |   |
| Swamp Hardwoods                    |                                     |                |              | Х               |                          |                    |   |
| Bottomland Hardwoods               | X3                                  |                |              | Х               |                          | Х                  | MARKET BY MOVE LODGE                              |

<sup>&</sup>lt;sup>1</sup> Harvest methods apply to the **cover type to be regenerated**, not necessarily the currently existing cover type.

Table 2-1: Generally Accepted Regeneration Harvest Methods by Forest Cover Type

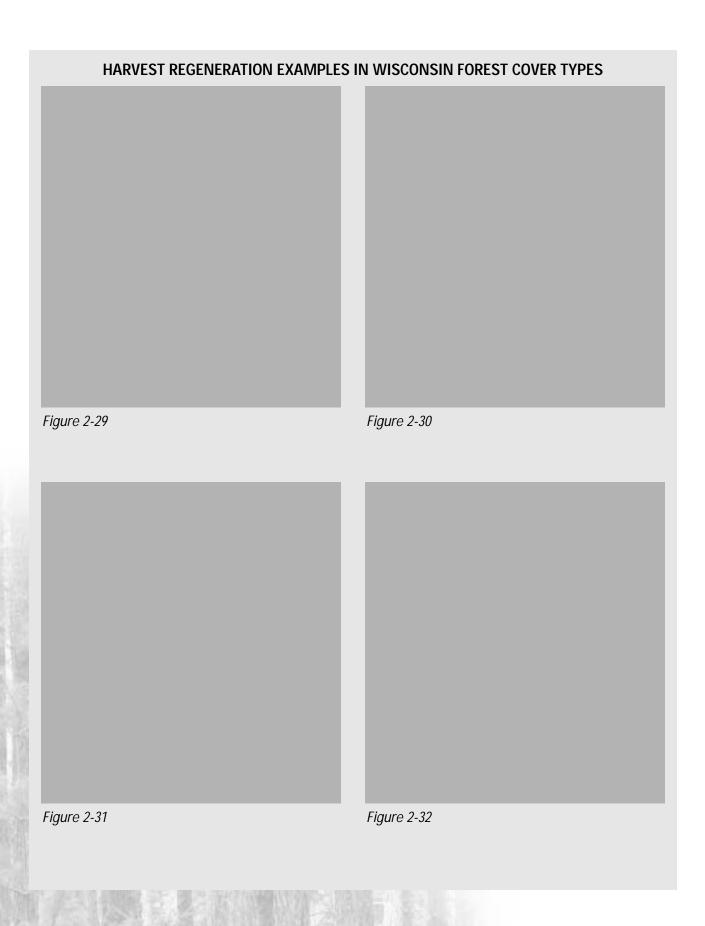
<sup>&</sup>lt;sup>2</sup> Strip clearcutting generally recommended.

<sup>&</sup>lt;sup>3</sup> When silver maple predominates.

<sup>&</sup>lt;sup>4</sup> Regeneration may be hampered due to animal browsing (herbivory).

<sup>&</sup>lt;sup>5</sup> Refers to reforestation, not afforestation.

<sup>6</sup> Overstory removal is acceptable for any timber type managed on an even-aged basis if desirable regeneration is well-established.



### PASSIVE OR NON MANAGEMENT OPTIONS

Figure 2-33

Some landowners and resource managers choose to "let nature take its course" on some forestland. In such cases, they make a conscious management decision to not actively manipulate the vegetation. This passive management is not considered a silvicultural system since it does not involve manipulation of vegetation.

Landowners and managers have different reasons for choosing to not actively manipulate vegetation. They may wish to protect and preserve fragile or special sites or communities (e.g. cliff communities, springs, groves of large old trees, and cultural sites). They may wish to develop habitat for specific wildlife that prefers relatively undisturbed forests. They may enjoy the appearance (aesthetics) and the recreational opportunities. Philosophical reasons may include the desire to allow nature to develop free of human impacts. Wilderness areas and some research control sites may be passively managed.

The concepts of "preservation" and "natural dynamics free of human impacts" are relative. Forests are dynamic communities that are

continuously changing and adapting to external inputs and internal disturbances. Natural processes like forest succession, plant competition, wildlife and insect activity, tree aging and decay, windstorms, fires, and climate change will cause changes in forest composition, structure, and function over time. Forests cannot be maintained in a static, unchanging condition. Also, there are no forest ecosystems undisturbed by human activities. Disturbance has occurred through impacts on climate, atmospheric composition and inputs, fire control, management of wildlife populations (intentional and unintentional), introduction of exotics, recreational use, other human uses, etc. Passively managed forests will continue to change and will be subjected to human impacts, however, these changes and impacts often will be different than in actively managed forests.

Passive management does require monitoring, and certain events may necessitate the implementation of some short-term active practices. Examples include control of exotics, fire management, disease and insect management, wildlife management, recreation management, removal of diseased or weakened trees that pose safety hazards, and loss of attributes desired by the landowner. Passive management requires an understanding of the effects of natural processes and the impacts of other human activities (internal and external to the forest) on the development of the forest. This knowledge will facilitate the achievement of landowner objectives and minimize the chances of counterproductive results or unintended consequences. In some situations, a blend of passive management and active silvicultural treatment may most effectively achieve landowner goals.

#### SALVAGE HARVESTS

In addition to regeneration harvests employed as part of a silvicultural system, salvage harvests are carried out as part of an overall forest management program. Unlike regeneration harvests, which are also designed to facilitate regeneration of the new stand, salvage harvests are geared only to the recovery and use of dead or dying trees that would otherwise go unharvested. Wind events, fire, flooding, insect and disease activity, and weather extremes can all wreak havoc on the best of forest management plans. High-quality trees can have significant economic value. Removal of infected trees is often necessary to prevent additional mortality.

It should also be remembered, however, that dead and dying trees are part of the overall forest system, and provide a number of benefits to wildlife and other ecological processes. Decisions to conduct or not conduct a particular salvage operation are often a balance between potential economic return, impact on stand silviculture, risk of wildfire, cost of salvage, and the ecological value of leaving the trees in place. When mortality is significant, a regeneration strategy should be developed to facilitate regeneration, based on current conditions and landowner goals.



Figure 2-34: Forest management plans are often modified by natural disturbances like this major wind storm in a northern Wisconsin hemlock stand.

#### UNSUSTAINABLE CUTTING METHODS

A silvicultural system is a planned program of treatments over the life of a stand. However, there are a number of cutting methods designed primarily to maximize short-term economic gain. They are not part of a long-term plan to ensure regeneration of a healthy, vigorous stand on a sustainable basis.

The following examples of unsustainable cutting methods are not an all-inclusive list. These methods may result in a new stand of trees, but due to the lack of consideration of specific species requirements, they often lead to stand degradation and are not considered generally accepted silvicultural practices that result in sustainable forestry:

- Diameter limit cutting or simply cutting all trees above a certain diameter, regardless of the impact on stand structure, stand quality, tree quality, species composition, or regeneration needs.
   Sometimes referred to as a "selective cut," the only criteria is diameter – as opposed to the selection criteria employed in a true single-tree selection harvest under the uneven-aged silvicultural system.
- Economic clearcutting, where any tree of economic value is cut with no consideration for site, silvics

of the species involved or regeneration needs. This practice differs from a clearcut used in the even-aged silvicultural system where all trees are harvested, regardless of value, in order to ensure residual shade and competition does not hamper the regeneration and development of a new stand.

• High grading (sometimes referred to as selective logging) refers to the practice of cutting only the largest, most valuable trees in a stand and leaving low value and poor quality trees to predominate. This practice is NOT the same as a single-tree selection regeneration harvest described in the silvicultural systems section (page 34). High grading is not designed to enhance the quality and reproductive potential of the residual stand, but rather to maximize immediate revenue. The term "selective logging" is sometimes used intentionally on the part of unscrupulous loggers to create false expectations on the part of landowners.

It's emphasized that economic gain and sustainability ARE compatible and that creativity and imagination in the application of sound silviculture is a much better alternative than the unsustainable cutting methods described previously.

### MANAGEMENT PRESCRIPTIONS

As the previous sections of this chapter explain, the basic question of "what to grow and how to grow it" is not as simple as it may first appear. Indeed, the answer can involve the collection and evaluation of a great deal of information, and the consideration of a number of alternative strategies. In the end, it's that very question – "what to grow and how to grow it" – that must be answered clearly, logically and completely. The final step in this process can be compared to the last phase of designing a new home – the development of a blueprint which spells out in detail exactly how your vision transfers to clear, specific action. The silvicultural counterpart to that blueprint is a management prescription.

A management prescription or recommendation is a detailed description of a specific treatment or cutting scheme designed to implement a specific stand management objective. Prescriptions describe the individual activities necessary to implement the overall silvicultural system in a given stand.

A forest management plan is written for entire properties and identifies general landowner goals as well as other property and landscape information. The more detailed plans also identify specific stand management objectives, and the series of management prescriptions describing specific actions needed for all stands for an entire operational period (see the chapter on "Forest Management Planning" in this guide for more detailed information).

It's important that a management prescription reflects consideration of all relevant factors and be written in a clear, logical fashion. Less complex prescriptions are normally written in a narrative format. More complex prescriptions involving a number of interdependent activities with the outcomes of each leading to different pathways may include a decision tree or diagram (Figure 2-35).

The development of a detailed management prescription for a given stand is a complex process. It requires a thorough understanding of the landowner's objectives, silviculture, silvics, capabilities and limitations of the resource, and the collection and evaluation of considerable vegetative and site data. Since each stand is unique, a forester and possibly other resource professionals should be involved to provide technical assistance.

# MANAGEMENT PRESCRIPTIONS: FACTORS TO CONSIDER

#### 1. Landowner's Objective:

- · Is it sustainable?
- Were all opportunities considered?

#### 2. Assess Biological Characteristics:

- Site capabilities
- Past disturbances
- Current vegetative condition and potentials (growth and succession)
- Forest health and protection

### Consider other relevant environmental, cultural, social, and economic factors, such as:

- Aesthetics
- Recreation
- Wildlife
- Presence of endangered species
- Invasive species
- Landscape scale issues (critical habitat, percentage of land in a cover type, etc.)
- Regulations (statutes, rules or local ordinances)
- Traditions (possibly related to ethnic heritage)
- Markets
- Community viability
- Watershed protection and erosion control

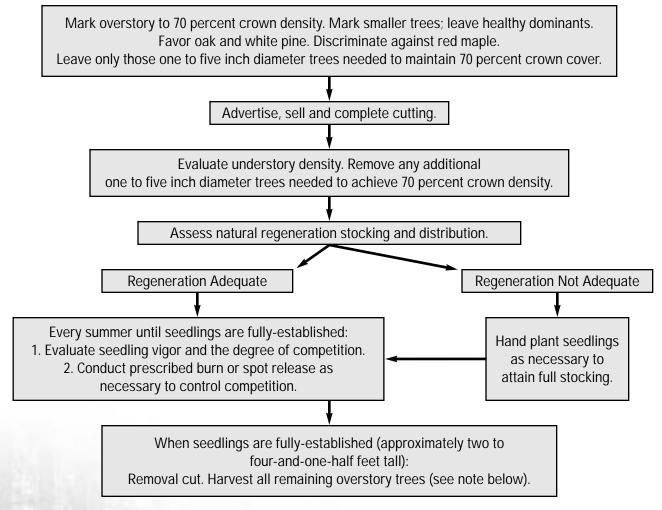


Figure 2-35: An example of a management prescription designed to implement a shelterwood regeneration harvest in a mature red oak stand.

Note: While this particular management prescription has a timber management focus, it could easily be modified to incorporate other objectives. To enhance wildlife habitat, for example, a portion of the residual overstory (20 to 30 percent) could be retained during the final removal cut to provide for a continuous supply of mast. The shade from the scattered residual large canopy red oak would somewhat hamper seedling growth and distribution, but the stand would still regenerate and the red oak cover type would be perpetuated long-term.

There is a significant amount of flexibility available to tailor a silvicultural system to meet various needs as long as the primary objective to regenerate the stand is not compromised.

## CHAPTER 3 — WILDLIFE HABITAT

| Specific Wildlife Habitat Guidelines               | 4 7 |
|--|-----|
| Leave Trees and Snags                              | 47  |
| Coarse Woody Debris and Slash                      | 49  |
| Conifer Retention and Regeneration                 | 50  |
| Mast   | 53  |
| Patterns of Cutting                                | 54  |
| Endangered, Threatened and Special Concern Species | 56  |
| Natural Areas and Sensitive Communities            | 59  |
| Affected Natural Communities                       | 60  |
| Field Survey Consultants and Other Resources       | 60  |
| Wetland Inclusions and Seasonal Ponds              | 61  |
| Riparian Wildlife Habitat                          | 62  |
| Resources for Additional Information               | 65  |

Wisconsin contains a diverse natural heritage with more than 1,800 plant species and 650 vertebrate species identified to date (WDNR 1995). In addition, thousands of fungi, invertebrates, and non-vascular plant species also contribute to healthy ecosystem functioning. Wisconsin is located at the junction of three of North America's six biotic provinces thus generating a number of different habitats and niches for species to occupy. Wisconsin's forests lie within all three of these provinces and therefore are also guite diverse. The Society of American Foresters (SAF) lists 19 forest types that occur within the state. Each forest type occurs along a gradient of moisture, temperature, soil type, and climate, creating hundreds of different habitats and niches for species to occupy. All told a significant percentage of Wisconsin's native flora and fauna is associated with forested habitats.

Each species associated with a forested habitat or niche contributes to ecosystem functioning and in turn larger ecosystem processes. For example, studies have shown that insect eating birds reduce overall levels of foliage loss from insect populations. As a result, bird populations can affect larger ecosystem processes such as carbon storage or primary productivity. Therefore, loss of organisms or groups of organisms from an ecosystem can have much larger consequences on forest health and larger ecological processes. The challenge is to conserve all the working parts within a particular ecosystem in order to maintain ecosystem resilience when disturbances occur. Simplified forest ecosystems suffer more damage from forest pests and are more likely to have problems regenerating effectively.

The primary focus of this chapter is on forest-dependent terrestrial and amphibious forms of wildlife. The intent is to provide practical, science-based guidelines to address a number of specific issues and projected impacts relating to forestry and wildlife. The resource directory

contains DNR and non-DNR contacts that can provide additional information on management of all wildlife species.

Certainly, much more can be done to enhance wildlife habitat or individual species than the steps recommended in these guidelines. Furthermore, each management practice, including the option to do nothing, will favor some species and hinder other species. As a result, it's not practical to provide a comprehensive set of guidelines covering all possibilities for improving habitat in Wisconsin forests. Instead, these guidelines cover the essentials for addressing site-level issues related to forestry practices. Those interested in pursuing objectives that focus primarily on wildlife management are encouraged to consult a professional wildlife manager for more information.

It should be remembered that it's difficult to separate site-level and landscape-level issues. For wildlife, more than for other forest resources, what occurs on a site influences the surrounding landscape and vice versa. While the guidelines focus on the site level as much as possible, some of the more important "landscape implications" will also be discussed. Landscape-level wildlife needs can best be addressed through professional planning for individual properties and cooperation among landowners and agencies within a landscape.

Finally, many wildlife habitat guidelines can be applied simultaneously. For example, leave tree clumps in clearcuts might also serve as rare species buffers, provide mast production and enhance vertical structure. These overlapping benefits may extend to other forest resources as well, such as for cultural resource protection and visual quality. In other cases, retention of various structural habitat components may create safety issues like the reduction of visual quality or increase the potential for pest damage. Other chapters of the guide will address some of the trade-offs that need to be considered relative to other resources.

### SPECIFIC WILDLIFE HABITAT GUIDELINES

### Leave Trees and Snags

#### **PURPOSE**

The purpose of this habitat aspect is to provide for wildlife requiring perches, tree cavities and bark-foraging sites through retention of suitable leave trees and snags on a site during forest harvesting and timber stand improvement. This guideline will also contribute to the continued presence of coarse woody debris on a site.

#### RATIONALE, BACKGROUND AND BENEFITS

In Wisconsin, up to 30 breeding birds, nearly 30 mammals, and several reptiles and amphibians use snags as breeding sites. Different species have adapted to different ecological conditions. Saw-whet Owls utilize cavities in and around lowland conifer swamps, while Red-headed Woodpeckers nest in cavities in open or semi-forested conditions. The major issue for cavity-dependent wildlife and timber harvesting is whether suitable trees and nest cavities remain for these species following logging or timber stand improvement.

Retention of leave trees and snags during timber harvesting provides habitat for wildlife that require perches, tree cavities or bark-foraging sites as the surrounding forest regenerates. Leave trees and snags may also provide unique niches and microsites for a variety of plants, especially within retained clumps. Leave trees or snags that fall over and decay will also benefit soil conditions as well as wildlife that utilize coarse woody debris.

The fundamental idea is to retain some structure for snag- and cavity-dependent species on a site or maintain the potential to produce such structure as a stand grows and develops (see Chapter 11: Timber Harvesting, pages 142 and 143, for specific recommendations on leave tree and snag selection and distribution).

#### **ECO-REGION APPLICABILITY**

Cavity and snag trees are important statewide.
Wildlife species that use cavities range in size from



Figure 3-1: Snags provide ideal conditions for wildlife requiring perches, tree cavities and bark-foraging sites.

small mammals such as bats and mice up to black bears. A range of tree sizes is necessary on a landscape scale to provide for the full use of this habitat feature.

Openland or brushland management may require felling of all stems to reproduce open conditions needed in these habitats. However, some openland species also require cavities. For example, Eastern Bluebirds will nest in single, scattered snags in an open landscape. Generally, dead standing stems do not detract from the establishment or maintenance of openland/brushland habitat. However, they may provide structure for some undesirable wildlife species in some situations. European Starlings will nest in cavity trees in open or semi-forested landscapes if the site is adjacent or near to an agricultural or urban/suburban setting. Starlings will outcompete other cavity nesting birds for this limited resource. In addition, if managing for openland species that are under severe predation pressure from raptors, consider removing all standing stems.



Figure 3-2: This strip of uncut pine provides a wildlife travel corridor through the clearcut trees.

Cavity/snag trees are equally important in forested stands. There are a number of cavity-dependent species that require a larger forested acreage with sufficient canopy cover. Small mammals, bats and breeding birds that live in heavily forested areas also nest in cavities and use snags for foraging sites. Black-capped Chickadees and Tufted Titmice are only two of a number of charismatic forest bird species that nest in cavities. When conducting a single-tree selection harvest consider leaving snag and cavity trees of varying diameters. Barred Owls and Pileated Woodpeckers utilize large cavities and snag trees, while Downy Woodpeckers and Chickadees utilize smaller trees. In addition, these trees will also eventually topple and contribute to coarse woody debris on the forest floor.

#### LANDSCAPE IMPLICATIONS

Although these guidelines address site-level recommendations for snags and leave trees, the contribution of an individual site should be considered in the context of the surrounding landscape. Many of the cavity-dependent species

being addressed have home ranges larger than the typical harvest unit; so planning for their needs requires a broader look, both spatially and temporally, at the larger forest community. Many other species have smaller home ranges than the typical harvest unit.

If suitable habitat exists surrounding a given harvest site, then leave trees may not be as critical on that site. However, if harvests are likely in the adjacent habitats, then the trees left on the initially harvested sites become more important as the surrounding forest regenerates. Consideration must be given to the time it takes for a regenerating stand to produce trees of adequate size and degree of decay to provide suitable structure.

Coordination among neighboring landowners may result in varying numbers of leave trees on a site if adjacent lands exceed or fall short of the recommendations. Managers of larger land-holdings may be able to plan for sufficient cavity-dependent wildlife habitat on portions of their property (such as riparian reserves) and reduce leave tree/snag requirements on other portions.



Figure 3-3: Numerous "islands" of uncut trees in this clearcut stand, along with scalloped edges, provide good wildlife habitat and improved visual impact after timber harvesting.

# Coarse Woody Debris and Slash

#### **PURPOSE**

The purpose of coarse woody debris and slash is to provide cover, food or growing sites for a diverse group of organisms through the retention or creation of coarse woody debris and slash during forest management.

#### RATIONALE, BACKGROUND AND BENEFITS

A wide variety of organisms benefit directly or indirectly from retention of coarse woody debris and slash. Small mammals dependent on slash and coarse woody debris in turn provide food for mammalian carnivores and forest raptors (such as the pine marten and the Broad-winged Hawk). Amphibians such as Wood Frogs, Four-toed Salamanders, and Red-backed Salamanders utilize the cool, moist microsites created by coarse woody debris as resting/feeding areas.

Woody detritus reduces erosion and affects soil development, stores nutrients and water, is a major source of energy and nutrients, serves as a seedbed for plants, and is a major habitat for microbes, invertebrates and vertebrates. For example, yellow birch, white cedar and eastern hemlock regeneration is enhanced by coarse woody debris. These tree species are important components of a diverse northern forest and provide habitat for an untold number of vertebrate and invertebrate species. Bird researchers in northern Wisconsin found that hemlock dominated natural areas contained higher species diversity and richness than the even-aged managed hardwood sites that dominate this landscape.

The fundamental idea is to retain or enhance the amount of coarse woody debris in a stand in order to benefit the organisms associated with coarse woody debris, and to support nutrient cycles that benefit healthy forests (see Chapter 11: Timber Harvesting, page 144, for specific recommendations on coarse woody debris).



Figure 3-4: Coarse woody debris provides cover, food, habitat structure, and growing sites for many different animals and plants.

#### **ECO-REGION APPLICABILITY**

Coarse woody debris is important to forests and forest organisms statewide. Each eco-region has a number of species that utilize slash and coarse woody debris. In the north, birds such as Winter Wrens and Ruffed Grouse utilize downed logs for nesting/feeding sites and for territorial displays. Blue-spotted or Northern Redback Salamanders enjoy the moist, cool microsites provided by rotting logs on the forest floor. In the south, birds such as Hooded Warblers or Kentucky Warblers may be taking advantage of the arthropods that live in and around coarse woody debris. Regardless of the location, coarse woody debris and slash is an important component of the forest ecosystem.

#### LANDSCAPE IMPLICATIONS

Although these guidelines address site-level recommendations for snags and leave trees, the contribution of an individual site should be considered in the context of the surrounding landscape. Coarse woody debris left on a specific site may be benefiting reptiles and amphibians living there but breeding elsewhere. Thus, coarse woody debris placement might be influenced by off-site factors. For example, when managing a pine plantation, coarse woody debris may be important as a salamander migratory corridor between an adjacent hardwood forest and a wetland breeding site. However, if the pine plantation is bordered by other dry or arid cover types and lacks wetlands of any type, coarse woody debris may not be important to salamanders at this site.

The size and position of intensive timber management may also determine the importance of coarse woody debris to associated organisms. For example, if a clearcut takes place surrounding a temporary wetland, coarse woody debris left in the clearcut and in the wetland would be essential habitat for breeding salamanders. Increased sunlight in the pond and harvested stand makes desiccation a problem for salamanders. More downed logs would provide cool, moist microsites in order to avoid direct sunlight during the heat of the day. In addition, leaving downed logs would also provide drumming sites for Ruffed Grouse. If however, the clearcut was smaller and the wetland was bordered by older forest, coarse woody debris left in the clearcut would not be as important for salamanders. However, it still may perform other ecological functions important to the forested stand.

# Conifer Retention and Regeneration

#### **PURPOSE**

The purpose of this aspect of habitat is to ensure diversity of wildlife habitat through the retention and regeneration of conifers for food, nesting and cover in mixed deciduous/coniferous stands. Conifers should continue to be a significant structural component in appropriate habitats and landscapes.

#### RATIONALE, BACKGROUND AND BENEFITS

Many wildlife species benefit from a mixture of conifer and deciduous trees and shrubs. Retaining young conifers, including isolated trees and scattered clumps, can provide habitat and food needed for many wildlife species, and can increase the probability that conifers will later regenerate on harvested areas.

Various animal species, including the Great Gray Owl, Bald Eagle, Pine Warbler, white-tailed deer, elk, pine marten, lynx, snowshoe hare, and red-backed vole, depend on coniferous stands for structural attributes. Others - including Spruce Grouse, Red-breasted Nuthatch, red squirrel, porcupine, and elk – depend on food that coniferous stands provide. Deer and elk will often winter in conifer forests due to the reduced snow depths and thermal cover that these stands provide. Many species associated with the boreal forests of Canada reach the southern limits of their range in the coniferous and mixed coniferous forests of northern Wisconsin. Examples of these include pine marten, fisher, gray wolf, Cape May Warbler, Boreal Chickadee, Great Gray Owl, Gray Jay and Palm Warbler.

Historically, conifers often existed as scattered trees or clumps within hardwood stands. Many of these conifers have been lost due to poor regeneration following early logging. A number of species are adapted to these scattered overstory conifers or patches of conifer within a hardwood stand. Pine Warblers are often heard singing from scattered overstory white pines that have persisted or regenerated within an oak or maple forest. Bald Eagles or Osprey often use these scattered superstory trees as nesting or roosting sites. Often aspen/birch stands in northern Wisconsin contain patches of regenerating or mature white spruce or balsam fir. Birds such as Cape May Warbler, Magnolia Warbler and Canada Warbler will locate territories in and around these coniferous patches. These dense areas of conifer also provide thermal cover for grouse, deer and other northern species during cold winters and warm summers.

When retaining conifers, clumps are preferable to scattered trees. Clumped conifers are more windfirm, are better potential seed sources because of improved pollination, can withstand snow and ice loads more successfully, and can provide better cover (see Table 3-1, page 52).

#### **ECO-REGION APPLICABILITY**

These guidelines are most applicable to the northern part of the state. Certain areas in west-central and central Wisconsin that do contain areas dominated or co-dominated by white pine and jack pine may also benefit from these recommendations.

It's important to match existing site conditions and silvicultural objectives to plans for conifer retention and regeneration. Consult the silvicultural handbook or DNR staff for distributions of different conifer species within different ecological landscapes. Conifer regeneration and retention will work best if done in appropriate conditions and site locations. For example, retention and regeneration of fir and spruce in aspen/birch stands would be most appropriate on the Superior Coastal Plain and other areas of northern Wisconsin that historically supported a mixed aspen/spruce forest type. Retention and regeneration of white or red pines might be most effective in the Northern Highland landscape, where white and red pines once dominated forest canopies.

#### LANDSCAPE IMPLICATIONS

Although these guidelines address site-level recommendations for conifer retention and regeneration, the contribution of an individual site should be considered in the context of the surrounding landscape. When discussing conifer retention and its importance to wildlife, landscape scale management can be very important. Many species that utilize coniferous or mixed/coniferous woods have much larger home ranges than the particular stand being considered for management, therefore, it's important to take into account neighboring properties. In other situations, scattered leave trees or clumps of conifer regeneration will provide wildlife benefits, even when isolated from similar conditions.



Figure 3-5: A deer trail meanders through a frost-covered opening. The retention of openings, created as log landings during harvesting, or as the result of other forest operations, can help provide a mix of habitat conditions for many wildlife species.

If the stand being considered for management is bordered by coniferous forest, or if the region contains a large percentage of coniferous/mixed coniferous forest, then conifer retention or regeneration will have a greater likelihood of benefiting those species with larger home range needs or area requirements. Species such as Blackburnian Warblers, Connecticut Warblers or Cape May Warblers will use conifer retained in managed areas if these landscape conditions are met. Often, small songbirds such as these will nest in loose colonies where extra-pair matings are an important part of the breeding strategy. Larger patches of habitat will increase the chances that this mating system will work.

If the stand being considered for management is isolated from appropriate coniferous or mixed coniferous habitat, it will be of lesser value to those species needing large areas of this habitat. However, other species may utilize smaller patches of coniferous regeneration. For example, small patches of thick fir or spruce may harbor wintering Ruffed Grouse or Saw-whet Owls. Scattered white pine canopy trees can be important nesting areas for Pine Warblers or Bald Eagles.

| CONIFER SPECIES   | EXAMPLES OF USES BY WILDLIFE   |
|-------------------|--|
| Red Pine          | Mature trees may be used by raptors for perches or nest trees. Seeds are important mast for winter songbirds and red squirrels. Larger stands of mature trees provide breeding habitat for Red Crossbills, Pine Warblers, Blackburnian Warblers, and Pine Siskins. Mature stands with dense deciduous or coniferous understories can contain diverse breeding bird assemblages, including some rare species.   |
| White Pine        | When young, provides good escape and severe winter cover for many species. High calorie large seeds eaten by many small mammals and winter songbirds. Mature trees are important for cavity-dependent wildlife, preferred Bald Eagle nest trees, and escape trees for bears. Roosting trees for Wild Turkeys where present in central and southern Wisconsin.  |
| Jack Pine         | Very good cover for a number of species when trees are young and stands are well-stocked. Used as browse, most notably by Spruce Grouse. Seeds eaten by red squirrels and Red Crossbills. Persistent cones provide a year-round food source. Mature stands in north western Wisconsin home to rare Connecticut Warbler.  |
| Balsam Fir        | Important winter and summer cover for deer, elk and many species of birds. Birds eat seeds and use trees for nesting. When allowed to persist in hardwood understory is important nesting cover for Black-throated Blue Warblers and other bird species.   |
| Black Spruce      | Important escape and severe winter cover. Birds such as White-winged Crossbills eat seeds and use trees for nesting. Buds and needles are important Spruce Grouse food. Often have diverse and abundant small mammal populations, which are important food sources for owls and other forest raptors. Black spruce wetlands contain many vertebrates and invertebrate species not commonly found in Wisconsin. Dead or dying trees often provide insects and snags for Black-backed Woodpeckers. |
| Tamarack          | Mature stands provide excellent habitat for owls and other birds. Snags are used as hunting/singing perches. Seeds are eaten by small mammals, Pine Siskins and Crossbills.  |
| White Cedar       | Mast is important food source for winter songbirds. Very important winter cover for deer. Important for browse during severe winters. Provides cover and cooling effect near water.  |
| White Spruce      | Important seed source for winter finches. Summer nest cover for rare songbirds such as Cape May Warbler and Evening Grosbeaks. Thermal cover for owls and grouse.  |
| Eastern Red Cedar | Important winter cover in southern Wisconsin. Berries used by birds for food.  |
| Hemlock           | Hemlock dominated forests or mixed stands contain distinct breeding bird assemblages not found in hardwood forests. Mature trees provide important owl roosting sites. Mast important to red squirrels and winter finches.   |

Table 3-1: Conifer Species and Examples of Use by Wildlife

#### Mast

#### **PURPOSE**

The purpose of this habitat aspect is to provide for wildlife that utilize mast production from trees and shrubs.

#### RATIONALE, BACKGROUND AND BENEFITS

Many species of trees and shrubs have developed a seed dispersal system that benefits many species of wildlife. Producing mast in the form of nuts or berries encourages mammals such as squirrels or birds to eat or transport the seeds contained within the fruit to other areas. Oaks may produce thousands of acorns in the hopes that a Blue Jay or Turkey will accidentally scratch one into the forest soil. Dogwoods and juneberries will produce fruit attractive to migrating birds, which will pass the seeds to neighboring areas during migration. This complex reproductive strategy is essential to the inner workings of many ecological systems in Wisconsin.

High levels of fat, protein and carbohydrates in mast contribute to energy stores critical for migration or hibernation, and for survival of newly-independent young. Many birds that eat insects on breeding grounds will consume berries during fall migration. Yearly variations in mast production may impact subsequent reproductive success of many species. Often, plentiful mast production will lead to abundant small mammal populations, which in turn benefits forest carnivores that prey on small mammals. During winter, some sources of mast remain available to forest wildlife on trees and shrubs, under snow or stored in caches (see Table 3-2, page 54).

Mast production is generally favored by increased crown exposure to light, crown size, maturity of trees or shrubs, increased soil nutrients, tempered microclimates (especially during flowering) and adequate soil moisture. Production on a site tends to vary considerably from year to year.

Other considerations with respect to mast include:

- Mast-producing species often depend on animals for their dispersal and reproduction.
- Riparian edges often contain a higher concentration and richness of mast-producing species.
- Most shrub species will regenerate well and produce mast after cutting, burning or soil disturbance.

Although concerns for oak and other dominant tree species are particularly important, especially in relation to game species (such as deer or gray squirrels), other mast species also provide important benefits.

#### **ECO-REGION APPLICABILITY**

Retention of mast and other key food-producing tree types should be prioritized in accordance with the local abundance of each tree species. In areas of least abundance, greatest attention should be applied to retention. Planning silvicultural treatments to increase mast-producing trees should be performed in accordance with silvicultural guidelines laid out in the silvicultural handbook.

#### LANDSCAPE IMPLICATIONS

Although these guidelines address site-level recommendations for mast production, the contribution of an individual site should be considered in the context of the surrounding landscape. Land managers in regions with low mast availability have opportunities to enhance wildlife habitat characteristics by careful management of mast species on their land. Some wildlife species may travel significant distances to obtain mast. The black bear, for example, may travel 10 miles to obtain mast. Breeding birds will often relocate family groups to wetland edges or areas with increased levels of berries during late summer before migration. In areas with sufficient mast production, mast production may not be as important.

| EXAMPLES OF USES BY WILDLIFE  |  |  |  |
|---|--|--|--|
| Deer, bear, Wild Turkey, Woodpeckers, Blue Jay,<br>Wood Duck, squirrels                               |  |  |  |
| Small mammals, Evening and Pine Grosbeaks   |  |  |  |
| Ruffed Grouse   |  |  |  |
| Common Redpoll, Pine Siskin, American Goldfinch   |  |  |  |
| Red squirrels, White-winged and Red Crossbills,<br>Pine Siskins, Red-breasted Nuthatch, Pine Grosbeak |  |  |  |
| Important to a number of birds and mammals as they prepare for migration and winter                   |  |  |  |
| Waxwings, Pine Grosbeaks and other bird and mammal species  |  |  |  |
| Numerous bird and mammal species  |  |  |  |
|   |  |  |  |

Table 3-2: Examples of Mast-producing Plants that Will Benefit Wildlife in Wisconsin

### Patterns of Cutting

#### **PURPOSE**

The purpose of this habitat aspect is to provide site- and landscape-level wildlife habitat requirements by using a variety of sizes and shapes of harvest areas. Understanding the impact from site-level management on the larger forested area will help land managers make better wildlife decisions.

#### RATIONALE, BACKGROUND AND BENEFITS

This management objective will involve making silvicultural decisions on a landscape basis. Ideally the management regime should range from the very fine-scale management represented by selection cutting to the coarse-scale management affected by

sizable clearcuts. The size of clearcuts and other treatments should be determined by considering issues such as size of the management unit, the home range requirements of large animals, aesthetics, and natural disturbance regimes.

Size and shape of both cut and uncut areas should mimic natural disturbance regimes that historically impacted the forest type to be managed. This will then benefit the native species of plants and animals adapted to this forest type and disturbance regime. Larger patch sizes historically occurred under natural disturbance regimes on even-aged, fire-dependent types, such as jack pine. Large clearcuts in such types can function for a short time as habitat for some area sensitive openland species such as Sharp-tailed Grouse and Upland Sandpipers.

These managed areas will be of even greater benefit to openland species if they are placed adjacent to more permanent open barrens. Colonization of new openland habitat created by forest management is much more likely to occur if it's adjacent to existing populations of openland species. As the managed area ages, it will become less attractive to openland species, but other early successional species such as Eastern Towhees and Brown Thrashers will colonize the site.

Smaller patches are appropriate in more heterogeneous forest types, such as deciduous forests on moraines. For example, northern mesic forests dominated by sugar maple, hemlock or beech were much more likely to undergo disturbance from wind than from large fires. Most wind events created smaller patchy canopy gaps within a larger forested matrix. Species like Black-throated Blue Warblers nest within the thick regeneration generated by these disturbance events, and thus could benefit from a silvicultural treatment that mimics this process.

The shape and size of the cutting area determines the total amount of 'edge' habitat created through management. An edge is defined as the transition area from two different forest types or successional stages. The amount of edge in a landscape will create conditions favorable for some species and detrimental to others. Many game species such as white-tailed deer and Ruffed Grouse, along with Indigo Buntings and Chesnut-sided Warblers, prefer the wide variety of cover and food resources found along forest edges, and tend to be very good competitors for those resources. Landscapes with high amounts of natural or man-made edges tend to favor these edge species. However, many species of birds, some mammals and herps prefer the interior of larger (greater than 100 acres) blocks of forest. Cerulean Warblers, Acadian Flycatchers, Hooded Warblers, Black-throated Blue Warblers, and many other interior species are listed as endangered, threatened or species of special concern by the Bureau of Endangered Resources due to loss of appropriate habitat. A large increase in the amount



Figure 3-6: Two age classes of aspen, managed for grouse by clearcutting, illustrate the "edge" where two stands meet.

of edge, through forest management activities or a natural disturbance in large blocks of forest, will increase edge species which will replace many interior species.

#### **ECO-REGION APPLICABILITY**

The soils, climate and geology of different eco-regions across the state favor different types of forests. Each forest type and its associated wildlife are adapted to a particular disturbance regime. Ideally, forest management activities should take these disturbance regimes into account.

In general, more diverse and larger patch sizes are possible in northern Wisconsin than in the forest fragments of southernmost Wisconsin. Since many of our southern forests have been converted to other uses, special consideration should be given to conserving large patch sizes of existing forests.

#### LANDSCAPE IMPLICATIONS

When employing large clearcuts, consider harvesting in segments over several years. This will provide both early successional diversity and, over the long term, a large mature forest stand. Coordinate with adjacent landowners when natural stand boundaries cross property lines.

# Endangered, Threatened and Special Concern Species

#### **PURPOSE**

The purpose of this habitat aspect is to increase awareness of endangered, threatened and special

concern species (ETS species), and manage forests to maintain or enhance populations of these species. In addition, this habitat helps to increase awareness of statewide forest policies to consider endangered and threatened species in the forest management decision-making process.

#### FREQUENTLY ASKED QUESTIONS

- What does it mean when rare species are found on my land? It means you have land that is quite different than most properties in the state. Native species that have been eliminated elsewhere still find a home on your land. This may have some legal obligations, but it may also yield some benefits.
- What is the difference between endangered and threatened species? Endangered means the species is in danger of becoming extinct. Threatened means the species is less vulnerable, but there is a chance they will soon become endangered.
- What if the species are plants? The plants
  that are found on private property belong to
  the landowner. What becomes of them is the
  decision of the landowner. Of course, the
  Department of Natural Resources wants to
  encourage and help the landowner protect
  and manage these valuable plants.
- What if the rare species turn out to be birds or other animals? Because animals usually travel freely from one property to another, they belong to everyone. Laws determine what anyone can do with these species. For example, it's illegal to shoot a timber wolf in Wisconsin, although it's not illegal to shoot a white-tailed deer in season. Laws also protect nesting birds or turtles from being disturbed during the nesting season. For example, it's illegal to disturb an active Bald

- Eagle nest. Sometimes habitats are protected. Many of our State Natural Areas protect large pieces of rare habitats such as beach dunes, sedge meadows, or old growth forest. These rare habitats often host a number of rare plants and animals. Chiwaukee Prairie State Natural Area in Kenosha County hosts 40 rare plants, birds, butterflies, insects, turtles, and natural communities.
- If an endangered species is found, who will get this information? The information is shared with the landowner or land manager, of course.
   Otherwise, it's confidential. It's not dispensed to the media, and is exempt from the open records law.
- How does a landowner benefit from the knowledge that an ETS species occurs on their property? You learn from biologists what makes your property special. You may get help with managing the natural resources on your land. Several programs are in place that can provide tax advantages or cost-sharing for management. Knowledge of the occurrence of rare plants and animals is increasing every year. The best information on occurrences of rare species is the Endangered Resources Program's Natural Heritage Inventory. Information on publicly-owned land is relatively good, however, private land is inventoried only with permission of the landowner and coverage is very patchy.

#### RATIONALE, BACKGROUND AND BENEFITS

By definition, ETS species are rare. Wisconsin is home to more than 12,700 fungi, 3,100 plant species, 37,000 invertebrate species, and 670 vertebrate species. The Wisconsin Department of Natural Resources lists 859 of these plants and animals as endangered, threatened or special concern, with more than 28 percent – 245 species – further identified as species that may be affected by forest management activities. Five of these are also listed as federally endangered or threatened.

All species found in a natural forest ecosystem contribute to its healthy functioning. Humans tend to place values on the species found in these ecosystems, however, for the plants and animals living in the forest, no value judgment is given. They are there, because that's where they live. Only we can make decisions affecting their habitats. Management decisions should occur with the best information available. Known reasons for considering all species in the decision include the following:

- Conservation of species because they have innate values.
- Conservation of rare species that play a critical role in ecosystem function.
- Conservation of nutrient recycling and soil enhancing animals and fungi.
- Conservation of natural disturbance regimes.
- Deter invasion by aggressive exotic species.
- Conservation of genetic strains that are adapted to local climate and site conditions.
- Conservation of aesthetic and recreational values.
- Conservation of species that may produce economically-valuable products or provide for eco-tourism benefits.
- · Scientific and educational benefits.

#### PROTECTION AND MANAGEMENT

Most forest management activities will not involve ETS species. Even when they are found, the laws seldom totally prohibit activities. The landowner owns the plants found on the property. On public land, endangered and threatened plant species are considered when developing a management plan or conducting a timber sale. Endangered and threatened animal species are protected by law, but many can be incidentally taken, if certain restrictions are followed. Special concern species have no legal protection, but that does not abdicate the responsibility to consider them in planning actions.

When found, most ETS species tend to be found in specialized habitats. Seeps, ephemeral ponds, cliffs, extensive bog areas, old-growth forest, and large blocks of southern Wisconsin forest harbor a vast majority of the 245 forested ETS species. Many species are also localized in their distribution. Several species are found in only a few locations in the state with the rarest species almost exclusively found on publicly-protected land.

Many studies on the relationship between timber harvest and vertebrates provide a basis for making decisions regarding those rare species. Relatively little is known about the impacts of timber harvest on rare plants and especially invertebrates. Long-lived and slow-dispersing understory plants and invertebrates, especially those that have their optimum habitat in late-successional or old growth forest, may be particularly affected by timber harvest.

The Managed Forest Law applies sound forest practices of timber cutting for effective propagation or improvement of various timber types. Sound forest practices also include, where consistent with landowner objectives, management of forest resources for endangered and threatened plants and animals. Managed forest law applications are screened for occurrences of endangered and threatened species through the NHI on-line database maintained by the Bureau of Endangered Resources (BER).



Figure 3-7: Cavity trees enhance the quality of wildlife habitat.

#### **LEGAL PROTECTION**

Endangered and threatened species are protected in Wisconsin by one or more of the following laws: the Federal Endangered Species Act of 1973 (Public Law 100-478), Lacey Act, Migratory Bird Treaty Act, Bald Eagle Protection Act, Wisconsin Endangered and Threatened Species Law (State Statute 29.604 and Administrative Rule NR27), and the Wisconsin Non-game Species regulations (State Statute 29.039).

Other laws, both state and federal, may apply to the protection of plants and animals in the state. Specific information may be obtained from your local DNR office or the Endangered Resources Program (BER) (see the Resource Directory). Other sources of information include:

- Local DNR biologists, foresters, park managers, or naturalists.
- Nature centers, colleges and universities, and UW Extension offices.
- NHI On-line Database, www.dnr.state.wi.us/org/ land/er/nhi/NHI ims/onlinedb.htm
- NatureServe we bsite, www.abi.org
- Wisconsin Vascular Plant Web Page, UW Herbarium, wiscinfo.doit.wisc.edu/herbarium/
- Breeding Bird Atlas Maps for Listed Species, www.uwgb.edu/birds/wbba/
- Wisconsin Herpetological Atlas Web Site, www.mpm.edu/collect/vertzo/herp/atlas/atlas.html



Figure 3-8: Eagle nest in the top of a white pine tree. Leaving trees like this provide ideal sites for nesting.

#### Natural Areas and Sensitive Communities

#### **PURPOSE**

The purpose of this habitat aspect is to increase awareness of protected natural areas and sensitive natural communities. Generally, natural areas are tracts of land or water-harboring natural features, which have experienced the least intrusive degrees of human disturbance, and which represent the diversity of Wisconsin's native landscape. They contain outstanding examples of native biotic communities, and are often the last refuges in the state for ETS species. Natural areas may also include exceptional geological features.

#### RATIONALE, BACKGROUND AND BENEFITS

Natural areas and sensitive communities represent only a small portion of the total forested area of the state. A statewide, county by county, inventory for the presence of natural areas was completed by the State Natural Areas Program in the period of 1969 through 1983. Each site was evaluated for landscape characteristics, natural community site values and species viability. Since 1985, this data and subsequent natural areas data is housed in the Natural Heritage Inventory database.

The presence of natural areas or sensitive natural communities can provide many benefits for the landowner and citizens of the state:

- Protect habitat for ETS species.
- Provide reference areas to compare the effects of more intensively managed areas.
- Provide opportunities for scientific research where natural processes are allowed to proceed essentially unimpeded.
- Provide opportunities for formal and informal education to gain an appreciation and understanding of biotic communities and their component species.
- Apply the principles of ecosystem management to the forest.

- Provide areas which are managed more intensively (barrens and savanna) or less intensively (late succession to old-growth forest) than normal sustainable forest practices.
- Protect significant geological features.
- Provide a reservoir of genetic and biological diversity.

Natural areas and sensitive natural communities are often managed by avoidance, while other sites can be maintained by fire, or appropriate silvicultural techniques.

The best information on natural areas and sensitive natural communities is provided by the DNR – State Natural Areas Program in the Bureau of Endangered Resources. A compilation of known occurrences of sensitive natural communities can be found at the BER web site listed under information sources. The extensive statewide inventory covered only a fraction of the forested land in the state. Many sites remain unknown. Identifying natural areas and sensitive natural communities can be challenging and may require expert evaluation.



Figure 3-9: A bald eagle resting on a white pine branch in northern Wisconsin.

# Affected Natural Communities

The following natural communities may possibly be affected by activities. The list of communities is based on State Statute 23.27 to identify natural areas meeting a critical level of importance in the state. The Endangered Resources Program manages the list of these forest communities:

- Black Spruce Swamp
- · Bog Relict
- · Boreal Forest
- · Central Sands Pine-oak Forest
- · Floodplain Forest
- · Forested Ridge and Swale
- · Hemlock Relict
- · Mesic Cedar Forest
- Mesic Floodplain Forest
- · Northern Dry Forest
- · Northern Dry-mesic Forest
- Northern Hardwood Swamp
- Northern Mesic Forest
- · Northern Wet Forest
- Northern Wet-mesic Forest
- Oak Woodland
- · Pine Relict
- Southern Dry Forest
- · Southern Dry-mesic Forest
- Southern Hardwood Swamp
- · Southern Mesic Forest
- Tamarack (Poor) Swamp
- · Tamarack (Rich) Swamp
- · White Pine/Red Maple Swamp

# Field Survey Consultants and Other Resources

The following resources can assist in a field survey to identify natural areas or sensitive natural communities:

- DNR Natural Areas staff, heritage ecologists, heritage zoologists, heritage botanists, non-game specialists, forest ecologists, or wildlife managers (see the Resource Directory).
- Local wildlife biologists, foresters, park managers or naturalists.
- Endangered Resources Web Site, dnr.state.wi.us/ org/land/er/nhi/NHI\_ims/onlineb.htm



Figure 3-10: Course woody debris in riparian and upland forests provide great habitat for nesting and foraging slamanders, small mammals and birds such as this Cape May Warbler (photo courtesy of Mike McDowell).

# WETLAND INCLUSIONS AND SEASONAL PONDS

- Wetland inclusions are wetland basins within an upland site.
- Seasonal ponds: Sometimes called vernal pools, seasonal ponds are depressions in the soil surface where water pools during wet periods of the year, typically in the spring and fall.
  - A seasonal pond will have an identifiable edge caused by annual flooding and local topography.
  - The edge is best identified during the spring or fall, but it may be identified during dry periods by the lack of forest litter in the depression. Such depressions typically are fishless and retain water for longer periods than puddles.

**NOTE:** The leaf litter is replenished annually but is consumed during inundated periods and noticeably depleted thereafter. Deciduous litter will likely be consumed faster and more thoroughly than conifer litter.

# Wetland Inclusions and Seasonal Ponds

#### **PURPOSE**

The purpose of wetland inclusions and seasonal ponds is to provide site-level wildlife habitat features for terrestrial species associated with wetland inclusions and seasonal ponds within forests.

#### RATIONALE, BACKGROUND AND BENEFITS

Wisconsin has a variety and abundance of wetland inclusions and seasonal ponds. The mixture of land and water features across the landscape provides an important dimension to the habitats of many wildlife species.

Wetland inclusions and seasonal ponds are different from puddles. Wetland inclusions and seasonal ponds retain water for longer periods and support populations of invertebrates that consume forest litter that falls into the depressions. These invertebrates provide food for birds, mammals, amphibians, and other species. Red-shouldered Hawks, a threatened species in Wisconsin, often choose forested areas that contain a number of wetland inclusions to ensure an adequate supply of prey for rearing young. Seasonal ponds are also important spring food sources for breeding waterfowl and migrating birds.

Seasonal ponds are best identified in spring when they are full of melt-water from the spring runoff. Frogs calling in spring, vegetation type or topography might provide additional clues to their location.

Amphibians are an important component of many forest ecosystems and many are dependent on seasonal wetlands for breeding habitat. These temporary or seasonal wetlands are important to amphibians because they don't contain fish populations, which prey on salamander eggs. Blue-spotted and spotted salamanders will enter these ephemeral wetlands as soon as they loose their ice cover in spring. Pay attention to the roadsides during the first warm rain of the spring and you will literally see the forest floor crawling with salamanders traveling to breeding sites. Five species of frogs are also heavy users of wetland inclusions. Anyone who has walked along a forest road at night can recall the croaking of wood frogs, the peeping of spring peepers and the distinctive notes of chorus frogs. Frog song can be so loud in these wetland inclusions that they block out all other sounds. Later in the spring and early summer, cope's and eastern gray treefrogs use these wetland inclusions for breeding. Because of the high biomass of amphibians in forested habitats, they are extremely important both as predators of invertebrates and as prey for other forest wildlife species.

Applying guidelines for water quality, leave trees and snags, coarse woody debris and slash during forest management activities can retain and create key habitat features (including woody debris, litter depth and plant cover) in these areas, while preventing siltation, excessive warming or premature drying-up of wetland inclusions and seasonal ponds.

#### THE NEED FOR RESEARCH AND MONITORING

Even though the ecological importance of wetland inclusions and seasonal ponds is recognized, the total number and location of all such water bodies in Wisconsin's forests is unknown. Existing inventories, such as the National Wetland Inventory, are incomplete with regard to wetland inclusions. Furthermore, seasonal ponds are sometimes difficult to recognize in the field. Uncertainty regarding the abundance and location of wetland inclusions and seasonal ponds indicates the need to document their occurrence, and further research their role in forest ecology in Wisconsin.

# Riparian Wildlife Habitat PURPOSE

The purpose of riparian wildlife habitat is to provide site-level wildlife habitat features for species that utilize riparian ecosystems.

#### RATIONALE, BACKGROUND AND BENEFITS

Riparian areas are among the most important parts of forest ecosystems. These areas have high plant diversity, both horizontally and vertically from the water's edge, which contributes to the high diversity of animals that live in these areas. Up to 134 vertebrate species occur in riparian forests in this region, but many of these species will also use non-riparian forest habitat. The species that are of most concern in riparian areas are "obligate" species, which require both the water and surrounding forests as habitat. In Wisconsin, obligate riparian species include amphibians, reptiles, birds, and mammals. Numerous plant and invertebrate species are also strongly associated with these habitats. Different animals are associated with different stream sizes. In general, larger animals are associated with larger streams and smaller species with smaller streams. A reverse pattern is found in some salamanders.

Although some degree of mature forest cover is desirable along many riparian areas, all habitat conditions are valid, given long-term disturbance regimes. The greatest concern for riparian habitats is in those areas of the state where uplands have been converted to agriculture, resulting in little additional forest of any kind in the region. This situation occurs more in the southeastern and western portions of the state rather than in the north, which affords more flexibility in age classes, structures and cover type (see Chapter 5: Riparian Management Zones and Wetlands, pages 82 and 84, for specific BMPs and harvesting criteria for riparian zones).

Forest streams come in many sizes, growing from spring-fed trickles to large rivers as they move downhill and converge with one another to drain larger and larger watersheds. Along this gradient, the ecological characteristics of a riparian area change in a gradual continuum. Because of these characteristics, management guidelines for riparian areas in general should be considered on a landscape level.



Figure 3-11: Wild lupine in central Wisconsin; the Karner Blue Butterfly's only known larval food plant. The Karner Blue is listed an an endangered species, even though they are relatively abundant in parts of Wisconsin.

It's important to keep in mind the following wildlife-related concerns for riparian habitats:

#### Leave Trees and Snags

- Prothonotary Warblers, Tufted Titmice, Wood Ducks, and a number of other species are dependent on existing cavities in riparian forests. Woodpeckers and chickadees select dying or diseased trees in which to excavate cavities. It's important to leave existing cavity trees and potential snags for use by the many cavity nesters that utilize riparian forests.
- Some riparian species require large super-canopy trees (trees above the existing canopy) for hunting perches and nesting sites. On larger rivers, Osprey will often perch in a large, dead white pine above a river to look for prey.
- Shade is essential for maintaining microhabitat conditions for some riparian animals. Winter Wrens, Northern Waterthrushes and many salamanders like the cool, moist conditions created by a closed canopy riparian forest. Yellow Warblers, Willow Flycatchers and some herps need more open riparian conditions. Providing a range of seral stages where appropriate will benefit a number of riparian species.

#### Coarse Woody Debris and Slash

 Many riparian animal species require downed logs for cover. Downed logs and slash in riparian areas provides additional microsites for insects and the species that prey on these insects. Salamanders, frogs and small mammals utilize these large logs as travel routes to avoid predation.

#### Mast

 Riparian edges often contain a higher concentration and richness of unique mast species, especially shrubs, than adjacent upland areas. It's well-documented that riparian areas are critical migratory stopover locations for birds that winter in the Neotropics. These areas often have more insect life in the spring before leaf out than associated uplands. In the fall, dogwoods, nannyberry, wahoo, honeysuckle, elderberry, and other mast producing shrubs and trees provide nourishment to birds migrating south and other species preparing for winter.

#### • ETS Species (see page 64)

- Many ETS species are found in riparian areas.
- Many of the bigger blocks of forest in the southern half of Wisconsin occur in riparian zones along the larger rivers. These are important areas for forest interior species such as Red-shouldered Hawks, Cerulean Warblers, Acadian Flycatchers, Yellow-throated Warblers, Yellow-crowned Night Heron, and a host of other species found in the southern half of the state.
- High-quality streams and rivers are important habitat for many rare dragonflies, fish, mussels and clams, and other invertebrates. Often the presence of these species is used to evaluate stream health. The middle St. Croix, middle and lower Chippewa and lower Wisconsin are good examples of riparian systems that host many rare species.

#### · Natural Communities and Sensitive Sites

- Many natural communities are associated with riparian ecosystems. Some, like floodplain forests, are always associated with riparian areas. Others, such as northern edge meadow, emergent aquatic and alder thicket are often associated with riparian areas, but can also be found in other situations. For a complete listing and description of natural community types in Wisconsin, see the BER web site.

# ETS SPECIES ASSOCIATED WITH RIPARIAN ECOSYSTEMS

- Red-shouldered Hawk (T)
- Cerulean Warbler (T)
- Acadian Flycatcher (T)
- Osprey (T)
- Great Egret (T)
- Snowy Egret (E)
- Yellow-throated Warbler (E)
- · Bald Eagle
- Yellow-crowned Night Heron (T)
- Prothonotary Warbler (SC)
- Louisiana Waterthrush (SC)
- Many rare fish species
- Many rare mussels and clams
- St. Croix snaketail, splendid clubtail and a host of other rare dragonflies
- · Blanchard's Cricket Frog
- · Massassauga Rattlesnake
- Wood Turtle
- · Western Ribbon Snake
- Bullfrog
- · Midland smooth softshell turtle
- Numerous other plants, snails and invertebrates



Figure 3-13: Large blocks of older forest are important to forest interior species such as this Cerulean Warbler (photo courtesy of Dennis Malueg).

#### **ECO-REGION APPLICABILITY**

These guidelines are applicable statewide.

#### LANDSCAPE IMPLICATIONS

In areas dominated by agricultural land use practices (in southern and east-central regions), where riparian forests represent the majority of the forests in the area, consider using uneven-age management. Most rare species associated with these forests require high-canopy closure and large blocks of forest.



Figure 3-12: This stand of red pine has been thinned three times and the shrub layer resulting from increased sunlight reaching the forest floor now provides good wildlife habitat.

#### RESOURCES FOR ADDITIONAL INFORMATION

Amphibians of Wisconsin, 2001, Bureau of Endangered Resources Publ. No. ER-105 2001, Wisconsin Department of Natural Resources, Madison, WI. BER publication that gives an overview of amphibian biology and conservation in Wisconsin. Has detailed life history and management information for each species in Wisconsin.

Bureau of Endangered Resources Web Site. This web site provides a wealth of information on rare species and natural communities, the State Natural Areas Program, Invasive Species, program information, and news and events regarding the Bureau, www.dnr.state.wi.us/org/land/er/.

Natural Heritage Inventory On-line Database. This application provides users an opportunity to search the Wisconsin Natural Heritage Inventory (NHI) Program's database for the status and distribution of endangered resources, or to learn what species or natural communities are known to exist within a particular area of interest. The On-line Database is intended for information and general planning purposes rather than regulatory decision-making, www.dnr.state.wi.us/org/land/er/nhi/NHI\_ims/onlinedb.htm

Snakes of Wisconsin, 2000, Bureau of Endangered Resources Publ. No. ER-100-00, Department of Natural Resources, Madison, WI. BER publication that gives an overview of snake biology and conservation in Wisconsin. Has detailed life history and management information for each species in Wisconsin.

The Endangered and Threatened Vertebrates Species of Wisconsin, 1997, Bureau of Endangered Resources Publ. No. ER-091.Wisconsin Department of Natural Resources, Madison, WI. BER publication that gives life history, distribution and management information for all threatened and endangered vertebrates in Wisconsin. A county by county listing of species occurrences is included, but is not up-to-date.

The Endangered and Threatened Plant Species of Wisconsin, 1993, Bureau of Endangered Resources Publ. No. ER-067, Wisconsin Department of Natural Resources, Madison, WI. BER publication gives basic occurrence and habitat information for the listed plant species in Wisconsin. Species descriptions are separated by general habitat type. Unfortunately, this document has not been updated since 1993, so not all information is current.

The Endangered and Threatened Invertebrates of Wisconsin, 1999, Bureau of Endangered Resources Publ. No. ER-085-99, Wisconsin Department of Natural Resources, Madison, WI. BER publication details life histories and general conservation issues of each listed invertebrate species in Wisconsin. Also includes a county by county listing of occurrences of these species at the end of the document.

Threatened and Endangered Species of Forests in Wisconsin: A Guide to Assist with Forestry Activities, 2000. A joint publication of International Paper Company, US Fish and Wildlife Service and the Wisconsin Department of Natural Resources is available from any of the sponsors. Gives a description, life history information and forestry considerations for endangered and threatened species that utilize forested habitats.

Vogt, Richard C. 1981. *Natural History of Amphibians and Reptiles of Wisconsin*. Milwaukee Public Museum and Friends of the Museum, Inc. 205 pp. Good source for general information of the natural history of herps in Wisconsin.

Wild Turkey: Ecology and Management in Wisconsin, 2001. Bureau of Integrated Science Services, Wisconsin Department of Natural Resources, Madison, WI. This publication gives a complete account of Wild Turkey re-introduction, management, and ecology in Wisconsin. Landowners interested in managing their land for Wild Turkeys should consider this source as a definitive guide to Turkey biology in Wisconsin.

Wildlife and Your Land: A Series About Managing Your Land for Wildlife. Bureau of Wildlife Management, Wisconsin Department of Natural Resources, Madison, WI. This source served as the foundation for many of the wildlife issues covered in the FMG handbook. This collaborative effort focuses on different management issues land managers and owners should consider when managing their property. This series is available in hardcopy form or on the web at www.dnr.state.wi.us/org/land/wildlife/publ/wildland.htm.

Wisconsin Breeding Bird Atlas Web Site. 2002. University of Wisconsin-Green Bay, www.uwgb.edu/birds/wbba/. This web site displays the results of the Wisconsin Breeding Bird Atlas performed from 1995 to 2000 on private and public lands across the state. It's a good source of information for the range and distribution of bird species within the state. The web site will generate a species list by quad or county and also contains pictures of the species that could be used in identification.

Wisconsin State Herbarium: University of Wisconsin – Madison Web Site. This web site contains on-line herbarium records for all plants found within Wisconsin. You can search the herbarium by species, genus or common name. Each species description contains information on location, habitat, photos, and a floristic rating. Locations are only given to the county level.

Wisconsin's Biodiversity as a Management Issue, 1995. Wisconsin Department of Natural Resources, Madison, WI. This report was written for Department of Natural Resources managers to provide them with a context for their work. This report gives an overview on the issues and implications of Wisconsin's rich biotic heritage. It also gives an overview of the ecological, social and economic issues tied to each major community type in Wisconsin. This is a good general source for information on the landscape surrounding a given property.

#### **COMMENTS WELCOME!**

- BER is looking for comments on the information given above so that we can better meet the needs of cooperating foresters and landowners. These comments would help us to revise this section for the Second Edition of the this guide.
- BER is working on developing better supporting information for managing ETS species.
- BER is evaluating the success of the on-line NHI database, and looking into ways to improve the web site for general use by land managers and owners.
- BER welcomes comments and suggestions on any information contained above regarding ETS species in Wisconsin.

## CHAPTER 4 — VISUAL QUALITY

| The  | Value of Visual Quality   | 68  |
|------|---|-----|
|      | A Concern for Aesthetic Quality                                 | 68  |
|      | Benefits of Visual Quality Management                           | 69  |
|      |   |     |
| Visu | ıal Sensitivity   | 7 1 |
|      | Recognizing Different Levels of Visual Sensitivity              | 71  |
|      | Visual Sensitivity Levels                                       | 71  |
|      | The Value of Recognizing Different Levels of Visual Sensitivity | 72  |

#### THE VALUE OF VISUAL QUALITY



Figure 4-1: The "most sensitive" level applies to those travel routes where significant public use occurs and where the visual quality is of high concern to typical users.

#### A Concern for Aesthetic Quality

Wisconsinites are concerned about the aesthetic quality of forested lands throughout the state, which are a great source of pride for Wisconsin citizens. Scenic beauty – or "visual quality" – is one of the primary reasons people choose to spend their recreation and vacation time in or near forested areas.

They are also attracted by the peace and quiet of the outdoors, the serenity, the solitude, and a host of other emotional, spiritual and sensory responses that make up the richly aesthetic and deeply personal experience that is so closely tied to time spent in or near our forests.

Wisconsin forests are particularly vital to the health of two industries: tourism and forest products. Many of the demands on the forests from these two industries are compatible and even complementary. Recognition of the importance of scenic values to recreational users has led to the development of a set of forest aesthestic management guidelines, which have been incorporated in the Wisconsin DNR Silviculture and Forest Aesthetics Handbook, 2431.5.



Figure 4-2: Scenic quality is one of the primary reasons people choose to spend their recreation time in or near forested areas.

# Benefits of Visual Quality Management

Visual quality is one important aspect of the broad, multi-faceted concept of integrated forest resource management. Visual quality management can:

- Enhance visual quality of forested lands for recreational users which results in a healthy tourism economy.
- Enhance public acceptance of forest management and timber harvesting, therefore helping to sustain a healthy forest products industry.
- Minimize visual and audible impacts of forest management activities on tourists and recreational users.
- Minimize visibility of harvest areas by limiting apparent size of harvest.
- · Minimize visual impact of slash.

- Minimize the impact of landing operations on recreational viewers and users.
- Minimize visual contrast created by snags and broken or leaning trees.
- Reduce visual impacts associated with the design and use of forest access roads.
- Reduce the visual impact of site preparation practices and reduce the time that the effects of these practices are visible.
- Promote more natural-appearing stands.
- Enhance the aesthetics of visual management areas by minimizing visual impacts of TSI activities.
- Reduce visual impacts of treated vegetation.
- Reduce noise and unsightliness related to gravel pits.



Figure 4-3: Slash from pine harvests is much smaller in size than hardwood tops and limbs. Slash from mechanical harvesting, commonly used in pine, aspen and birch, is usually compacted by the processing machine.



Figure 4-4: Careful planning and control of the logging operation can have a major impact on the visual quality following a timber harvest.



Figure 4-5: Untreated logging slash, such as these oak tops, takes longer to decay and is often objectionable to landowners. Lopping of tops or harvesting firewood may provide a solution.



Figure 4-6: Large, unbroken clearcuts along well-traveled roads are often viewed by the public as unsightly, at least until the new regeneration becomes established on the site.



Figure 4-7: This aerial view shows a mosaic of pine and aspen stands with scalloped boundaries in a portion of the Northern Highland State Forest that is managed to enhance aesthetic quality.



Figure 4-8: This ground-level photo was taken in the center of the aerial view shown in Figure 4-7 (left) while looking toward the lower left. This area, managed for aesthetic quality, shows oak sprouts and young aspen in the foreground, young jack pine and older aspen in the middle, and mature red and jack pine in the background.

#### VISUAL SENSITIVITY

Recognizing Different Levels of Visual Sensitivity Some of the factors important in the determination of visual sensitivity include:

- The perceived degree of sensitivity of users of that travel route or recreation area concerning landscape aesthetics.
- The volume and type of use the travel route or recreation area receives.
- The speed of travel within the route or area.

#### Visual Sensitivity Levels

#### **MOST SENSITIVE**

Applies to travel routes and areas where significant public use occurs and where visual quality is of high concern to typical users. Examples of such routes may include public highways, local roads, recreational lakes and rivers, and designated recreational trails and areas that provide a high level of scenic quality.

#### **MODERATELY SENSITIVE**

Applies to travel routes or recreation areas, not identified as "most sensitive," where visual quality is of moderate concern to typical users. Examples of these routes and areas may include public highways and local roads, recreational lakes and rivers, and designated recreational trails that provide moderate to high scenic quality but less significant public use.

#### **LESS SENSITIVE**

Applies to travel routes or recreation areas, not identified as "most sensitive" or "moderately sensitive," where visual quality is of less concern to typical users. Examples of these routes may include public highways and low-volume local forest roads, non-designated trails, and non-recreational lakes and rivers.



Figure 4-9: The selective thinning in this red pine stand was designed to mimic natural changes that occur over time. Trees were removed from all size classes, so that the remaining stand has a mix of sizes, quality and tree spacing, therefore providing a more "natural" and less "plantation" look.

#### The Value of Recognizing Different Levels of Visual Sensitivity

Recognition of the level of visual sensitivity helps the landowner, resource manager and logger choose visual quality guidelines that help fulfill the landowner's expectations.

Timber sale contracts should reflect differences in visual sensitivity. An area classified as "most sensitive" would normally have different contract specifications than those used in an area classified as "less sensitive." Landings, for example should be avoided within view of travel routes or recreation areas classified as "most sensitive," while they might be visible in areas classified as "less sensitive," but located outside the travel route right-of-way.



Figure 4-10: A buffer strip of uncut trees has been retained between this clearcut and the highway in the lower left of the photo to improve visual impact. A riparian management zone between the harvested area and the wetland on the right-hand side has been left uncut as well.

## CHAPTER 5 — RIPARIAN AREAS AND WETLANDS

| The Value of Riparian Areas                                 |    | $\dots 74$ |
|---|----|------------|
| A Transition from Aquatic to Terrestrial Ecosystems         | 74 |            |
| Potential Threats to Riparian Areas: Pollutants and Impacts | 75 |            |
| Protecting Riparian Functions and Values                    | 77 |            |
| Riparian Management Zones                                   |    | 80         |
| Background: What is a RMZ?                                  | 80 |            |
| Agricultural and Urban Areas                                | 81 |            |
| Existing Regulations  | 82 |            |
| Best Management Practices for Riparian                      |    |            |
| Management Zones  |    | 82         |
| BMPs: Riparian Management Zones                             |    |            |
| BMPs: Lakes & Navigable Perennial Streams                   |    |            |
| BMPs: Navigable Intermittent Streams                        | 83 |            |
| BMPs: Non-Navigable Streams                                 | 83 |            |
| Wetlands  |    | 84         |
| BMPs: General   | 84 |            |

#### THE VALUE OF RIPARIAN AREAS

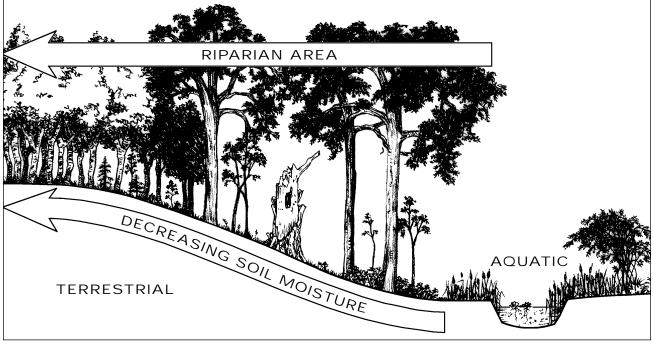


Figure 5-1: Transition from aquatic to terrestrial habitat in a riparian area.

# A Transition from Aquatic to Terrestrial Ecosystems A riparian area is the area of land and water forming a transition from aquatic to terrestrial ecosystems along streams, lakes and open water wetlands (see Figure 5-1).

Riparian areas are among the most important and diverse parts of forest ecosystems. They support high soil moisture and a diversity of associated vegetation and wildlife, and they perform important ecological functions that link aquatic and terrestrial ecosystems:

- Riparian areas maintain streambank, channel and shoreline stability and stream temperature and water quality.
- Riparian areas provide water storage and conservation, nutrient and food input to the aquatic system, in-stream structure of coarse woody debris, and a moderated microclimate.

- Riparian areas also provide important habitat for many species of fish, mammals, birds, reptiles, amphibians, and insects.
- Riparian areas are also important for recreation, tourism, forest products, hunting, fishing, biological diversity, and other human values they provide.

To protect the functions and values of riparian areas, management practices are modified within **riparian management zones (RMZs)** for streams and lakes to protect water quality, fish and other aquatic and terrestrial resources. These RMZs are applied adjacent to lakes and navigable perennial streams, navigable intermittent streams and non-navigable streams.

Potential Threats to Riparian Areas: Pollutant Types and Impacts

One of the biggest threats to water quality in the United States is **nonpoint source pollution**. Non-point source pollution occurs when surface water runoff from rainfall or snowmelt moves across or into the ground, picking up and carrying pollutants into streams, lakes, wetlands or groundwater. Soil becomes a non-point source pollutant when water runoff carries large amounts of soil into a water body. BMPs are practical and cost-effective ways to prevent or reduce nonpoint source pollution.

nonpoint source pollution is the source for about half of all pollutants entering our nation's waters. Three to nine percent of all nonpoint source pollution comes from forestry practices nationwide. Because Wisconsin is relatively flat, only about three percent of the state's nonpoint source pollution comes from forestry practices. While three percent sounds small, localized nonpoint source pollution can be significant. And the cumulative effects of all sources can seriously degrade water quality in a drainage system.

Forest management activities can generate the following forms of nonpoint source pollution:

#### **SEDIMENT**

Forest floor vegetation and organic debris protect the soil from the erosive action of falling raindrops and runoff. Forestry management activities, such as road building, can remove this protection. This can lead to erosion of the soil creating sediment. When sediment is carried away in runoff and deposited elsewhere, sedimentation occurs. Without using appropriate BMPs on exposed and sloping land, the soil will likely erode and may wash into a body of water. Sediment is the primary pollutant associated with forestry activities, especially at stream crossings for forest roads and skid trails.

In the natural world, sedimentation is a slow, naturally occurring process. However, human activities often speed it up. The result can be large



Figure 5-2: Vernal pools, or casual water, provide habitat for certain wildlife species. Forestry operations should be conducted at the proper time to avoid disruptions to these small ecosystems.

amounts of sediment accumulating in lakes, streams and wetlands that speed up the aging of lakes and bury fish spawning grounds and aquatic plants. These plants are a source of food and habitat for fish and other aquatic organisms.

Accumulating sediment also constricts naturally flowing channels, leading to increased stream bank erosion and possible flooding. Suspended sediment can cloud the water, reducing the hunting success of sight-feeding fish; it can also damage the gills of some fish species, causing them to suffocate.

#### **ORGANIC DEBRIS**

Leaves and large woody debris (generally large fallen logs, at least 12 inches in diameter with root ball attached) that naturally fall into streams can greatly benefit aquatic ecosystems. However, too much organic debris deposited in a short time can harm water quality. This can occur during logging when treetops and branches fall or wash into streams. Too much decomposing matter in streams can decrease dissolved oxygen in the water, which fish need to thrive and reproduce.



Figure 5-3: A small intermittent stream tumbles over the rocks down a southern Wisconsin hillside.

#### **NUTRIENTS**

Nutrients such as nitrogen and phosphorus exist naturally in forest soil and can enter water bodies if the soil erodes into water. Also, if fertilizers are used in forest management, they can wash into water bodies in runoff. Excessive amounts of nutrients may cause algal blooms in lakes and streams, which can reduce levels of dissolved oxygen in the water to below what fish and other aquatic species need to survive.

#### **TEMPERATURE**

Some sunlight filtering through trees is healthy for many streams. It can promote plant growth (food) in the water and foster healthy ground vegetation along shorelines. However, when trees and the shade they provide are removed along most small streams, peak mid-summer water temperatures climb as a result of increased solar radiation. This can eliminate cold water fish, reduce dissolved oxygen and affect the metabolism and development of fish.

#### **CHEMICALS**

Pesticides (herbicides, insecticides and fungicides) help control forest pests and undesirable plant species. But when applied improperly, pesticides can be toxic to aquatic organisms. Also, fuel, oil and coolants used in harvesting and road-building equipment must be handled carefully to avoid water pollution.

#### **STREAMFLOW**

Timber harvesting can increase peak streamflow which increases chances for flooding, streambank erosion and sedimentation. When 60 percent or more of a basin's area consists of trees less than 15 years old, snow can melt at several times the rate that occurs in forests more than 15 years of age. This increase in snowmelt can also increase peak streamflows.

If timber harvesting equipment compacts a large area of the forest soil, water infiltration into the soil is reduced and surface runoff into streams increases. This also reduces water percolation through the soil to recharge groundwater. Groundwater provides cool, clean water to lakes and streams, maintaining steady streamflows and lake levels throughout the summer.



Figure 5-4: Large woody debris that falls naturally into streams can greatly benefit aquatic ecosystems.

# Protecting Riparian Functions and Values

Clean water is essential to Wisconsin's economy and rich quality of life. Lakes and streams provide habitat for wildlife, fish and other aquatic species. Our forests play a vital role in purifying and maintaining clean water for streams, lakes and groundwater.

The most practical and cost-effective method to assure that forestry operations do not adversely affect water quality in Wisconsin is through the use of the voluntary best management practices (BMPs). These BMPs are voluntary in the sense that they are not legally mandated. However, the Wisconsin Department of Natural Resources (DNR) strongly encourages their use by all Wisconsin forest landowners, land managers and forestry professionals. BMPs are identified by a "

"."

Several categories of public and private landowners in Wisconsin already use forestry water quality BMPs to guide their management activities. For example, compliance is required on DNR properties such as State Forests, and lands enrolled in the Managed Forest Law Program since 1995. In addition, the forestry water quality BMPs have been adopted by all 29 counties enrolled in Wisconsin's County Forest Law program. The majority of Wisconsin's industrial forest land is enrolled in the American Forest and Paper Association's Sustainable Forestry Initiative which requires water quality BMP compliance and logger training as a condition of membership.

It's U.S. Department of Agriculture - Forest Service policy to promote and apply approved BMPs for control of nonpoint sources of water pollution. The Chequamegon and Nicolet National Forests support the BMPs developed by the Wisconsin Department of Natural Resources.

In addition to the BMPs described in this manual, you should be aware of existing municipal, county,



Figure 5-5: This headwater segment of a small southern Wisconsin perennial stream is designated Category 5 trout water. Forestry operations near such waters must be consistent with various regulations, and BMPs should be used within the riparian management zone.

state, and federal regulations relating to forest management and water quality (see Appendices E and F for information on permits and regulations).

This guide can help you when making decisions about management activities on your land.

Applications of BMPs may be modified for specific site conditions with guidance from a forester or other natural resource professional if modifications provide equal or greater water quality protection, or if the modification has no impact on water quality.

You can get professional advice on BMPs and all forest management activities from natural resource professionals such as:

- Consulting foresters
- Industrial foresters
- Wisconsin DNR foresters, fish managers and water quality staff
- USDA Natural Resources and Conservation Service staff
- County Land Conservation Department staff



Figure 5-6: Too much decomposing debris, such as treetops and limbs from logging, can decrease the oxygen in streams which fish need to thrive and reproduce.

Careful planning for forest management activities, such as road construction, timber harvesting and site preparation will minimize nonpoint source pollution. A well thought-out plan will lead to harvest operations that use BMPs, remove forest products efficiently and profitably, and promote sustainable forest growth and water quality protection.

A comprehensive forest management plan should include forestry BMPs for water quality. The level of formality and detail should be appropriate to the project size, cost and environmental risk. The plan should also be flexible and adaptable to changing conditions.

Landowners and land managers should select the best forest management strategy to protect water quality specific to the site. A contractor (i.e., logger, road developer) working with the landowner and land manager, is usually responsible for implementing forestry BMPs.

Wisconsin DNR foresters and consulting or industrial foresters can work with you to develop a list of BMPs to include in your forest management plan. Cost-sharing assistance may be available for plans written by a consulting forester.

Use the following checklist to plan forest management activities:

- Plan forest management activities to avoid operations in wetlands, including building landings, skid trails and roads. Where avoidance is not practical, minimize impacts by limiting the extent of wetland activities.
- Make a list of site-specific forestry BMPs you will need to protect water quality in all timber sale contracts, timber harvest plans and forest management plans.
- Develop a forest management plan that states the management objectives for the site. Plan operations to protect water quality by considering site conditions. Identify on a map the following site conditions:
  - Harvest unit boundary
- Property boundaries
- Existing forest road system (roads, skid trails and landings)
- Sensitive areas include streams, lakes, wetlands, flood plains, habitat areas for known threatened or endangered aquatic and terrestrial plant and animal species, steep slopes and erodible soils.
- Riparian management zones
- Stream crossings
- Equipment maintenance and fueling areas



Figure 5-7: Wetland with scattered black spruce and tamarack surround a small northern Wisconsin lake.

- The following resources can be used to identify site conditions:
  - United States Geological Survey (USGS)
     Topographic Maps (7.5 minutes): Available from the Wisconsin Geological and Natural History Survey and some outdoor and sporting supplies retailers.
  - Aerial Photographs: Available from the USDA Farm Services Agency, the Wisconsin Department of Natural Resources (DNR) and the USDA Natural Resources and Conservation Service.
  - County Soil Surveys: Available from county land conservation departments and the USDA Natural Resources and Conservation Service.
  - **Floodplain Maps**: Available from local county zoning administrators.
  - Wisconsin Wetland Inventory Maps: May be reviewed at DNR service centers and local county or municipal zoning offices, or can be purchased from the Wisconsin DNR, Bureau of Fisheries Management and Habitat Protection, P.O. Box 7921, Madison, WI 53707-7921.



Figure 5-8: Trees and other vegetation along the shoreline of this undeveloped northern Wisconsin lake help reduce soil erosion.

- Conduct on-site evaluations.
- Obtain necessary permits and licenses before beginning management activities. For existing regulations pertaining to forest management activities, see Appendix E.
- Plan to stabilize bare soil as soon as possible after exposing it to prevent erosion into streams, lakes, wetlands and riparian zones. This is especially important on steep slopes and erodible soils, in riparian management zones, and at stream crossings (refer to the Soil Stabilization section in Chapter 10: Forest Roads, page 128).
- Maintain a spill containment and cleanup kit appropriate for the materials on the operation.
   For more information, see the Equipment, Fuel and Lubricants section in Chapter 9: General Operational Guidelines, page 113.

#### RIPARIAN MANAGEMENT ZONES

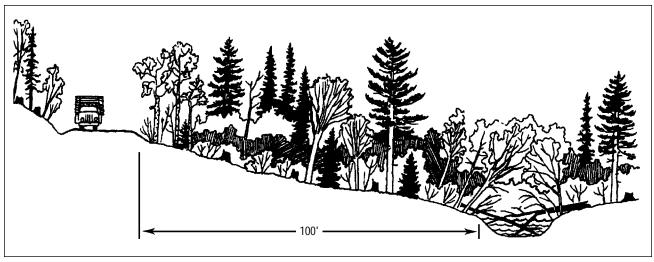


Figure 5-9: Cross-sectional depiction of a riparian area.

Riparian management zones (RMZs) are land and vegetation areas next to lakes and streams where management practices are modified to protect water quality, fish and other aquatic resources. These areas are complex ecosystems that provide food, habitat and movement corridors for both aquatic (water) and terrestrial (land) communities. Also, because these areas are next to water, RMZs help minimize nonpoint source pollution impacts to surface waters.

Riparian management zones help to:

- Filter sediment and nutrients from runoff. As runoff water moves through plants and the duff layer (needles, leaves and decaying matter), it slows and drops sediment that has been carried along. This settling process keeps sediment and nutrients from flowing into streams and lakes. It also allows plant roots to take up the nutrients that have dissolved in the runoff and soaked into the soil, further reducing the amount of pollution flowing into lakes and streams.
- Allow water to soak into the ground. Trees and plants, leaves and twigs slow surface runoff, allowing the water to soak into the soil. This helps to reduce peak flow levels in streams and

replenishes the groundwater that helps maintain lake levels and stream flows.

- Stabilize streambanks and lakeshores. Trees and plants along streambanks and lakeshores can reduce soil erosion because their roots hold the soil together, making it more difficult for waves, currents and runoff to wash the soil away. Plants also reduce the impact of raindrops on exposed soil, decreasing erosion.
- Shade streams. In most cases, plants and trees along streambanks are necessary to shade streams, keeping the water from becoming too warm for aquatic life in the summer.
- Provide food and habitat for aquatic organisms. Fallen leaves and other organic debris from trees are the base of the food chain for aquatic organisms in small forest streams. Large woody debris (large fallen logs, generally at least 12 inches in diameter with an anchored root ball) create riffle areas and plunge pools, critical habitat for fish and other aquatic organisms. The pools trap leaves and twigs long enough for microorganisms to decompose them. These microorganisms become food for insects and other invertebrates, which in turn become food for fish.

A gricultural and Urban Areas Riparian zones are very valuable to agricultural, urban and forested areas. Runoff from cultivated fields, as well as city streets and lawns, can contain sediment, pesticides and fertilizer. Plants in riparian zones can filter out these contaminants, reducing the amount of pollutants entering waterbodies.

Riparian zone landowners in all agricultural and urban areas should maintain or restore riparian management zones. Do not allow livestock to graze in forested RMZs (contact the USDA Natural Resources and Conservation Service or your local land conservation department to establish a grazing plan).

#### LAKE/POND

A still waterbody that 1) is navigable; 2) has an ordinary high-water mark; and 3) has a bed and banks, and is a "reasonably permanent" body of water although it may dry up during periods of drought.

#### **STREAM**

A watercourse that 1) has an ordinary high-water mark; 2) has bed and banks; 3) flows at least periodically; 4) does not lose its character as a watercourse even though it may become braided in a wetland complex. There are two kinds of streams:

- Perennial streams have constant flow except during droughts.
- Intermittent streams usually flow only after rainstorms or snowmelt and are dry most of the year. Intermittent streams must be protected because they channel runoff into perennial streams and lakes and may become part of the aquatic ecosystem when water flows in them.

#### ORDINARY HIGH-WATER MARK

The point on a bank or shore up to which the presence and action of water is so continuous it leaves a distinct mark either by erosion, destruction of terrestrial (land) vegetation, or other easily recognized characteristics.

#### **NAVIGABLE**

A waterway is navigable if it has bed and banks, and it's possible to float a canoe or other small craft in the waterway on a regular reoccurring basis; even if only during spring runoff.

**NOTE:** Lakes and streams (perennial and intermittent) identified on current USGS topographical maps (7.5 minute/1:24,000 scale), should be considered navigable. Other lakes and streams may be determined to be navigable by a Wisconsin DNR water management specialist. If you have a question about navigability, contact a Wisconsin DNR water management specialist.

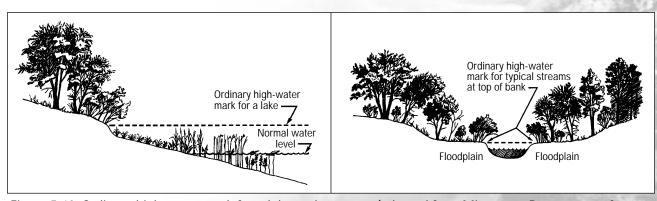


Figure 5-10: Ordinary high-water mark for a lake and a stream (adapted from Minnesota Department of Natural Resources, 1989).

#### **Existing Regulations**

All cutting practices next to lakes and navigable streams must be consistent with local county shoreland and wetland zoning ordinances. Wisconsin Administrative code, NR 115, provides state-required minimum standards for the cutting of trees and shrubbery to be included in county shoreland ordinances to protect the natural beauty, control erosion and reduce the flow of effluents, sediments and nutrients from the shoreland area. A special exception (or conditional use) permit may

be required to harvest next to lakes and navigable streams. When planning to harvest within the RMZ, contact your local county zoning office before beginning any harvesting. For more information about Administrative Code NR 115, see Appendix E.

Stream crossings, grading next to lakes and streams, and other forestry activities are also subject to permits as described in Appendix F. Contact a Wisconsin DNR water management specialist for more information.

# BEST MANAGEMENT PRACTICES FOR RIPARIAN MANAGEMENT ZONES

### BMPs: RIPARIAN MANAGEMENT ZONES

There are three categories of riparian management zones for BMPs:

- Lakes, ponds and navigable perennial streams
- Navigable intermittent streams
- Non-navigable streams

## BMPs COMMON TO ALL THREE RMZ CATEGORIES

- ✓ Locate roads outside the RMZ unless necessary for stream crossings. For stream crossings, follow recommendations in the Stream Crossings section of Chapter 10: Forest Roads, page 120.
- ✓ Locate landings outside the RMZ.
- ✓ Do not move slash into or pile slash within the RMZ. Keep slash out of lakes and stream channels and away from areas where it may be swept into the water.
- Minimize soil exposure and compaction to protect ground vegetation and the duff layer.

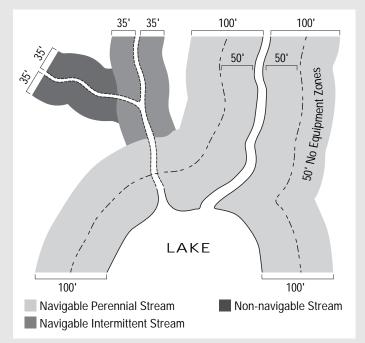


Figure 5-11: Three riparian management zone categories.

Note: On steep slopes or on areas of highly erodible soils, you should widen the RMZ.

#### BMPs: LAKES & NAVIGABLE PERENNIAL STREAMS

- ✓ The RMZ for these waters is a strip of land running along the shoreline of lakes and on each side of streams. It begins at the ordinary high-water mark and extends a minimum of 100 feet landward.
- ✓ Do not operate wheeled or tracked harvesting equipment within 50 feet of the ordinary high-water mark except on roads or at stream crossings.
- ✓ Harvesting intervals should be a minimum of 10 years.

- ✓ Harvesting plans should leave at least 60 square feet of basal area per acre in trees five inches diameter breast height (DBH) and larger, evenly distributed.
- ✓ Use selective harvesting and promote long-lived tree species appropriate to the site. Long-lived tree species include 1) hardwoods such as sugar and red maple, white and black ash, elms, and oaks and 2) conifers such as eastern hemlock, white pine, red pine, and white cedar.
- ✓ Develop trees 12 inches DBH and larger.

#### BMPs: NAVIGABLE INTERMITTENT STREAMS

The RMZ for these streams is a strip of land on each side of the stream, beginning at the ordinary high-water mark and extending a minimum of 35 feet landward.

- ✓ Operate wheeled or tracked harvesting equipment within 15 feet of the ordinary high-water mark only when the ground is frozen or dry.
- ✓ Harvesting intervals should be a minimum of 10 years.

- ✓ Harvesting plans should leave at least 60 square feet of basal area per acre in trees five inches DBH and larger, evenly distributed.
- ✓ Use selective harvesting and promote long-lived tree species appropriate to the site. Long-lived species include 1) hardwoods such as sugar and red maple, white and black ash, elms and oaks and 2) conifers such as eastern hemlock, white pine, red pine, and white cedar.

#### BMPs: NON-NAVIGABLE STREAMS

Non-navigable streams are found in the field but may not be identified on current U.S. Geological Survey topographical maps (7.5 minute/1:24,000 scale).

The RMZ for these streams is a strip of land on each side of the stream, beginning at the ordinary

high-water mark and extending a minimum of 35 feet landward.

✓ Operate wheeled or tracked harvesting equipment within 15 feet of the ordinary high-water mark only when the ground is frozen or dry.

#### **WETLANDS**

Wisconsin state statutes (section 23.32) define a wetland as "an area where water is at, near or above the land surface long enough to be capable of supporting aquatic or hydrophytic (water-loving) vegetation, and which has soils indicative of wet conditions." Wisconsin wetlands include marshes, bogs, floodplain forests, wet meadows, and low prairies. These wetlands provide many functional values in the ecosystem:

- Shoreline Protection. Shoreline vegetation absorbs the force of waves and currents, protecting against erosion. Roots of wetland plants hold together lake shores and streambanks.
- Flood Protection. By storing runoff from heavy rain and snowmelt, wetlands reduce flood damage.
- Water Quality Protection. Wetlands store and filter pollutants such as sediment and the nutrients in sediment. Also, wetlands can transform some pollutants into non-polluting forms.
- Groundwater Recharge and Discharge. Some
  wetlands recharge groundwater by moving surface
  water into the groundwater system. Groundwater
  discharge occurs when groundwater flows to the
  surface and into streams, lakes and wetlands. This
  discharge is especially important in summer by
  providing stream baseflows critical to aquatic life.
- Animal and Plant Habitat. Many animals spend their lives in wetlands, while others use wetlands for feeding, breeding, resting, nesting, escape cover, or travel corridors. Wetland plants provide food and shelter for many animal species. Many of the rare and endangered plant species in Wisconsin are found in wetlands.

Forestry BMPs in wetlands protect water quality from erosion and minimize changes to the surface and below-surface water movement that can occur from rutting and road building. Changing the surface and below-surface water movement can affect the health of the wetland ecosystem and its flood protection function.

Activities in wetlands are often subject to municipal, county, state, and federal permit and regulatory requirements. Some of these regulations are listed in Appendix E: Regulations (see Section 404, Chapter NR 103, and Chapter NR 117). When you suspect your project involves a wetland and want to know what regulations apply, the sequence of contacts include 1) your county zoning office; 2) a Wisconsin DNR water management specialist; and 3) the U.S. Army Corps of Engineers.

Maps from the Wisconsin Wetland Inventory can help you make a preliminary determination as to whether your project will affect wetlands. These maps may be reviewed at DNR offices and county or municipal zoning offices, or purchased from the Wisconsin Geological and Natural History Survey.

#### **BMPs: GENERAL**

- ✓ Follow all planning BMPs on pages 82 to 84 of this chapter. Whenever practical, avoid locating roads and landings in wetlands.
- ✓ Whenever possible, forest management activities in wetlands should occur on frozen ground during the winter to minimize rutting.
- ✓ For activities in wetlands, consider allowing more flexibility for completion dates in timber sale contracts to allow the logger time to complete logging activities during firm or frozen ground conditions.
- ✓ Identify riparian management zones along all streams and lakes.
- ✓ Do not move slash from upland sites into wetlands, and keep slash out of open water.
- ✓ Only use pesticides labeled for use in wetlands.
- ✓ If possible, avoid equipment maintenance and fueling in wetlands; otherwise, use extreme caution. Clean all spills promptly (see page 113 Chapter 9: General Operational Guidelines).

## CHAPTER 6 — CULTURAL RESOURCES

| Cultural Resources   | 86 |
|--|----|
| Forest Management for the Protection of Cultural Resources | 86 |
| What Cultural Resources Are                                | 87 |
| Economics of Cultural Resource Management                  | 87 |
| Potential Impacts  | 88 |
| Cultural Resource Management and the Law                   | 88 |
| Cultural Resource Inventories                              | 89 |
| Assessing Cultural Resource Potential                      | 89 |
| Field Identification of Cultural Resources                 | 90 |
| Assessing Management Alternatives                          | 90 |
| When Accidental Discovery Occurs                           | 90 |

#### CULTURAL RESOURCES

#### Forest Management for the Protection of Cultural Resources

This chapter of the guidelines was developed to provide landowners, loggers and resource managers with an increased awareness of cultural resources and recommendations on how to protect them during forest management activities. Those involved in managing forest lands need to understand that:

- Cultural resources are scarce and nonrenewable.
- Good forest land management is compatible with the protection of cultural resources.

There is a growing recognition that cultural resources have value and should be wisely managed. Cultural resources represent parts of an inheritance shared by all people. This heritage is of fundamental value to modern-day societies. Cultural resources often possess spiritual, scientific and other values that are weighed differently by different cultures. Today the management of cultural resources is a necessary component of land stewardship.



Figure 6-1: Indian burial mounds are a cultural resource that can be found in many Wisconsin forested areas. Although not as large as some, this mound is easily spotted because the understory has been removed. Other mounds may not be as easily detected when forest operations are conducted.

What Cultural Resources Are Cultural resources include historic structures, archaeological sites, cemeteries, and traditional use areas. Together, they represent roughly 13,000 years of human occupation in Wisconsin - from the end of the last ice age to the present day. Prehistoric cultural resources reflect the activities of Indian people prior to initial French contact in 1634. Since the first written records of Wisconsin began at that time, 1634 marks the beginning of the historic period. To be considered important, a cultural resource has to be at least 50 years old. Types of cultural resources include:

#### Historic Structures

- Houses, barns and outbuildings
- Lime kilns
- Bridges and railroad trestles
- Schools and churches
- Stores and office buildings
- Mills and factories

#### Cemeteries

- Platted cemeteries
- Family cemeteries and individual graves
- Burial mounds

#### Archaeological Sites

- Campsites and villages
- Caves and rock shelters
- Quarries and flintknapping workshops
- Large animal kill and butchering stations
- Ridged fields and other types of garden beds
- Enclosures and earthworks
- Fish weirs
- Rock art sites
- Ruins of trading posts and homesteads
- Shipwrecks

#### Traditional Use Areas

- Sugar bushes
- Medicine gathering areas
- Sacred springs
- Ceremonial sites



Figure 6-2: The archaeological deposits in this thousand-year-old Indian village site lie only six to 10 inches below the ground surface, so even very shallow ground disturbance can cause harm (photo courtesy of the Wisconsin DNR).

## **Economics of Cultural** Resource Management Economically, CRM will not usually pay for itself,

but some forest landowners will discover that reserved and protected cultural resources can be financial assets.

- Cultural resource conservation efforts often contribute to soil, water and wildlife habitat conservation measures.
- The return on investment in the preservation, rehabilitation and adaptive reuse of above-ground cultural resources is often reflected in increased resale values, and may be used as an effective tool for developing a sense of corporate or community identity that encourages new investment.
- A growing number of federal and state laws provides financial incentives for preserving and protecting cultural resources. For example, through conservation easements landowners may qualify for a federal income tax deduction or property tax credits.

#### Potential Impacts

In general, cultural resources are fragile. Many archaeological deposits lie within a few inches of the ground surface. Hence even very shallow ground disturbance can destroy the context of artifacts or features such as the dirt floors of ancient houses. Threats range from natural forces (erosion, flooding, weathering and fire) to human action (logging, agriculture, mining, land development, and vandalism). Potential damaging effects to cultural resources resulting from forest land management activities include:

- Soil disturbance, including rutting
- · Soil compaction
- Change in vegetation that is part of a traditional use area
- Damage to above-ground features



Figure 6-3: This millstone was found near the site of a grist mill that burned to the ground in the early 20th-century (photo courtesy of the Wisconsin DNR).

#### Cultural Resource

Management and the Law The legal basis for CRM is rooted in federal and state legislation concerned with natural resource conservation and environmental protection going back to the early 1900s. The National Historic Preservation Act (NHPA) of 1966, as amended, is the centerpiece of the national historic preservation program. It established the National Register of Historic Places and provides for State and Tribal Historic Preservation Officers to implement the national preservation program. Section 106 of NHPA requires that federal agencies consider the effects of their activities on cultural resources. Federal law applies whenever activity takes place on federal land, will use federal funds, or will require a federal permit.

The Wisconsin Field Archeology Act requires state agencies to contact the Wisconsin Historical Society if the agency's actions may impact an archaeological site, burial site or historic structure listed in cultural resource inventories. State law applies whenever the activity is on state-owned land, will use state funds, or requires a state permit. However, timber harvesting is exempt from review unless new logging roads are to be constructed.

State law affords special protection to burial sites, regardless of age or land ownership (including private lands). All human burials are afforded the same legal protection as platted cemeteries.

# Cultural Resource Inventories

The Wisconsin Historical Society maintains an inventory of the archaeological sites, burial sites and historic structures that have been reported to their office. However, since most of the state has never been formally surveyed, unreported cultural resources likely outnumber those listed in their inventories. Archaeological sites are more apt to be inventoried if they have been plowed, exposing artifacts on the field surface, or if they have above ground features such as burial mounds or piles of logging camp refuse. Access to the archaeological site and burial site inventories is restricted to protect sites from looting, discourage trespass and show respect for sites that some regard as sacred. The statewide inventory of known historic structures is openly available through the Wisconsin Historical Society's web site.

#### Assessing Cultural Resource Potential

If a forest management site has not been previously surveyed for cultural resources, individuals may conduct their own assessment of the area's potential. One might begin by checking existing maps, air photos and printed historical information. The next step is assessment of the landscape. The following have high potential for cultural resources:

- Current shorelines or terraces adjacent to lakes, rivers or streams
- · Shorelines of ancient lakes and old river channels



Figure 6-4: Old log homes are sometimes found in forested areas of Wisconsin. Few abandoned buildings from the 19th-century are as intact as this log house. You are more apt to find some rotted wood and a cellar depression (photo courtesy of the Wisconsin DNR).

- Junctions of water bodies, including river junctions and lake inlets and outlets
- · Peninsulas or points of land along a shoreline
- Islands
- Good places to camp, including areas where people camp now
- Areas adjacent to fish spawning beds, good fishing spots and wild rice beds
- Transportation routes, such as old trails, roads, and portages

# Field Identification of Cultural Resources

During a walk-over inspection of the management area, in preparation for a timber sale, forest managers and landowners may discover unrecorded cultural resources. Some things to look for are:

- · High spots offering a panoramic view
- · Unusual natural features
- Surface artifacts (check bare spots, tree tip-ups and cut banks)
- Surface features
  - Cellar and well holes
  - Cement or asphalt slabs
  - Fieldstone foundations
  - Miscellaneous building materials (bricks, roofing materials, plaster and stucco)
  - Metal well pipes
  - Earthen berms and trenches
  - Shallow depressions (such as graves or ricing pits)
- Milled lumber (such as boards suitable for burial crosses, spirit houses or building construction)
- Domestic or exotic plants (including lilac bushes, fruit trees and daylilies)
- Old roads, trails and portages (especially where two come together)
- Trash dumps containing antique items or jumbo-sized tin cans
- Standing structures and buildings

# Assessing Management Alternatives

 Protection by law. If the pre-field review indicates the project area contains a site protected by law (such as a burial site), further action will be determined by statute or regulations.

- Identification as a low-sensitivity site. If no cultural resources have been recorded and the pre-field review and walk-over inspection yielded no indications of important cultural resources, the site would have low sensitivity. Proceed with the management activity.
- Identification as a high-sensitivity site. If cultural resources are known to exist or if the pre-field review and walk-over inspection indicate their presence, the site has high sensitivity. In this case, it's recommended that the forest manager avoid the sensitive area or bring in a cultural resource management professional to conduct a survey.

# When Accidental Discovery Occurs

Unrecorded cultural resources may be discovered during operations. Guidelines for proceeding depend on the nature of the discovery.

- In the case of human burials, if such discovery occurs, temporary suspension of operations in the vicinity of the discovery is required. If a human burial site is accidentally discovered, contact the Burial Sites Preservation Office at the Wisconsin Historical Society.
- For other types of cultural resources, such as archaeological artifacts, temporary suspension is not required, but is recommended. Suspending operations in the immediate vicinity of the cultural resource will provide time to contact a cultural resource professional or develop plans to apply appropriate guidelines to avoid or mitigate potential effects.
- Documentation of cultural resources discovered during forest management activities is not required. However, landowners and operators are encouraged to make a written record of their discoveries and share that information with the Office of the State Archaeologist at the Wisconsin Historical Society.

## CHAPTER 7 — FOREST SOIL PRODUCTIVITY

| The  | Value of Forest Soil Productivity             | 92 |
|------|---|----|
|      | Sustainable Soil Productivity9                | 2  |
|      |   |    |
| Soil | Characteristics and Potential Impacts         | 92 |
|      | Three Related Groups of Soil Characteristics9 | 2  |
|      |   |    |
| Арр  | lying Guidelines to Varying Site Conditions   | 98 |

#### THE VALUE OF FOREST SOIL PRODUCTIVITY

Sustainable Soil Productivity Soil productivity is defined as the capacity of soil, in its normal environment, to support plant growth. It's reflected in the growth of forest vegetation or the amount of organic material produced by plants and animals. In forest management, soil productivity is often measured in volume of trees produced, but, other methods of determining productivity exist.

Soil is the fundamental resource of the forest. Without it, other resources of the forest will vanish over time. Identifying and reducing impacts to the soil is an essential part of a strategy for sustainable forest management. Primary considerations in maintaining soil productivity include the following:

- Soil productivity is a major factor in determining the amount of timber harvesting that can be sustained over time. It also affects other forest attributes, such as wildlife habitat and biodiversity.
- Soil productivity limits the kinds of tree species that will grow on a site as well as their rate of growth.
- Maintaining soil productivity keeps forest soils in a condition that favors regeneration, survival and long-term growth of desired forest vegetation.



Figure 7-1: A handful of soil can tell a forester much about the management prospects for a property.

- Maintaining forest soil productivity is less costly than correction or mitigation, after the fact.
- Maintaining the productivity and sustainability of forest soils is key to meeting society's need for forest products and other amenities of the forest.

A certain amount of soil impact is inevitable when conducting some forest management activities. Many of the recommended practices are aimed at keeping this impact to a minimum level.

#### SOIL CHARACTERISTICS AND POTENTIAL IMPACTS

# Three Related Groups of Soil Characteristics

Soils have physical, chemical and biological aspects. All three characteristics are closely interrelated, and impacts on one may influence others:

- The physical properties of soil include such factors as texture, structure, porosity, density, drainage, and hydrology.
- The chemical properties of soil include its nutrient status and rates of cycling, and pH.
- The biological properties of soil include the multitude of organisms that thrive in soil such as mycorrhizae, other fungi, bacteria, and worms.

Because of the nature of forest management activities, the risk or significance of impacts to soil properties appears to be highest for physical properties, followed by chemical properties and then biological properties.

For example, forest sites where nutrient loss has occurred are few, while sites that have suffered due to physical impacts are relatively common. If the physical and chemical properties of the soil are not damaged, then the biological aspects take care of themselves. However, if a soil is severely compacted, plants cannot utilize nutrients because of the poor physical rooting environment, and the soil organisms responsible for nutrient cycling are also limited.

# CHARACTERISTIC 1: PHYSICAL CHARACTERISTICS OF SOIL AND POTENTIAL IMPACTS

Soil physical properties are very important in determining species composition and rate of growth. These properties affect the ease of root penetration and depth of rooting, the availability of water and the ease of water absorption by plants, the amount of oxygen and other gasses in the soil, and the degree to which water moves both laterally and vertically through the soil.

#### Soil Compaction

Soil compaction is one of several types of closely related physical soil disturbances that can occur during timber harvesting and forest management activities. The other types of physical soil disturbance include puddling, rutting and displacement. These disturbances often occur simultaneously and are almost exclusively caused by movement of heavy equipment during felling, forwarding, skidding and site preparation operations. Vehicle tires bearing heavy loads compress and pack down the soil, resulting in soil compaction.

Soil compaction is the increase in soil density resulting from loads applied to the soil surface. During the compaction process, soil volume is decreased primarily through the elimination of macropores (pores greater than 0.002 inches in diameter). Pore volume and pore size are key properties that govern air and water movement in the soil. Because of their relatively large diameter, macropores are particularly important in regulating the rates of water and gas movement.

The first few trips (with heavy equipment) over the soil surface produce the greatest increase in soil density (i.e., the most compaction; Froehlich et al 1980; see Figure 7-2). Machine vibration may also contribute to compaction.

Recovery of compacted soil is variable depending on the severity of the compaction and local conditions. Compaction is a long-term rather than short-term effect. Severely compacted soils may require up to 40 years or more to recover naturally, according to Hatchell and Ralston (1971). Froehlich and McNabb (1984) state that "... the effects of soil compaction should be assumed to persist for several decades on forest sites."

Even in cold climates, where the action of freezing and thawing presumably loosens soils quickly, the density of compacted soils decreases slowly (Voorhees 1983 and Corns 1988). In an ongoing study in Minnesota and the Lake States (Stone and Elioff 1998), no reduction in soil density has been measured five years after intentional compaction.

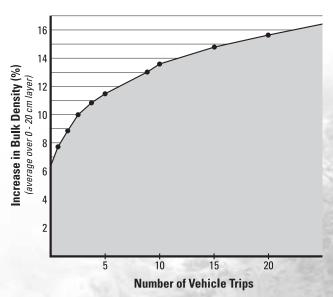


Figure 7-2: Effect of vehicle trips on soil density. Adapted from Froehlich et al, 1980.

Soil compaction can decrease the rate of tree growth. Several processes are involved. Soil aeration is diminished, making oxygen less available for respiration in tree roots. Concentrations of carbon dioxide and other toxic gasses can build up, injuring roots. Soil micro-organisms that play a role in making nutrients available to plants are also negatively affected by the lack of oxygen and high levels of injurious gasses. Compaction further affects root growth by increasing soil resistance to root penetration. It decreases pore space, which reduces soil infiltration capacity (the rate of water movement into the soil), so that less moisture is available for plant growth. Also, when infiltration rates are reduced, more rainfall flows over-land. which can increase erosion and sedimentation.

Fine- and medium-textured soils are more easily compacted than coarse sandy soils. Most compaction occurs when soil moisture conditions are near or at saturation. Dry soils are less susceptible to compaction. Limiting equipment traffic to drier seasons of the year is one way to reduce compaction and other physical damage to the soil. Frozen soils are also relatively resistant to compaction, so winter operations are often an option for wetter sites.

#### Rutting

Rutting is the creation of depressions made by the tires of vehicles such as skidders, log trucks and pickup trucks, usually under wet conditions.
Rutting occurs when soil strength is not sufficient to support the applied load from vehicle traffic.

- Rutting directly affects the rooting environment. It physically severs roots, compacts and displaces soil, and reduces aeration and infiltration, thereby degrading the rooting environment.
- Rutting disrupts natural surface water hydrology by damming surface water flows, which creates increased soil saturation up-gradient from ruts. Alternatively, ruts that run parallel to a slope gradient can divert

- water flow away from a site, drying or draining it, and sometimes contributing to erosion and sedimentation.
- Soil rutting occurs along with other physical soil impacts, including compaction and puddling.

#### Puddling

Puddling is the loss of soil structure that results from squeezing and churning wet soils with the tires or tracks of heavy equipment. Puddling often occurs in ruts with standing water. Soil particles



Figure 7-3: Skidder traffic, and hence soil compaction, can be reduced when the operator pulls cable to the logs instead of driving the machine to each one.

become dispersed in water, and after they have dried and settled, the smaller particles form a crust on the surface. Puddled soils affect forest regeneration and growth in ways similar to compacted soils.

#### Displacement

The surface layers of most forest soils are very important to site productivity. These layers are rich in organic matter; they contain the bulk of the soil's nutrient and moisture-holding capacity; and they support the microbial population. Surface horizons cushion soil from traffic and buffer extremes in temperature. Organic matter contributes to soil aeration, and provides sites for seedling germination and rooting. Conserving organic matter is an important factor in maintaining site productivity. Displacement of surface soils, whether moved within a stand or removed from the site, can be detrimental.

Loose sandy soils are sometimes impacted by heavy equipment that removes or wears away the surface vegetation during skidding and hauling, leaving the soil unprotected. On slopes or roadcuts, these sandy soils can slump downhill due to gravity, or can be eroded by wind and water. The continual displacement of the surface soil prevents revegetation on these areas, and removes them from productivity.

#### Soil Erosion

Soil erosion is a type of physical soil impact that is usually not a factor in forest management in Wisconsin except on roads and skid trails. Erosion seldom occurs on areas with vegetative cover, or on flat areas. Clearcut harvesting that temporarily removes all forest cover on steeper slopes can occasionally result in accelerated erosion. Extra care should be taken on silt, silt loam, loam, very fine sandy loam, sandy clay loam, silty clay loam and clay loam soils, as these soils tend to erode more easily when disturbed or exposed, especially on long slopes or slopes greater than 10 percent.

- Protecting Soil Physical Properties
  - Compaction and Rutting: Soils most susceptible to compaction and rutting include fine-textured

soils (silty clay, sandy clay and clay) and medium-textured soils (fine sandy loam, very fine sandy loam, loam, silt loam, silt, silty clay loam, clay loam, and sandy clay loam). Poorly and very poorly drained soils of any texture are susceptible to compaction and rutting during most years when not adequately frozen.

The susceptibility of soil to compaction and rutting is primarily dependent on soil texture and moisture content. Soils are most susceptible to compaction, puddling and rutting when they are saturated. Such conditions occur during spring and early summer months, immediately following heavy rains, and in the fall after transpiration has ceased and before freeze-up.

Timing of forest management activities, development of infrastructure, and selection of equipment and operating techniques are all critical factors that affect the soil resource. It's important to avoid operating heavy equipment on a site when adverse soil impacts are likely, and to limit direct trafficking of a site to the smallest area possible.

The preferred operating season for any one site may vary depending on local climatic conditions, equipment being used and operating techniques. The use of low ground pressure (LGP) equipment and operating techniques such as the use of slash mats can extend operating seasons on low-strength soils. Infrastructure development, including roads, landings and skid trails, almost always results in direct soil compaction and reductions in forest growth. It's critical to minimize the area occupied by infrastructure to reduce the impact to soil productivity. For more information on how to obtain soil interpretations for equipment operation, see Appendix H, the Resource Directory, page 221.

 Soil Displacement: Mechanical site preparation techniques often involve soil displacement.
 Severe treatments that remove or displace the surface organic and mineral soil layer may result in nutrient removal and other site degradation, such as soil erosion and compaction.

Site preparation techniques that move surface soil away from seedlings (such as dozing soil into windrows) should be avoided, as these practices remove much of the nutrient and moisture supply that a seedling needs. The loss of surface soil is exaggerated with extremes of soil types. Coarse, dry soils and wet, fine soils or soils shallow to bedrock, are most likely to be severely impacted (see Chapter 12: Mechanical Site Preparation, for more discussion on selecting methods, page 149).

Retaining slash on site provides shelter and organic matter for seedlings. Although it may be difficult to plant a site with slash present, windrowing or piling of slash should be avoided, and scattering of slash should be encouraged.

Prescribed fire is sometimes used to reduce slash before planting, control competing vegetation, or expose mineral soil for seeding. Fire "mineralizes" soil nutrients, making them readily available to plants, but leaching can also occur. Fire-adapted ecosystems in Wisconsin are generally restricted to sandy outwash plains, where vegetation is adapted to fire and can take up the nutrients quickly. However, sites without native ground vegetation may be subject to leaching losses. Extremely hot fires may volatilize some nitrogen, but most is retained under conditions prevalent in most prescribed burns.

**Erosion** can be a severe problem on roads and skid trails that lack vegetative cover, resulting in downcutting of the roadbed and sediment delivery to streams. Techniques for limiting soil erosion and sedimentation from roads are discussed in Chapter 10: Forest Roads, page 115.

# CHARACTERISTIC 2: CHEMICAL CHARACTERISTICS OF SOIL AND POTENTIAL IMPACTS

Soil chemical properties include nutrient status of a soil and soil pH. Soil chemical characteristics are influenced by many factors, including soil origin, soil texture and drainage, degree of soil weathering and development, and organic matter content. Forest management affects the nutrient status of a soil/site through 1) removal of nutrients in forest products and 2) disturbance of surface soils through harvesting and site preparation activities.

#### Nutrient Cycling

Nutrient cycling is the process by which nutrient elements move into, out of and within an ecosystem. Forested ecosystems receive natural inputs of nutrients through atmospheric deposition and mineral weathering (see Figure 7-4, page 97).

Through the life of a stand, these inputs can be significant. Outputs of nutrients occur through timber harvesting or other practices that remove soil or organic material from a site, and through leaching and surface runoff.

In contrast to the annual harvests associated with agriculture, a forest harvest typically occurs only once per rotation or every 40 to 120 years. This reduces the rate of nutrient removal as compared with agriculture, and allows sufficient time for replacement by atmospheric deposition and weathering of soil minerals.

In forest ecosystems, timber harvesting and some site preparation practices can remove nutrients and have the potential to create deficiencies. Nutrient depletion could occur if removal is greater than replenishment that occurs between harvests. The likelihood of nutrient depletion is greater with shorter rotations, nutrient-demanding species, and on sites with low inherent nutrient reserves.

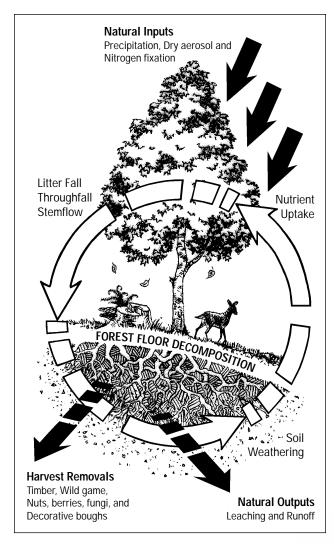


Figure 7-4: Nutrient Cycling

#### Nutrient Status and Removals

The initial nutrient capital of a site varies widely by soil type. For example, a loamy soil formed in loess over glacial till may contain several times the amount of calcium in the rooting zone than a sandy soil formed in outwash deposits.

Different nutrients are stored in different parts of a tree, and different tree species store the nutrients in different relative abundance. In general, the greatest portion of mineral nutrients is stored in the leaves, followed by small branches, large branches, and boles (Kramer and Koslowski 1979). Some species, however, store more calcium and

magnesium in the bark than in the leaves. For example, aspen utilizes a relatively high amount of calcium and stores roughly 50 percent of the calcium in the bole wood and bark. Nutrients contained within the harvested portion of a tree are removed from the site so managing for species that store relatively high levels of nutrients in the bole-wood and bark will potentially remove greater amounts of nutrients from a site.

Nutrient removal associated with timber harvest is dependent on the species and portions being harvested, and on the season. For example, a whole-tree harvest during the growing season will remove virtually all the nutrients stored in the above-ground part of the trees. In the case of bole harvest, with limbing at the stump, nutrients in the crown and other non-merchantable portions are retained on site. If trees are skidded to a landing before limbing, the nutrients in the crown are removed from the immediate vicinity, but could be moved back into the stand.

There is no evidence that nutrient depletion has occurred in Wisconsin due to forest management. Studies in Michigan on sandy outwash soils found nutrient depletion in conjunction with whole-tree aspen harvest (Stone 2001). This could become a concern for sites containing similar circumstances.

#### Nutrient-retention Strategies

- Retaining or redistributing slash on the site
- Avoiding whole-tree harvesting
- Addition of nutrients to the site
- Avoiding shortened rotations

Many modern harvesting systems require full-tree skidding for efficiency of the operation. In these situations, slash can be redistributed out to the site from the landing. Caution should be exercised during non-frozen seasons to avoid trafficking additional areas while redistributing slash. The negative effects of soil compaction due to increased trafficking could outweigh the positive benefits of redistributing slash. It may be advantageous to leave clumps of slash (drags left along skid trails) or leave slash in the skid trails.

# CHARACTERISTIC 3: BIOLOGICAL CHARACTERISTICS OF SOIL AND POTENTIAL IMPACTS

 Biological characteristics of soil include the populations of plants and animals, including microflora (fungi, bacteria, algae) and microfauna (worms, arthropods, protozoa). Forest soils contain a multitude of microorganisms that perform many complex tasks relating to soil formation, slash and litter decomposition, nutrient availability and recycling, and tree metabolism and growth. Generally the number of organisms are greatest in the forest floor and the area directly associated with plant roots (Pritchett 1979). The population of soil organisms (both density and composition) and how well that population thrives is dependent on many soil factors, including moisture, aeration, temperature, organic matter, acidity and nutrient supply (Pritchett 1979).

 Physical and chemical soil characteristics can be influenced by forest management as previously discussed. Impacts to these soil properties may directly impact soil biology, thereby impacting the functions of the organisms, many of which are beneficial to plant growth. Implementation of practices that protect the physical and chemical properties of the soil also protects the habitat of the soil organisms and sustains their populations.

#### APPLYING GUIDELINES TO VARYING SITE CONDITIONS

Forests in Wisconsin grow on a variety of soils and site conditions. Some of these include 1) loamy and clayey soils formed in rolling glacial till, often overlain with a silt loam "loess cap" deposited by wind after glaciers melted; 2) silty or loamy soils formed in alluvial plains along rivers; 3) droughty sands formed in outwash plains or sandy lake sediments; and 4) organic soils formed in wetlands.

Topography also varies greatly throughout Wisconsin. Much of the state displays glacial features like steep, hilly end moraines, gently rolling ground moraines, and nearly level outwash and lake plains. The "Driftless Area," which was not glaciated during



Figure 7-5: Retaining slash on skid trails is one way to help reduce soil compaction and rutting from heavy logging machines.

the Wisconsin Ice Age, has steep eroded hillsides and level valley bottoms. The Lake Superior clay plain has fine-textured clay soils that are highly-erodible, and if not managed properly can contribute a significant amount of sediment to streams.

Because site conditions vary, it's important that individuals making forest management decisions evaluate the soil and topography of each site. Site-specific information helps the manager develop individualized prescriptions to ensure productive capacity is not reduced as a result of forest management activities.



Figure 7-6: Retaining slash may be a bit unsightly, but it provides some shelter for new seedlings and adds organic matter and nutrients to the soil. When crushed by heavy equipment, it decomposes rapidly.

# CHAPTER 8 — FOREST MANAGEMENT PLANNING

| Forest Management Planning                                   | 100 |
|--|-----|
| Incorporating Sustainability into Forest Management Plans101 |     |
| Forest Management Plan Elements106                           |     |

### FOREST MANAGEMENT PLANNING

A forest management plan is a written evaluation of a property that provides information about the landowner's goals and objectives, a description of the resource, its condition and recommendations for applied management prescriptions along with a timetable for implementation. Plans, simple to complex, take many forms and fulfill different needs. All plans should:

- Be tailored to the landowner's individual needs and objectives within the capability of the land.
- Make clear to the owner how carrying out the plan will help reach their goals.
- Be in accordance with generally accepted silvicultural principles.
- Avoid technical forestry terminology or define all technical terms used.
- · Be based on ecosystem considerations.
- Be concise, including information that's relevant to the parcel and accurate.
- Provide a timetable for accomplishing needed forestry practices.

- Incorporate publications or other attachments to describe routine, repetitive information.
- Explain where a landowner can get help to follow through with the plan.

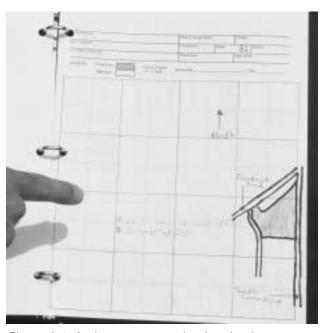


Figure 8-1: An important step in planning is to identify site types, delineate individual stands and prepare a map of the property.

# Incorporating Sustainability into Forest Management Plans<sup>1</sup>

The essence of developing a sustainable forest management plan is an understanding of forest community dynamics as a function of site and disturbance, and identifying a much wider range of acceptable silvicultural options than that based simply on the forest cover types currently occurring. This concept was introduced in Chapter 2: Site Evaluation and Stand Delineation (page 17), and will be further explained in the following steps.

#### STEP ONE: IDENTIFYING LANDOWNER GOALS

Forest resource professionals must communicate with the landowner to identify his/her long-term goals for ownership and management of forestland. Communication skills, particularly the ability to listen, are required. Sample goals may be 1) to create habitat for a wide range of wildlife species; 2) to maximize income from wood production; or 3) to provide the best possible deer habitat.

At first, a landowner might not have clearly articulated objectives or might not be aware of opportunities on their land. Use the planning process to learn more about various management opportunities and better define objectives.

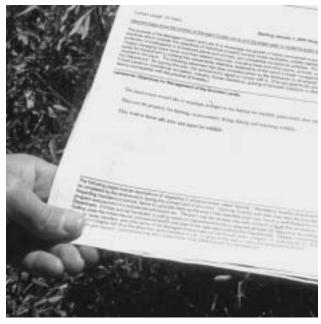


Figure 8-2: An important first step in developing a satisfactory management plan is to identify the landowner's specific objectives and list them in the written plan.

Foresters and other resource managers should carefully consider the objective statement provided by the landowner and help refine it, if necessary, with the landowner's involvement.

<sup>1</sup> This section is adopted from Kotar, J. 1997. Approaches to Ecologically Based Forest Management on Private Lands. University of Minnesota Extension Service, publication NR-604.



Figure 8-3: Frequent communication between the landowner, forester and other resource professionals helps insure that management objectives are fully achieved.

# STEP TWO: CONDUCTING A SITE EVALUATION AND DELINEATION OF SITE TYPES

Secure aerial photographs, topographic maps, soil surveys, Natural Heritage Inventory (NHI), cultural heritage and other resources available to analyze the property. Sources of this information include local Soil and Water Conservation District (SWCD) offices, local USDA Natural Resource Conservation Services (NRCS) offices, local Department of Natural Resources (DNR) offices, and county land departments.

Conduct an on-the-ground evaluation of the land. It's important to have firsthand knowledge of the

area being considered. Evaluate soil conditions to determine tree species, preferred seasons of operation, site preparation and regeneration techniques, and other information related to forest management decisions. Identify resources, features and site conditions that may require special attention (e.g. perennial and intermittent streams, lakes, wetlands and seasonal ponds, steep slopes, rock outcrops, unstable or poorly drained soils, sinkholes, seeps and springs, snags and nesting sites). Assess cultural resource potential, and threatened, endangered or specialist interest (ETS) species.

While identifying the physical characteristics of a site, think about how the characteristics might affect the planning and design of a particular forest management activity. Some of these considerations include soil capabilities and limitations; location and width of filter strips and riparian management zones (RMZs); stream crossings; visual sensitivity; and the network of access roads, approaches, trails and landings needed to access the site.

Delineate site types (see Chapter 2, page 17). Land within an ownership can be relatively homogeneous or heterogeneous in terms of its ecological capability. Major factors affecting species' ability to grow, reproduce and complete include soil depth, texture and chemical properties, and position on the landscape (such as north or south slope aspect, ridge or valley, etc.). Any areas within the ownership that can be differentiated on the basis of such factors should be identified as "site types." In some areas, formal site classification systems have been developed.

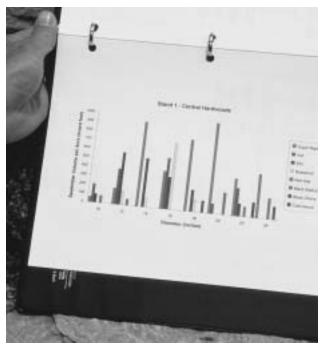


Figure 8-4: An inventory of each stand will provide basic information to guide management decisions. The chart in this photo indicates the board-foot volume per acre by species and diameter for a specific stand.

# STEP THREE: DELINEATION OF STANDS WITHIN SITE TYPES

Because stands (vegetative units) represent communities of different compositions and structure, and therefore different stages of development cycles, they must be considered separately if management based on ecological



Figure 8-5: Having a trained forester collect inventory data for each stand on the property is necessary before prescriptions can be developed to achieve the management objectives.

principles is to be attempted. Each stand is considered to be an "ecological opportunity unit." A forest manager may elect to divide a site type into more than one stand in order to apply a mixture of treatments (or passive management) to meet a variety of landowner objectives.

# STEP FOUR: IDENTIFICATION OF SILVICULTURAL AND ECOLOGICAL ALTERNATIVES FOR EACH STAND

Short- to mid-term compositional and structural changes in most vegetation units are relatively predictable. However, current development trends are not necessarily the only ecologically acceptable pathways, and they may not meet the landowner's goals. Before deciding on the most viable management option, a resource professional should first attempt to identify other ecological alternatives.

Each stand, if properly delineated, can be expected to respond uniformly to a given natural disturbance or management action. Although there are definite limitations due to site, stand composition, and availability of external seed sources, there is almost always more than one ecologically sound silvicultural alternative available. All too often, regenerating the existing cover type is the only option considered. Such a choice may not always be ecologically desirable nor may it best meet the landowner's goals. More management options can be offered to the landowner if all ecologically feasible alternatives are first identified.

Systematically identify ecological and silvicultural alternatives by evaluating the following factors:

- Successional role of each species comprising the current stand (overstory and understory). This information is essential for planning changes in stand composition and regeneration techniques.
- The age structure of the stand. Species and age structure are two fundamental properties of any forest stand. They must be taken into account in any management consideration.
- Relative growth potential of each species on the identified site type. This may be the most important information for any management

- decision because growth potential relates not only to economic outputs, but also strongly affects forest dynamics.
- Presence of advance regeneration. Presence of advance reproduction to a large extent dictates the type of regeneration techniques that will be applied. Also, advance reproduction may or may not be of the desired species.
- Expected reaction of advance regeneration to different types of stand manipulation. If advance reproduction is of mixed species, different growth rates can be expected with different degrees of canopy removal. Seedlings of most species benefit from complete canopy removal, but some shade tolerant species respond best to gradual canopy removal.
- Expected effect of competing vegetation after opening of the canopy. Understory plant species respond differentially to removal of the forest canopy and present different degrees of competition to tree seedlings. Response of competing vegetation also varies among site types. Generally, the more mesic the site, the stronger the understory competition. However, potential competing species are not necessarily present in every stand.
- Potential for inducing advance reproduction of each canopy species. Regeneration requirements vary greatly with species. Some conditions are more difficult to meet artificially than others.
- Existing and potential damaging agents.
   Some species are more susceptible to specific damaging agents (e.g., insects, pathogens, frost, windthrow) in certain regions or on certain site types.

# STEP FIVE: IDENTIFICATION OF VIABLE ALTERNATIVES BY EVALUATING LANDOWNER'S CONSTRAINTS AND OPPORTUNITIES

- Landowner's Resource Constraints: Some silvicultural and ecological opportunities identified above may not meet an owner's financial expectations or may exceed his/her commitment of time.
- Regional Ecological Issues and Concerns: Management practices that are ecologically sound on a site or local ecosystem level may not address landscape and regional concerns. Although private owners are not obligated to consider regional ecological concerns (other than those specifically covered by law, e.g. the Endangered Species Act), many of them are interested and often eager, to accommodate them within limits of economic efficiency. Resource professionals working with private owners should be aware of such issues and bring them to the owner's attention when preparing management plans. Such issues vary greatly from region to region and cannot be addressed comprehensively.

The following are some examples of regional ecological considerations:

- Lack of large contiguous blocks of specific habitats to accommodate wide-ranging animal species or those that do not thrive in edge habitats.
- Need for special wooded corridors to accommodate movement of some animal species between suitable habitat patches.
- Loss of certain vegetation types (and accompanying fauna) due to changes in natural disturbance regimes (e.g. loss of oak savannas or pine forests due to suppression of wild fires).

- Shortage of mature stages of forest development due to uniformly applied economic rotation age.
- Reduced compositional and structural diversity of forest communities due to prevailing management practices.
- Lack of tree regeneration, and reduction of shrub/herb density and diversity due to high deer densities.
- External Socioeconomic Constraints: Certain
  activities may be constrained by zoning laws or
  forest practice regulations, while others may
  simply conflict with the prevailing attitudes of
  neighbors or the general public. While the latter
  does not bind the owner, a conscientious resource
  professional will keep landowners informed in
  order to minimize potential future conflicts.
- Socioeconomic Incentives: Socioeconomic constraints often can be balanced by incentives. These may include lower property taxes on managed forestland, income tax deductions for forest management investments, government cost-sharing for management practices and others. Some practices may also engender greater public acceptance than others without compromising an owner's goals.

# STEP SIX: DEVELOP MANAGEMENT OBJECTIVES FOR EACH STAND

The steps described above identify ecologically sound silvicultural alternatives for individual stand and eliminate from consideration those that cannot be supported on socioeconomic terms. The landowner now must select the management (or silvicultural) objectives for each stand (i.e., what to grow and how to grow it as explained in Chapter 2, page 43).

#### STEP SEVEN: PREPARE MANAGEMENT PLAN

Only when management objectives have been defined through this type of process should the management plan (i.e. the "action plan") be developed. The management plan is a written document that summarizes all of the above information, and then clearly prescribes management unit activities and a timeline for accomplishing them.

Detailed silvicultural prescriptions are not part of the initial management plan; these are developed immediately prior to a scheduled management practice in order to take into account unique stand conditions. For example, a timber harvest or tree planting project should have a detailed project plan with specific instructions or performance criteria.

A suggested process to develop management options is depicted in Figure 8-6. It should be emphasized that this is a process (i.e. a sequence of steps to consider) and not an outline of items to be specifically included in actual management plans (which are covered in Table 8-1, see pages 107 and 108).

### Forest Management Plan Elements

As noted at the beginning of this chapter, a forest management plan may be brief or detailed, depending on its purpose and the interests of the landowner. For purposes of state and federal programs in Wisconsin, forest management plans generally fall into two categories:

• Basic Plans address a specific management practice or practices and may be in the form of a letter or summary of management prescriptions. They are often used as a follow-up to an initial contact with a new landowner to augment verbal recommendations and lay the groundwork for further action in the future. A Basic Plan might not meet the plan standard requirements for cost-sharing or forest tax programs, but should still incorporate the sustainable forestry principles described in the first section of this chapter.

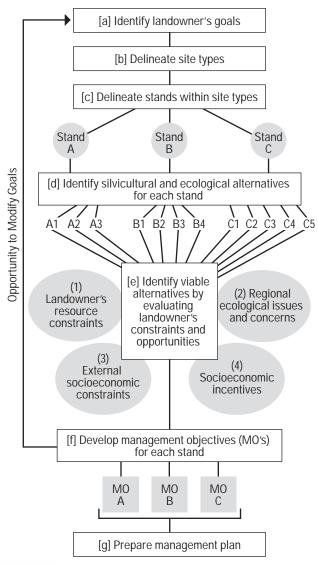


Figure 8-6: Model of an approach to the development of ecologically sound forest management plans (Kotar 14).

Comprehensive Plans such as Managed Forest
Law plans and Forest Stewardship plans, are
more complete than Basic Plans. They incorporate
sustainable forestry principles and may go into
some detail to identify and describe activities
that will enhance or protect soil, water, aesthetic
quality, recreation, timber, water, and fish and
wildlife resources based on the landowner's
objectives for the land.

## ■ Required • Recommended

| Plan Component   | Managed Forest<br>Law Plan | Forest<br>Stewardship Plan | Basic<br>Plan* |
|--|----------------------------|----------------------------|----------------|
| #1: IDENTIFICATION   |                            |                            |                |
| a. Landowner name, address, with necessary signatures and dates.   | •                          | •                          | •              |
| b. Landowner signature of approval.  |                            |                            |                |
| c. Plan preparer name, address and phone number.   |                            |                            | •              |
| d. Plan preparation date.  |                            | •                          | •              |
| e. Legal description (T, S, R minimum).  |                            | •                          | •              |
| f. Planned acres.  |                            |                            | •              |
| g. Plan length (shows number of years covered by plan).  |                            | •                          |                |
| h. Overall landowner goals and objectives for the property.  |                            |                            | •              |
| <ul> <li>The pages are numbered sequentially, order number<br/>on all pages.</li> </ul>  |                            |                            |                |
| #2: DESCRIPTION (May be presented in a narrative   | e or tabular format        | as appropriate.)           |                |
| <ul> <li>Map with property boundaries, cover types, water,<br/>roads, adjoining land use, acreage, etc., clearly and<br/>adequately labeled.</li> </ul>  | •                          | •                          | •              |
| b. General property description.   | •                          |                            |                |
| c. Regional landscape overview.  | •                          |                            |                |
| d. Interaction with surrounding properties.  | •                          | •                          |                |
| e. Soils information (can be generalized over entire property when soils are uniform; may be included in a data table).  |                            |                            |                |
| f. Stands by cover type and area (acres).  |                            | 1000                       | •              |
| g. Descriptive overview of the timber type.  |                            | •                          | •              |
| h. Stand silvicultural objective (what you are trying to grow and how you intend to achieve it; indicate target timber type or land cover, and the even-age or all-age technique used for this objective). Provide a link to landowner's objectives where practical. |                            |                            |                |
| <ol> <li>Forest characteristics; Land Exam Form 2450-128 Part<br/>A (and Part B for MFL) or similar stand-based table<br/>(providing a copy to the landowner is recommended<br/>though not required).</li> </ol>   |                            |                            |                |
| j. Plan addresses known, threatened and endangered species, and cultural/historical resources.   |                            | 17.50                      |                |

Table 8-1: Wisconsin Forest Management Plan Standards which summarizes recommended and required elements in forestry plans (continued on next page).

■ Required • Recommended

| Plan Component  | Managed Forest<br>Law Plan | Forest<br>Stewardship Plan | Basic<br>Plan* |
|---|----------------------------|----------------------------|----------------|
| #3: MANAGEMENT ACTIVITIES   |                            |                            |                |
| a. Recommendations consider landowner's available time, interest, money and energy based on landowner's objectives.   | •                          | •                          | •              |
| b. Plan identifies and describes actions (practices) to be<br>taken by the landowner to protect soil, water, range,<br>aesthetic quality, recreation, timber, and fish and<br>wildlife resources in a manner that is compatible with<br>landowner objectives. | •                          | •                          | •              |
| c. MFL Mandatory Practices**  |                            |                            |                |
| d. MFL Optional Practices**   |                            |                            |                |
| e. Year practices should/must be completed (a chronological summary of mandatory or recommended activities is also desirable, but not required).  | •                          | •                          | •              |
| f. Enforceable language: Specific requirements as<br>appropriate (basal area residuals, trees per acre,<br>follow-up requirements, etc.).   | •                          |                            |                |
| g. Prescriptions are consistent with Wisconsin DNR approved silvicultural standards.  | •                          | •                          |                |
| h. Gypsy moth control considerations.   |                            | •                          |                |
| #4: PRESENTATION  |                            |                            |                |
| a. The plan information is presented in a logical format that is easy to follow.  | •                          | •                          | •              |
| b. The writing style is easy to read and understand, and presented in a professional manner.  | •                          | •                          | •              |
| c. The writer reasonably avoids wordiness, jargon, and mistakes in grammar, spelling and formatting.  | •                          | •                          | •              |
| d. The plan meets the landowner's needs and provides useful advice in a skillful way.   | •                          | •                          | •              |

<sup>\*</sup> Foresters will need to use judgment in deciding which components in addition to those designated in the chart are needed for each individual Basic Plan. A CRP Planting Plan, for example, might require many of the same components as a Forest Stewardship Plan.

**NOTE**: An MFL checklist is included in the Appendix B, covering all the items needed in a fieldwork packet for an MFL entry.

Table 8-1: Wisconsin Forest Management Plan Standards (continued from previous page).

<sup>\*\*</sup> Mandatory and Optional Practices are required to be included in MFL plans to the extent needed to address sound forestry and the landowner's objectives listed in the plan.

# CHAPTER 9 — GENERAL OPERATIONAL GUIDELINES

| 110 |
|-----|
| 110 |
| 111 |
| 111 |
| 112 |
| 113 |
| 113 |
| 113 |
| 113 |
| 114 |
|     |

#### OPERATIONAL CONSIDERATIONS

# Timing and Coordination of Activities

The timing of forest management activities or recreational activities can be constrained by pre-existing or seasonal conditions, regulations and limitations, such as seasonal road load limits, seasonal forest access limitations, forest fire hazard conditions, and appropriate times for such activities as herbicide treatments, tree planting and road construction.

- Conduct forest management activities when soil conditions are firm enough to support the type of equipment being used, in order to protect soil productivity and minimize damage to any cultural resources that may be present.
- Plan to conduct forest management activities in wetlands when frozen or when firm enough to support equipment being used. Evaluate the site based on weather conditions to ensure adequate support for equipment to prevent or minimize rutting. Examples of weather conditions that could be cause for concern include heavy rain, flooding, significant snow before frost, and three consecutive nights above freezing after frost has been established.
- Plan for removal of equipment and cut material from wetland areas prior to thawing at the end of the winter season, or leave it until the next winter.
- Plan to conduct activities during the preferred operating periods for site and soil conditions.
   Preferred operating periods for a site may vary due to local and seasonal climatic conditions, equipment being used and operating techniques.
- Combine and integrate forest management activities where appropriate to reduce or eliminate the need for multiple entries by heavy equipment. For example, full-tree skidding may be used for preparation of jack pine seed beds, eliminating the need for additional site preparation.
- Protect reserve areas and structural habitat components retained in previous stand treatments.

# TIMING AND COORDINATION OF ACTIVITIES TO REDUCE NOISE AND VISUAL IMPACTS

- Avoid management operations during periods of peak recreational use whenever possible.
- Reduce noise in early morning, late evening and other appropriate times when possible.
- Selectively restrict use of recreational facilities to avoid conflict with management activities.
- Temporarily relocate recreation trails away from management activity areas.
- Inform and educate recreational users regarding management issues, limitations and timing prior to, during and after management activities.
- Time management activity with consideration for public use patterns.
- Minimize direct conflict with forest recreational users during peak use and special event periods.



Figure 9-1: Winter harvesting is one example of timing forest management activities to protect soils, especially in lowland areas such as this black spruce stand (photo courtesy of UW-Kemp Station).



Figure 9-2: At the end of a forest operation, a simple earthen traffic barrier may be satisfactory for preventing unwanted vehicle traffic.

# Designing Operations To Fit Site Conditions

- Determine the preferred operating season for a specific site to help avoid unwanted impacts to the site, as well as the costly process of moving equipment from a site or shutting down operations if negative impacts are occurring.
- Take into account that the preferred operating season may vary for any one site depending on soil characteristics, local climatic conditions, equipment being used, and operating techniques. The use of low ground pressure (LGP) equipment and such operating techniques as using slash mats to drive on can extend operating seasons on low-strength soils.

- Use caution when operating heavy equipment on sites whenever adverse soil impacts are likely.
   Soil susceptibility to compaction and rutting is primarily dependent on soil texture and moisture content. Soils are most susceptible to compaction, rutting and puddling at the following times:
  - During spring and early summer months.
  - Immediately following heavy rains.
  - During the period between when transpiration ceases in the fall and before freeze-up occurs.

# Managing and Minimizing Infrastructure

In the context of forest management activities, infrastructure is defined as the network of access roads, approaches, trails, and landings used to move equipment onto and around a forest management site.

Any reduction in the total amount of area occupied by such infrastructure reduces the impact on soil productivity, as well as potential impacts to cultural resources, riparian areas and wildlife habitat.

- Consider future management activities that may use common infrastructure for management of adjacent stands or ownerships. Develop or plan infrastructure accordingly.
- Examine existing access routes to determine whether they are the best routes to improve.
   Consider whether relocation would provide a better long-term access route.
- Where appropriate, limit direct trafficking of a site to the smallest area necessary when planning such management activities as harvesting and site preparation.

#### PROTECTING CULTURAL RESOURCES



Figure 9-3: To be effective, gated road closures must be located properly. Otherwise, vehicle traffic will simply go around as they have on this forest road.

Some types of cultural resources are protected by federal or state law (see Chapter 6: Cultural Resources, Cultural Resource Management and the Law, page 88).

- When feasible, avoid management activities
  within cultural resource areas. Delineate such
  areas with flagging, signs, or temporary fencing,
  and make sure that loggers and equipment
  operators understand that there is to be no work
  in the marked area.
- When it's not feasible to avoid cultural resource areas during forest management activities, protect resources by one of the following measures:
  - Temporarily brace walls and board up windows and doors of historic buildings.
  - Avoid felling trees onto historic buildings, structures or surface features of archaeological sites.

- For cultural resources that cannot be protected from damage, consider data recovery (professional excavation of archaeological sites or documentation of above-ground cultural resources).
- If a human burial site is accidentally discovered during operations, cease operations immediately in the vicinity of the discovery. Contact the Burial Sites Preservation Office at the Wisconsin Historical Society, and your local law enforcement agency.
- For the accidental discovery of other types of cultural resources such as archaeological artifacts, temporary suspension is recommended but not required. Suspending operations in the immediate vicinity allows time to contact a cultural resource professional.

### FUELS, LUBRICANTS, WASTE, AND SPILLS

Fuels, Lubricants and Waste Logging, road building and other forest activities require motorized equipment. Antifreeze, fuels and lubricants used in machinery can potentially pollute lakes, streams, wetlands, and groundwater. Planning for forestry operations should include practices to handle solid and liquid wastes generated in the field.

# BMPs: NONPOINT POLLUTION PREVENTION

The following BMPs will help prevent non point source pollution from fuels, lubricants and wastes during forest management activities.

- ✓ Use biodegradable lubricants whenever practical. Biodegradable lubricants are less toxic than other lubricants but still need to be disposed of properly. To contact manufacturers of biodegradable lubricants, see the Resource Directory: Wetlands Protection, page 228.
- ✓ Maintain equipment regularly. Check hoses and fittings to prevent leaks or spills.
- ✓ Designate specific areas for equipment maintenance and fueling. Locate these areas on level terrain, a minimum of 100 feet from all streams and lakes.
- ✓ Collect all waste lubricants, containers and trash. Store them in leak-proof containers until they can be transported off-site for recycling, reuse or disposal at an approved site. Call your local DNR regional office for more information. Note: It's illegal to dump fuel and lubricants on the land or in waters in the state of Wisconsin.
- ✓ Separate all fluids and materials and keep in different labeled containers to avoid creating "hazardous waste" and expensive waste disposal. Call your local DNR regional office to determine if a waste is hazardous and how to dispose of hazardous waste.

#### Spills

Report all hazardous substance spills immediately to the Wisconsin Department of Natural Resources by calling the **24-hour Emergency Hotline number** at **1-800-943-0003**.

Spills of fuel, lubricants or pesticides during forest management operations can occur as a result of fueling, hydraulic hose breaks, mechanical damage, or vandalism. All spills of hazardous substances that adversely impact or threaten to adversely impact public health, welfare or the environment must be 1) immediately reported to the DNR and 2) cleaned up. In some instances, small quantities of petroleum products and agrichemicals do not require reporting to the DNR. During timber harvesting operations, reporting a spill is not necessary for a gasoline spill less than one gallon, or for a diesel or hydraulic fluid spill less than five gallons, as long as there is no threat to the environment. However, the spill still needs to be cleaned up.

For more details on spill reporting requirements or clean-up, contact your nearest DNR Regional Spill Coordinator:

| Eau Claire  | 715-839-3775 |
|-------------|--------------|
| Green Bay   | 920-492-5592 |
| Madison     | 608-275-3332 |
| Milwaukee   | 414-229-0838 |
| Rhinelander | 715-365-8963 |
| Superior    | 715-392-0802 |

Note: Proper equipment maintenance will prevent many spills.

## BMPs: SPILLS

The following best management practices are general guidelines for spills of fuel and lubricants used in forestry field operations. These practices complement specialized training given to persons using pesticides or other hazardous materials.

- ✓ Maintain a spill-containment and clean-up kit appropriate for the materials on the operation. At a minimum, a kit for petroleum products should include:
  - 1) Plugs and clamps to control a hydraulic line break.
  - 2) A container to catch leaking fluid.
  - 3) A shovel, and
  - 4) Absorbent material such as sawdust to absorb fluid which is especially useful in the winter when soil is frozen.
- ✓ If a spill should occur, use the following order:
  - Protect yourself and others. Wear protective clothing and use equipment appropriate for any hazardous materials on the operation. Avoid coming in contact with any toxic drift or fumes that may be released.
  - 2) If able, control the spill; stop the leak.
  - 3) If able, contain the spill; keep it from spreading. Shovel a dike around the spill. Use absorbent material, such as sawdust or loose soil, to soak up fluid. Place a bucket under a hydraulic hose break. Keep the spill from flowing into lakes or streams.
  - 4) Isolate the spill material.
  - Report all hazardous substance spills immediately to the Wisconsin 24-hour Emergency Hotline at 1-800-943-0003.
  - 6) Contact your local DNR regional office for disposal guidance.

## POST-OPERATIONAL ACTIVITIES AND FOLLOW-UP VISITS

- If a road will provide access to a cultural resource, consider closing the road after the operation is completed.
- Remove flagging, signs or other markings that identify a cultural resource when a forest management activity is completed.
- Restore watercourses to approximate their natural condition by removing temporary drainage structures and stabilizing the soil along the banks.
- Stabilize bare soil areas and install water diversion devices and erosion control barriers where appropriate to prevent or minimize erosion and sedimentation from roads, skid trails and landings into surface water and cultural resource areas.
  - Seed and fertilize as appropriate.
  - Fill in ruts as necessary, weighing the benefits of filling in ruts on skid trails against the potential for additional impact to soil productivity as a result of equipment used to eliminate ruts.
  - Inspect erosion control measures periodically and maintain or remove as needed.
- Place traffic barriers where appropriate to prevent vehicles from disturbing recently stabilized areas.
   Barriers should be visible and well-marked, and they should not present a safety hazard.
- Conduct follow-up visits to areas where structures (such as culverts or water bars) or other protection measures (such as seeding of bare areas) are used to minimize impacts on water quality and wetlands. Such follow-up visits can help assure that protection measures remain functional.

# CHAPTER 10 — FOREST ROAD CONSTRUCTION AND MAINTENANCE

|      | Considerations                              | .116 |      |
|------|---|------|------|
| Upla | and Forest Roads                            |      | .118 |
| '    | BMPs: Planning, Location and Design         |      |      |
| Stre | am Crossing Design and Construction         |      | .119 |
|      | BMPs: Stream Crossings                      | .120 |      |
|      | BMPs: Pipe Culverts for Stream Crossings    | .121 |      |
|      | BMPs: Fords                                 | .123 |      |
| Roa  | d Construction and Drainage                 |      | .123 |
|      | BMPs: Road Construction and Drainage        | .124 |      |
| Drai | nage Structures                             |      | .125 |
|      | BMPs: Drainage Structures                   | .125 |      |
|      | BMPs: Pipe Culverts for Cross-drains        | .126 |      |
|      | BMPs: Open-top Culverts                     | .126 |      |
|      | BMPs: Broad-based Dips                      | .127 |      |
|      | BMPs: Waterbars                             | .127 |      |
|      | BMPs: Diversion Structures                  | .128 |      |
| Soil | Stabilization                               |      | .128 |
|      | Mulch and Seeding                           | .128 |      |
|      | BMPs: Mulch and Seeding                     | .128 |      |
|      | BMPs: Sediment-control Structures           | .129 |      |
| Wet  | land Forest Roads                           |      | .130 |
|      | BMPs: Wetland Roads, Skid Trails & Landings | .130 |      |
| 15 F | ederal Requirements                         |      | .131 |
|      | BMPs: Forest Roads in Wetland               | .131 |      |
| Roa  | d Maintenance                               |      | .132 |
|      | BMPs: Road Maintenance                      | .132 |      |

Roads, skid trails and landings are all part of a forest transportation system (skid trail and landing BMPs are covered in Chapter 11: Timber Harvesting, pages 140 and 141). Roads connect the forest land to existing public roads. They provide forest access for such activities as managing timber, improving fish and wildlife habitat, fighting fires, and recreation.

Forest roads located, constructed or maintained poorly are the largest source of nonpoint source pollution from forest management activities. Roads over steep slopes, erodible soils or stream crossings hold the greatest potential for degrading water quality.

There are three types of forest roads (listed below). Make sure to identify the type of road system you need during your planning phase.

- Temporary Roads: These are the most common type of forest road. They are designed and constructed for short-term use during a specific project such as timber harvesting. These roads are used only when the ground is frozen or firm. When the project is complete, the temporary road is closed, all stream crossing structures are removed, and the road is naturally or artificially revegetated.
- Permanent Seasonal Roads: Maintained as part of the permanent road system, seasonal roads are designed for use only when the ground is frozen or firm. These roads are generally narrower than all-season roads, built to lower engineering standards, and have minimal surface gravel.
- Permanent All-season Forest Roads: These roads usually have gravel surfaces and are designed for year-round use. However, there may be some restrictions on use at various times of the year.

#### Considerations

A well-planned access system is a sound method of reducing erosion and sedimentation in areas requiring frequent or temporary access. Proper location and construction of roads will provide for safety, longer operating periods, lower maintenance

and operating costs, and minimal impacts to forest resources. Servicing as many acres of forest with as few roads as possible is a sound method of reducing impacts to forest resources from road construction.

#### **FACTORS IN DECISION-MAKING**

- The number, size and design of forest access roads will be influenced by the frequency of access, amount of anticipated traffic, seasons during which access is required, and safety concerns.
- Distribution of necessary management activities will affect the number and location of access roads.
- Choices regarding road construction standards and maintenance activities will be influenced by site characteristics and the value of the resources served. Culverts and ditches may be necessary with any road construction technique.
- Surfacing can be the major cost of low-volume road construction. Alternatives should be evaluated according to expected use and potential impact on sediment load. Where grades make the potential for surface erosion significant, the road should be surfaced with materials that will minimize potential water quality and soil productivity impacts (such as crushed rock, compacted gravel, sod, or asphalt).
- Visual impacts and the concentration of forest management activities can result from poor design, construction and maintenance of forest access roads. Take into account the following considerations when planning to reduce noise and visual impacts associated with the design and use of forest access roads:
  - Noise from traffic, especially large trucks, buses and heavy equipment.
  - Potential increased costs of building forest access roads to accommodate visual quality concerns, and potential increased costs of using existing roads that require traveling greater distances.

- The limited road construction season that generally coincides with the tourist season.
- Traffic during wet periods that can increase maintenance needs and create unsightly ruts and mudholes.
- Visual impacts and noise impacts created by gravel pits are not compatible with recreational user sensitivities. Take into account the following considerations when planning to reduce noise and unsightliness related to gravel pits:
  - Local sources of gravel are necessary for efficient, cost-effective road building and maintenance.
  - Recreational use of gravel pits may cause conflicts.
- Site-specific soil, topographic and forest inventory information will assist resource managers or landowners in planning road location and layout.
   For more information, see the Resource Directory.

#### MINIMIZING IMPACTS FROM ROADS

- Because roads take soils out of production, effort should be made to keep the length and width of roads to a minimum without sacrificing safety.
- To minimize road mileage and reduce costs, coordination with adjacent landowners may be desirable.
- The greatest potential for soil erosion occurs immediately after construction. Disturbed areas should be shaped and stabilized as soon as possible to minimize erosion potential.

#### **MAINTENANCE NEEDS**

- The purpose of maintenance procedures is to ensure measures taken to minimize impacts on forest resources are working and continue to work into the future. Surfacing materials and the amount of use determine the level of maintenance required.
- Roads that are open for use require more maintenance than roads that are closed to



Figure 10-1: Seeding can be as easy as spreading grass seed by hand as this landowner is doing on his freshly-graded woods road.

vehicular traffic. Inactive roads (roads currently not in use) whether closed temporarily or permanently, require occasional work to reduce potential impacts on streams, lakes, wetlands, and seasonal ponds.

 Road layout, construction methods and erosion, and access control all contribute to the longevity, utility, safety, and maintenance cost of roads.

# PROTECTING WATER QUALITY AND WATER FLOW

- Incorporating guidelines to protect water quality into overall road project design can minimize the potential impact of wetland roads on water quality, as well as alterations to normal water flow patterns.
- Effective road construction techniques minimize the disturbance to the natural flow of water over the landscape and ensure the structural integrity of the road embankment.

The goal is to provide a simple road structure of adequate strength to support heavy vehicle traffic and provide drainage structures to pass water at its normal level through the road corridor.

#### UPLAND FOREST ROADS

### BMPs: PLANNING, LOCATION AND DESIGN

Decisions made at the planning stage will affect a road's construction costs, long-term maintenance needs, service life, and the amount of nonpoint source pollution it causes. Loggers and landowners should plan, locate and design the road system together.

- ✓ Plan road systems that minimize the number, width and length of roads to limit the total area of the site disturbed. Remember to:
  - Consider future uses of the road system
  - Coordinate development with adjoining landowners when possible; and
  - use temporary roads where practical
- ✓ Use existing roads when they provide the best long-term access. Consider relocating existing roads if doing so improves access and reduces environmental impacts. Reconstruct existing roads to provide adequate drainage and safety. Do not disturb stable road surfaces.
- ✓ Select road locations that allow for drainage away from the road.
- ✓ Minimize the number of stream crossings.
- ✓ Identify optimum stream crossing locations before locating the rest of the road. Optimum locations include straight and narrow stream channels with low banks and firm rocky soil. Roads should approach streams at the least gradient possible.
- ✓ Where possible, locate roads on well-drained soils.

- ✓ Locate roads outside riparian management zones except at stream crossings. For more information, see Chapter 5: Riparian Areas and Wetlands, page 73.
- ✓ Road grades should not exceed 10 percent. If road grades greater than 10 percent are necessary, limit grade length to minimize erosion, or break the grade using drainage structures (see "Drainage Structures" on page 125). Graveling the road surface on steep grades can also help maintain stability. Note: Optimum road grades should be less than five percent (see Figure 10-2).

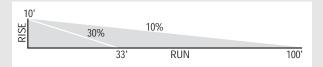


Figure 10-2: Road Grade % = Rise ÷ Run x 100.

✓ Locate roads to follow natural contours and to minimize cut and fills. Balance cut and fills to minimize the need for fill or removing excess materials (see Figure 10-3).

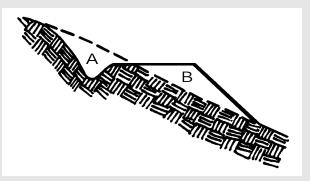


Figure 10-3: A side-hill cross-section illustrating how cut materials (A) equals fill materials (B).

# REDUCING VISUAL IMPACTS DUE TO ALIGNMENT AND LOCATION OF ROADS

- Minimize the number of roads approaching travel routes or recreation areas.
- Locate roads and trails to minimize visibility from nearby vantage points such as scenic overlooks, streams and lakes.
- Reduce visual penetration with appropriate curves in the road alignment.
- Minimize total road mileage and ground disturbance required to meet landowner objectives and anticipated traffic loads.
- Avoid tracking mud onto highways by using appropriate road surface material.



Figure 10-4: Seeding a logging road helps prevent soil erosion while providing wildlife food and habitat. This road curves after entering the woods and thereby reduces visual penetration.

## STREAM CROSSING DESIGN AND CONSTRUCTION

Operating equipment in or near perennial or intermittent stream channels may add sediment directly to streams. Stream crossings poorly located or constructed may erode streambanks.

As roads approach a stream crossing, proper road drainage is critical to avoid sedimentation in streams. Three common stream crossing structures include culverts, bridges and fords.

Stream crossings must be designed, constructed and maintained to safely handle expected vehicle loads and to minimize disturbance of streambanks, channels and, ultimately, aquatic organisms. Consider streambed material, stream size, storm frequency, flow rates, intensity of use (permanent or temporary), and the passage of fish when planning crossings. The USDA Natural Resources and Conservation Service, your local land conservation department, or a private consultant can help with designing fords and culverts. To design a bridge, contact a private consultant or experienced contractor.



Figure 10-5: This waterbar, placed at the proper angle to the road, will intercept runoff water and direct it into the adjoining vegetation.

### **BMPs: STREAM CROSSINGS**

- ✓ A permit is required to construct a ford or install a culvert/bridge across any navigable intermittent or perennial stream. A stream is navigable if it has bed and banks, and it's possible to float a canoe or other small craft in the waterway on a regular reoccurring basis – even if only during spring runoff. Streams identified on current U.S. Geological Survey (USGS) topographical maps (7.5 minute/1:24,000 scale) should be considered navigable. Other lakes and streams may be considered navigable by a Wisconsin DNR water management specialist. If you have a question about navigability, contact a Wisconsin DNR water management specialist.
- ✓ For temporary stream crossings for skid trails, see the Stream Crossings for Skidding section in Chapter 11: Timber Harvesting, page 141.
- ✓ Use soil stabilization practices on exposed soil at stream crossings. Use seed and mulch, and install temporary sediment control structures such as straw bales or silt fences immediately following construction to minimize erosion into streams. Maintain these practices until the soil is permanently stabilized (see Chapter 10: Forest Roads: Soil Stabilization, page 128).
- ✓ Design, construct and maintain stream crossings to avoid disrupting the migration or movement of fish and other aquatic life. Bridges or arch culverts that retain the natural stream bottom and slope are preferred for this reason.
- ✓ Install stream crossings using materials that are clean, non-erodible and non-toxic.
- ✓ Install stream crossing structures at right angles to the stream channel.
- ✓ Minimize channel changes and the amount of excavation or fill needed at the crossing.
- ✓ Limit construction activity in the water to periods of low or normal flow. Keep use of equipment in the stream to a minimum.

✓ Construct a bridge or place fill directly over a culvert higher than the road approach to prevent surface runoff from draining onto the crossing structure and into the stream (see Figure 10-6).



Figure 10-6: Use of fill when placing a culvert.

✓ Divert road drainage into undisturbed vegetation, preferably outside the RMZ so the drainage does not directly enter the stream (see Figure 10-7 and Diversion Structures on page 128).



Figure 10-7: Example of a diversion ditch.

- ✓ Stabilize approaches to bridge, culvert and ford crossings with aggregate or other suitable material to reduce sediment entering the stream.
- ✓ Anchor temporary structures on one end with a cable or other device so they do not float away during high water. Install them so they can be easily removed when no longer used, regardless of the season.

### BMPs: PIPE CULVERTS FOR STREAM CROSSINGS

- ✓ Install pipe culverts long enough so that road fill does not extend beyond the ends of a culvert.
- ✓ Install permanent culverts that are large enough to pass flood flows and are a minimum of 12 inches in diameter. Culverts that are too small can plug up with debris and result in the road washing out or in flooding upstream. Wisconsin law states that the landowner and/or contractor are responsible to obtain a flood easement from any affected property owners upstream of culvert crossings that are not designed to pass the 100-year flood. The USDA Natural Resources and Conservation Service, your local land conservation department or a private consultant (i.e., engineer or registered land surveyor) can help with sizing culverts.
- ✓ Install culverts so there is no change in the stream bottom elevation. Culverts should not cause damming or pooling (see Figure 10-8).
- ✓ Firmly compact fill material around culverts, particularly around the bottom half. Cover the top of culverts with fill to a depth of one-third of the pipe diameter or at least 12 inches, whichever is greater, to prevent crushing (see Figure 10-9).
- ✓ Use riprap around the inlet of culverts to prevent water from eroding and undercutting the culvert. For permanent installations, use filter fabric under the riprap. In addition, consider using flared-end culvert sections for inlets (see Figure 10-10).

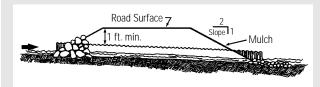


Figure 10-8: Install culverts so there's no change in the stream bottom elevation.

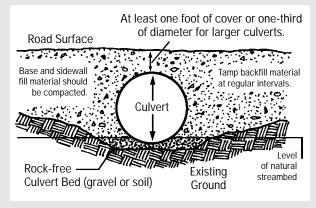


Figure 10-9: Installation of culverts.

✓ Keep culverts clear and free of debris so that water can pass unimpeded at all times. This is especially important in areas where beaver are present.

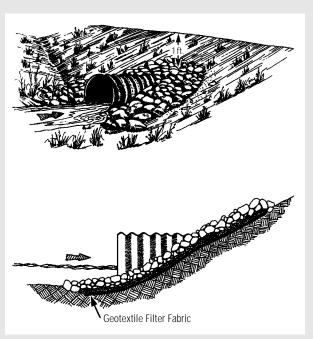


Figure 10-10: Use riprap around the inlet of culverts. Also use geotextile filter fabric for permanent installations.



Figure 10-11: The number and size of culverts depends on stream size, rate of flow and flood potential (photo courtesy of the Wisconsin DNR).



Figure 10-12: This box culvert, made from two-inch lumber, helps to divert runoff water to the road's downhill side (photo courtesy of the Wisconsin DNR).



Figure 10-13: Pulpwood stacked above the culvert elevates this woods road, and reduces the approach grade at the steam crossing. This helps minimize erosion potential from runoff water (photo courtesy of the Wisconsin DNR).



Figure 10-14: This culvert, half-full of sediment, should be cleaned out to enable it to handle runoff water. Periodic maintenance is essential if water handling structures are to function properly.

# BMPs: FORDS

Use fords for crossing dry streambeds or where fording would cause minimal water quality impacts.

- ✓ Locate fords where streambanks are low.
- ✓ Streambed should have a firm rock or gravel base. Otherwise, install stabilizing material such as reinforced concrete planks, crushed rock, riprap, or rubber mats on streambeds.



Figure 10-15: A ford was approved for this stream crossing because the stream banks are low and the streambed is gravel.

### ROAD CONSTRUCTION AND DRAINAGE

The most effective method to control erosion on forest roads is to keep water from accumulating on the road surface. Fast-moving water can easily erode soil from road surfaces and ditches, but

road erosion can be controlled when water drains off the road surface and is dispersed into vegetation and ground litter.





Figures 10-16 and 10-17: This road shows past erosion and grading will clear up the problem temporarily. However, high berms (right photo) alongside the road prohibit water from running off, and erosion is likely to reoccur. A ditch is needed to properly handle the runoff water.

### BMPs: ROAD CONSTRUCTION AND DRAINAGE

- ✓ Design and construct roads to remove water from road surfaces to keep roads dry and structurally sound. Show three common designs: crowned, outsloped and insloped. Install insloped roads with ditches and adequate cross drainage. Outsloped roads (usually outsloped one to two percent) are less expensive to construct and maintain; use them on roads with moderate gradients and stable soils (see Figure 10-18).
- ✓ Construct stable cut-and-fill slopes that will revegetate easily, either naturally or artificially.
- ✓ Do not bury debris in the road base. It causes uneven settling that can lead to erosion and frost-heaving that creates mud holes.
- ✓ Compact the road base material or allow it to settle before using the road to reduce the amount of water that soaks into it. This will increase the road's carrying capacity, reduce road maintenance and reduce erosion.

- ✓ Surface the road with gravel where steep grades, erodible soils or high-traffic volume make the potential for surface erosion significant.
- ✓ Locate gravel pits outside RMZs using proper location, development and soil stabilization practices to minimize erosion from the pits.

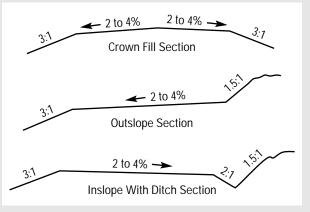


Figure 10-18: Typical road designs for drainage and stability.

# REDUCING VISUAL IMPACTS OF ROAD CLEARINGS

- Utilize merchantable timber within road clearings.
- Burn, screen or bury road-clearing debris such as stumps, rocks and boulders, so it's not visible from travel routes or recreation areas.
- Move cleared debris outside of the travel route right-of-way so it's minimally apparent.
- Avoid creating a corridor of debris.
- Do not leave jackstrawed or overturned stumps in the immediate foreground.
- Reduce height of dozed clearing debris during road construction.

# REDUCING NOISE AND VISUAL IMPACTS OF GRAVEL PITS AND BORROW AREAS

- Locate borrow pits and crushing operations out of the visible corridor as much as possible.
- Screen pits from travel routes or recreation areas using existing vegetation or landscape berms.
- Reduce noise in early morning, late evening and other appropriate times whenever possible.
- Develop gravel or borrow pits from the back to the front of pits (moving toward the predominant view or vantage point).
- Rehabilitate pits upon completion of use.

#### DRAINAGE STRUCTURES

### BMPs: DRAINAGE STRUCTURES

Road-drainage structures include cross-drains (pipe culverts, open-top culverts, broad-based dips and waterbars) and water-diversion structures. Cross-drains allow water from roadside ditches to move from one side of the road to the other.

- ✓ Where necessary to protect water quality, install road drainage structures to remove storm water or seepage from the road surface and ditches. Space these structures at intervals
- close enough to minimize waterflow volume and speed, avoiding ditch erosion. As road grades increase, use drainage structures more often (see Table 10-1).
- ✓ Where necessary, provide erosion protection for outflows from road drainage structures to minimize erosion and disperse the water, allowing it to soak into the soil. Riprap, mulch and/or seeding may be necessary (see next few pages on Soil Stabilization, page 128).

| Road Grade | Distance Between Waterbars | Distance Between Broad-based<br>Dips and Cross-drain Culverts |
|------------|----------------------------|---|
| 1%         | 400 Feet                   | 500 Feet  |
| 2%         | 250 Feet                   | 300 Feet  |
| 5%         | 130 Feet                   | 180 Feet  |
| 10%        | 80 Feet                    | 150 Feet  |
| 15%        | 50 Feet                    | 130 Feet  |
| 25%+       | 40 Feet                    | 110 Feet  |

Table 10-1: Recommended distances between drainage structures on forest roads and skid trails.



Figure 10-19: This truck haul road has just been graded at the close of timber harvesting activities. Water diversions, seed and gate closures will be completed next.



Figure 10-20: A seeded logging road with a properly located gate to limit motorized access mark the end of this timber sale.

### BMPs: PIPE CULVERTS FOR CROSS-DRAINS

- ✓ Install pipe culverts to provide cross-drainage on road grades at regular intervals immediately above steep grades, below bank seepages, and where water will run onto log landings or forest roads.
- ✓ Install pipe culverts long enough so that road fill does not extend beyond the end of a culvert.
- ✓ Install cross-drain pipe culverts at grades at least two percent more than the ditch grade and angled 30 to 45 degrees to improve inlet efficiency (see Figure 10-21).
- ✓ Select the size of cross-drain culverts according to the size of the road and area drained by the ditch. To avoid clogging, permanent culverts should be at least 12 inches in diameter. The USDA Natural Resources and Conservation Service, your local land conservation department, or a private consultant (i.e., engineer or registered land surveyor) can help with sizing culverts.
- ✓ Install pipe culverts on a surface of compacted granular material. Firmly compact fill material around culverts, particularly around the bottom half. Cover the top of the culvert with fill to a depth of one-third of the pipe diameter, or at

- least 12 inches (whichever is greater) to prevent crushing (see Figure 10-9, page 121).
- ✓ Use riprap around the inlet of culverts to prevent water from eroding and undercutting the culvert.

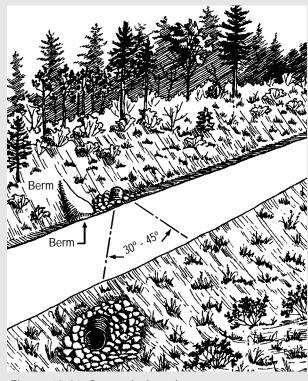


Figure 10-21: Cross-drain culvert.

### **BMPs: OPEN-TOP CULVERTS**

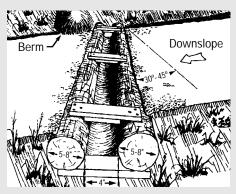


Figure 10-22: Open-top log culvert.

Open-top culverts provide cross-drainage and road-surface drainage, and are usually installed on seasonal or temporary roads (see Figure 10-22).

- ✓ Install open-top culverts to provide cross-drainage immediately above steep grades, below bank seepages, where water will run onto log landings or forest roads, and on road grades at regular intervals.
- ✓ Clean open-top culverts frequently since they easily fill in with debris.

### BMPs: BROAD-BASED DIPS

Broad-based dips can provide cross-drainage and road-surface drainage for roads and skid trails with a gradient of 15 percent or less. Broad-based dips can be used instead of culverts, usually at lower cost and with lower maintenance. Dips are not used for draining seeps, or for intermittent or permanent streams (see Figure 10-23).

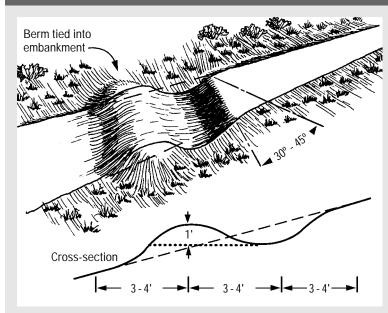
- ✓ Construct broad-based dips deep enough to provide adequate drainage and wide enough to allow trucks and equipment to pass safely.
- ✓ Place a surface of crushed stone or gravel on the dip and mound for soils and conditions where rutting may occur.



Original Grade Construction Final Grade

#### Figure 10-23: Broad-based dip (and cross-section).

## BMPs: WATERBARS



A waterbar is a shallow trench with a mound (or berm) which provides cross drainage and intercepts runoff from skid trails, recreational trails, firebreaks, or inactive or closed roads. Constructing a waterbar will minimize erosion and provide conditions for natural or artificial revegetation (see Figure 10-24).

✓ Place waterbars at a 30 to 45 degree angle with a cross-drainage grade of two percent.

Figure 10-24: Waterbar.

## **BMPs: DIVERSION STRUCTURES**

Diversion ditches, or berms, divert water away from roads and side ditches, and channel it into vegetation. These structures are often used before stream crossings to ensure that water will be diverted into vegetation and not directly into a stream, lake or wetland (see Figure 10-7, page 120).

✓ Construct diversion ditches so they intersect the roadside ditch at the same depth and are outsloped one to three percent (see Figure 10-7).

#### SOIL STABILIZATION

Soil stabilization practices are used where soil is exposed and natural revegetation is inadequate to prevent soil erosion and subsequent sedimentation into streams, lakes and wetlands. This occurs during road construction and when the road system is being used (active) or is closed (inactive). Practices include mulching, seeding and installing sediment control structures. References include the Wisconsin DNR's Wisconsin Construction Site Erosion Control Handbook and Chapter 10 in the Wisconsin Department of Transportation's Erosion and Sediment Control Facilities Development Manual. To obtain these references, see the Resource Directory. Contact a Wisconsin DNR forester or the USDA Natural Resources and Conservation Service for more information.

It's always more efficient and cost-effective to prevent erosion than to repair damage after the fact.

## Mulch and Seeding

Mulch such as straw, woodchips or bark, retains soil moisture important for seed germination, and protects the soil surface from erosion due to runoff and raindrop impact. Mulch can be used to:

1) promote natural revegetation or 2) protect seeds that have been spread over an area. If you seed, apply mulch immediately afterward. Netting may be necessary to hold mulch in place on steep slopes or on areas where water flow concentrates.

## BMPs: MULCHING AND SEEDING

✓ Use mulch and/or seed where necessary to minimize soil erosion into streams, lakes and wetlands.

Seed mixtures should include fast growing species for quick soil protection plus perennial species for longer soil protection until native vegetation returns to the site. Recommendations for seed mixes that are best for specific regions in Wisconsin are available from your local Wisconsin DNR wildlife management specialist and USDA Natural Resources and Conservation Service office. However, a suggested generic seed mixture, applied at the rate of 31 lbs./acre, is as follows:

| White Dutch Clover        | 8 lbs./acre         |
|---------------------------|---------------------|
| Perennial Rye Grass       | 5 lbs./acre         |
| Annual Rye Grass          | 8 lbs./acre         |
| Creeping Red Fescue       | 10 lbs./acre        |
| Total                     | 31 lbs./acre        |
| (Note: One acre equals 43 | 3,560 square feet.) |

A list of native seed mixtures based on physical site characteristics is contained within the technical guide critical area planting standard 342. This technical guide is available from USDA Natural Resources Conservation Services offices or on-line at www.wi.nrcs.usda.gov/fotg/standards4.asp

#### BMPs: SEDIMENT-CONTROL STRUCTURES

Install sediment-control structures where necessary to slow the flow of runoff and to trap sediment until vegetation is established at the sediment source. Sediment-control structures include straw bale fencing, silt fencing and

sediment traps. Maintain, clean or replace sediment-control structures until areas of exposed soil are stabilized (see Figures 10-25, 10-26 and 10-27).

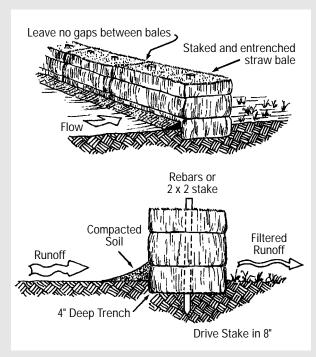


Figure 10-25: Straw bale fencing to slow runoff and trap sediment for sheet flow or channelized flow.

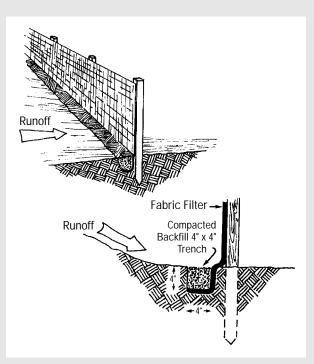


Figure 10-26: Silt fencing to slow runoff and trap sediment primarily for sheet flow, not channelized flow.

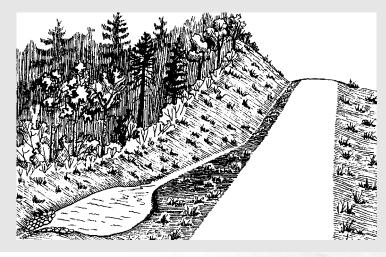


Figure 10-27: A sediment trap to slow runoff and trap sediment for channelized flow.

#### WETLAND FOREST ROADS

#### BMPs: WETLAND ROADS, SKID TRAILS & LANDINGS

Planning, Location and Design: Wetland Roads, Skid Trails and Landings Temporary roads, skid trails and landings require firm or frozen ground. Permanent roads in wetlands that require road-fill material must follow existing regulations, and be built carefully to avoid restricting the natural waterflow of the wetland under the road.

- ✓ Construct upland road approaches to wetlands so surface runoff is diverted away from the road and does not enter the wetland (see Chapter 10: Forest Roads: Drainage Structures, page 125).
- ✓ If landings are necessary in a wetland, build them to the minimum size required for the operation and to achieve the landowner's objective.
- ✓ Avoid operating equipment in areas of open water, springs or seeps.
- ✓ Provide for adequate cross-road drainage to minimize changes to natural surface and subsurface flow in the wetland.
  - For permanent fill roads, use permeable fill material for at least the first layer of fill, and install culverts or bridges a minimum of 300 feet apart and at all natural drainageways. Install at least one drainage structure at each wetland crossing.
  - For temporary roads, provide adequate cross-road drainage at all natural drainageways. Temporary drainage structures include culverts, bridges and porous material such as corduroy or

- chunkwood. Temporary non-organic structures such as metal culverts and bridges, should be removed promptly when work is complete.
- ✓ Equipment operations should cease when rutting becomes excessive.
- ✓ Use low-ground pressure equipment such as wide-tire or tracked equipment, if necessary to minimize rutting.
- ✓ Minimize rutting in wetlands by conducting forestry activities on firm or frozen ground that can support the equipment used. To achieve this:
  - Operate equipment on a day-to-day basis depending on weather conditions.
  - Consider using corduroy, chunkwood or rubber mats to improve the soil's ability to support traffic.

#### In the winter:

- To promote frost penetration, compact snow, grass, and brush.
- Monitor air temperatures daily. As air temperatures rise above freezing, you may not be able to operate equipment beyond late morning without creating ruts. Soil frost begins to disappear when night temperatures stay above freezing for three or four consecutive nights.

#### In the summer:

 Operate equipment only when soils are dry enough to support equipment. Soils may become too wet after storms and extended wet spells.

#### 15 FEDERAL REQUIREMENTS

#### BMPs: FOREST ROADS IN WETLANDS

The following 15 BMPs must be implemented in order to qualify for the silvicultural exemption from a federal section 404 permit when building a temporary or permanent road or skid trail in a wetland (33 CFR Part 323.4). The silvicultural exemption is only applicable when the primary purpose of the road is for normal silvicultural purposes. This listing is an attempt to explain the 15 BMPs in lay language. The exact language of the law may be obtained by contacting the Army Corps of Engineers.

- ✓ Limit the number, length and width of roads and skid trails to the minimum necessary to accomplish the landowner's objective.
- ✓ Locate roads outside riparian management zones except at stream crossings.
- ✓ Road fill must be bridged, culverted or otherwise designed to prevent restriction of expected flood flows.
- ✓ Properly stabilize and maintain road fill during and after road construction to prevent erosion.
- ✓ While building a road with fill material, minimize the use of road construction equipment in the wetland area that lies outside the boundaries of the road fill.
- ✓ Minimize disturbance of vegetation while designing, constructing and maintaining roads.

- ✓ Correctly design, construct and maintain wetland road crossings to avoid disrupting the migration or movement of fish and other aquatic life.
- ✓ Use fill from upland sources whenever feasible.
- ✓ Place fill in a way that does not take or jeopardize the continued existence of a threatened or endangered species (as defined under the Endangered Species Act) or adversely modify or destroy the critical habitat of such species.
- ✓ Avoid placing fill in breeding and nesting areas for migratory waterfowl, spawning areas and wetlands if practical alternatives exist.
- ✓ Fill shall not be placed near a public water supply intake.
- ✓ Fill shall not be placed in areas of concentrated shellfish production.
- ✓ Fill shall not be placed in waterbodies or on land regarded as part of the National Wild and Scenic River System.
- ✓ Use fill free from toxic pollutants in toxic amounts.
- ✓ Completely remove all temporary fills and restore the area to its original elevation.

#### ROAD MAINTENANCE

#### BMPs: ROAD MAINTENANCE

Roads must be well-maintained or water quality protection structures may quickly degrade. For both active and inactive roads, follow BMPs in Chapter 10: Forest Roads: Soil Stabilization, page 128).

#### **ACTIVE ROADS**

- ✓ Inspect the road system at regular intervals, especially after heavy rainfall, to detect problems and to schedule repairs.
- ✓ Clear debris from culverts, ditches, dips, and other drainage structures to decrease clogging that can lead to washouts. Place the debris where it cannot be washed back into these structures or into open water.
- ✓ Keep traffic to a minimum during wet periods and spring breakup, to help reduce maintenance needs.
- ✓ Shape road surfaces periodically to maintain proper surface drainage. Fill in ruts and holes with gravel or compacted fill as soon as possible to reduce erosion potential.
- ✓ Remove berms along the edge of the road if they will trap water on the road.
- ✓ When dust control agents are used, apply them in a manner that will keep these compounds from entering lakes, streams and groundwater. Consult a qualified road engineer from the County Highway Commissioner's Office or Wisconsin Department of Transportation for assistance in selecting the appropriate chemicals and amounts. Note: It's illegal to spread oil on roads, land or water in Wisconsin.

Figure 10-28: Maintaining woods roads helps prevent erosion. This grader is properly crowning the road so that water runs off properly (photo courtesy of the Wisconsin DNR).

#### **INACTIVE ROADS**

When forest roads are inactive for extended periods, closing the system will help to protect the road surface and the water quality protection structures. Consider erecting a barrier to traffic such as a gate or berm, and post "Closed" signs at the entrance of temporarily closed roads. Stating the length of time and/or reason for closure, and inviting acceptable uses may be helpful to assure compliance.

- ✓ Remove all temporary drainage and stream crossing structures.
- ✓ Shape all road system surfaces to maintain proper surface drainage, if necessary.
- ✓ Install waterbars where necessary (see Chapter 10: Forest Roads: Waterbars, page 128 and follow the recommendations in Table 10-1 on page 125).
- ✓ Inspect and maintain road surfaces, permanent drainage and stream-crossing structures (ditches, culverts, bridges, etc.) to minimize erosion.



### CHAPTER 13 — PESTICIDE USE

|      | Considerations  | 156 |    |
|------|---|-----|----|
| Plan | ning  | 1   | 56 |
|      | Incorporating Integrated Pest Management Strategies                         | 156 |    |
|      | Characteristics Affecting Ground and Surface Water Contamination Potential. | 157 |    |
|      | Selecting Pesticides  | 158 |    |
|      | Selecting Application Methods   | 159 |    |
|      | Emergency Planning and Community Right-to-Know                              | 160 |    |
|      | Spill Response  | 160 |    |
|      | BMP: Spill Response   | 160 |    |
| Ope  | rational Considerations   | 1   | 61 |
|      | Transportation of Pesticides  | 161 |    |
|      | Storage of Pesticides   | 161 |    |
|      | Mixing and Loading Operations   | 162 |    |
|      | BMP: Mixing and Loading Operations  | 162 |    |
|      | Pre-Application Activities  | 162 |    |
|      | Timing and Weather Considerations   | 163 |    |
|      | BMP: Timing & Weather Considerations  | 163 |    |
|      | Applying Pesticides   | 164 |    |
|      | BMPs: Applying Pesticides   | 164 |    |
|      | Protecting Water Resources  | 165 |    |
|      | BMPs: Protecting Water Resources  | 165 |    |
| Post | -Operational Considerations   | 1   | 66 |
|      | Equipment Clean-up  | 166 |    |
|      | BMP: Equipment Clean-up   | 166 |    |
|      | Container and Waste Disposal  | 166 |    |
|      | BMPs: Container and Waste Disposal  | 166 |    |

The purpose of a pesticide application is to assist in meeting forest management, utility and rights-of-way objectives by promoting the establishment, survival, growth or maintenance of a desired species or condition through the use of chemical compounds or biological agents that control undesirable plants, animals, insects or diseases.

#### Considerations

 Planning is the essential first step in reducing pest problems. Maintaining water quality and

- protecting other resources is an important consideration in all aspects of pesticide operation planning.
- The effective treatment time for most pesticides is during the active growing season, which corresponds with the summer tourist/recreational use season.
- Broadcast application methods for herbicides may have a greater visual quality impact than band or spot treatment methods.

#### **PLANNING**

## Incorporating Integrated Pest Management Strategies

• Employ integrated pest management (IPM) strategies.

IPM can be defined as an ecological approach to pest management in which all available necessary techniques are combined into a unified program. The goal is to manage pest populations in a way that avoids economic or aesthetic damage and minimizes the adverse side effects.

Pesticide use should be considered as part of an overall program to control pest problems. Integrated pest management strategies have been developed to control forest pests without relying solely on chemical pesticides.

These strategies incorporate a balanced combination of chemical, biological and cultural activities to control forest pests.

A good IPM program has five steps:

- 1. Detect and Identify problems.
- 2. Research the biology of the pest.
- 3. Determine whether or not the injury caused by the pest is significant, biologically or economically and whether or not a pesticide application is economically valid.



Figure 13-1: A spray plane equipped with special wing-mounted hoppers for dispensing Phermone Flakes mixed with glue to control the spread of Gypsy Moths.

- Select tactics.
- 5. Evaluate the program.

For sources of information on IPM programs, see Resource Directory.

#### Characteristics Affecting Ground and Surface Water Contamination Potential The three main pesticide characteristics that can greatly affect a pesticide's potential to contaminate surface or ground water are solubility, adsorption and half-life.

- Solubility is the ability of a pesticide to dissolve in water. The greater the solubility, the greater the chance that the pesticide will leach to ground water or move in solution in surface water.
   Pesticides with very low water solubility's tend to remain at the soil surface and potentially move to surface water attached to sediment carried in runoff.
- Adsorption is the inherent ability of a pesticide to attach to soil particles. Some pesticides stick very tightly to soil, while others are easily dislodged:
  - The greater a pesticide's ability to adsorb to soil particles, the less the potential for that pesticide to move (except by soil erosion in surface runoff).
  - Conversely, the lower a pesticide's ability to adsorb to soil particles, the greater the potential for that pesticide to leach to ground water or move in solution in surface runoff.

Adsorption increases as soil organic matter increases. An index or measure of soil adsorption is expressed by the Koc value.

 Half-life is the time it takes for a pesticide in soil to be degraded so its concentration decreases

- by one-half. Each pesticide will have successive half-lives that will continually decrease concentrations by one-half.
- The persistence of the pesticide in soil is the time it takes for the pesticide to degrade to the point where it's no longer active. Pesticides that do not break down quickly can be a hazard if they move to ground water or surface water in toxic forms.

There are also soil and site characteristics that influence whether or not a pesticide will reach groundwater or surface water.

- Soils that are deep, high in organic matter, medium to fine textured (silty or clayey) and structurally sound are relatively good at "capturing" pesticides until they can be broken down by microbial activity. In general, the greater the depth to ground water, the more the filtering action of the soil.
- Soils that are shallow (less than 20"), very coarse (sandy or gravelly) or drought-prone, are more likely to leach pesticides. Soils that are crusted or compacted are more likely to encourage pesticide run-off in surface water. A shallow depth to ground water with highly permeable soils will also increase the chances of pesticide movement into groundwater. Surface water contamination can easily occur when pesticides are applied to sites adjacent to lakes, streams, wetlands and natural drainage ways. If there is a quick conduit from the surface to the water table, such as a sinkhole, pesticides can be washed directly into the groundwater.



Figure 13-2: A handful of Phermone Flakes used for Gypsy Moth control instead of a chemical pesticide.



Figure 13-3: Exercise caution when mixing and loading pesticides into the spraying tank. Carefully measure the required amount in accordance with the pesticide label.

#### Selecting Pesticides

When the decision is made to use pesticides, choose products suitable for use on the target species and registered for the intended uses.

- Use only pesticides registered by the U.S. Environmental Protection Agency and the Wisconsin Department of Agriculture, Trade and Consumer Protection.
- Read and follow all label directions carefully prior to using any pesticide.
- Maintain current labels and Material Safety Data Sheets (MSDS). The MSDS is a source of cautionary information and data.
- Evaluate other factors besides effectiveness and cost when selecting among pesticide options.
   Factors that influence potential impacts on water quality and other forest resources include site characteristics, pesticide characteristics, application conditions, delivery systems and application techniques.
- Select only pesticides labeled for aquatic use on sites where surface water is present at the time of application.
- Select pesticides, application methods, equipment and formulations that:
  - Avoid the potential for pesticide drift.
  - Avoid pesticide residue movement to surface water and ground water.

### Selecting Application Methods

- Choosing the proper application method will help ensure the target organism is affected and help prevent drift, non-uniform coverage and exposure to non-target organisms. There are several application methods including but not limited to broadcast, directed spray, foliar, foliar and stem, basal, cut-stump, frill and hatchet injection, spot and soil application, injection or incorporation. Your choice should be based on careful consideration of the nature and habits of the target organism, the site, pesticide chosen, available equipment and cost and efficiency.
   As mentioned previously, drift, surface and ground water contamination must be avoided.
- Design chemical treatments of regenerating stands to protect reserve areas and structural habitat components retained in previous stand treatments.

- Promote protection or growth of mast species and browse by employing chemical site preparation methods that target pesticide application (low intensity, spot, band) in preference to broadcast applications.
   Regenerating oak, an important mast species, may warrant more liberal application.
- Use pesticide application equipment that minimizes soil disturbance.
- Consider non-broadcast application of pesticides where appropriate.
- If pesticides must be applied to sites containing endangered, threatened or special concern species (ETS species), select pesticides, application methods, equipment and formulations to protect those species.





Figure 13-4 and 13-5: Aerial views, in late June, of Forest Tent Caterpillar defoliation of primarily aspen trees in northern Wisconsin.

### REDUCING VISUAL IMPACTS OF TREATED VEGETATION

- Favor non-herbicide treatment methods.
- Favor band treatment or spot treatment over broadcast treatment.
- Leave untreated or selectively treated areas adjacent to travel routes and recreation areas.
- Favor late-season or dormant-season herbicides.
- Use methods of application consistent with integrated resource management principles.

## Emergency Planning and Community Right-To-Know

The federal Emergency Planning and Community Right-To-Know Act and the Wisconsin Superfund Amendments and Reauthorization Act (SARA) provide guidance for communities to prepare responses to accidental releases of chemicals listed as extremely hazardous substances. OSHA and SARA maintain lists of substances considered extremely hazardous. Some pesticides appear on these lists.

The EPA also prepared a list of extremely hazardous substances and their threshold planning quantities (TPQs). If you use or store any listed substance in a quantity at or greater than its TPQ at any one time, you must contact the State Emergency Response Board and your local emergency planning committee. The local committee should assist you in preparing a facility site plan. Employers who are subject to OSHA's Right-To-Know law are also subject to community right-to-know reporting requirements.

For a complete list of extremely hazardous substances of for more information regarding the Emergency Planning and Community Right-to-Know Act, contact the State Emergency Response Board at (608) 242-3232.

#### Spill Response

A spill is a release of compound into the environment, including air, water, soil etc. in any manner other than its intended use.

Forestry pesticides that are spilled can enter surface water or ground water. Spills near or in geologically sensitive areas have a high probability of a portion of the spill reaching ground water.

#### **BMP: SPILL RESPONSE**

- ✓ Maintain a spill containment and clean-up kit appropriate for the materials on the operation and report all spills. For general guidelines, see Chapter 9: General Operational Guidelines, Spills, page 113.
- Contact the Wisconsin DNR Duty Officer whenever a spill occurs at 1-800-943-0003.
   Phones are answered 24 hours per day. When the phone is answered, press "1" for spills.
- Treat spills properly. Recommended steps include the following:
  - Act quickly.
  - Protect yourself.
  - Control the spill (stop the leak).
  - Contain the spill (keep it from spreading).
  - Guard the site.
  - Notify the authorities.
  - Clean up the spill.

#### OPERATIONAL CONSIDERATIONS

 Conduct on-site meetings with the contractor, landowner and resource manager prior to moving equipment onto a site. Such meetings can help assure common understanding of landowner objectives, contract specifications and site conditions.

Proper pesticide management practices make efficient use of chemicals while preventing or minimizing impacts on surface water, ground water and other forest resources. Residues of pesticides used in forestry can affect these resources at any time – from transporting of pesticides to container and waste disposal.

Transportation of Pesticides
The federal Department of Transportation has
designated many chemical compounds, including
some pesticides active ingredients, as hazardous
materials. Special training is required to transport
hazardous materials. For questions on this topic,
contact the Wisconsin State Patrol office.

- The safest way to transport pesticides is secured in the back of a truck; never carry pesticides in the passenger compartment of any vehicle. Do not allow passengers or pet to ride in the back of the truck with the pesticide. Do not carry food, feed, seed, propagation material, or fertilizer with pesticides in the back of a vehicle.
- Inspect all containers prior to loading, and ensure that all caps, plugs and bungs are tightened.
- Wear the proper protective work clothes and chemical-resistant gloves even when handling unopened pesticide containers.
- Select transportation routes to minimize the impact of a potential spill on water quality.
- Never leave pesticides unattended.
- Keep the emergency number for reporting spills handy.

Storage of Pesticides
If you store pesticides, you must protect the secure
the area to keep out unauthorized people and
animals. Also, post signs that clearly indicate you
store pesticides in the building.

- Locate pesticide storage facilities at sites that minimize the possibility of impacts on water quality in case accidents or fires occur. Locate the facility down wind and down hill from sensitive areas such as houses, play areas and livestock facilities.
- Avoid storing pesticides on or adjacent to treatment areas.
- Where impractical, select unloading and operational storage locations where spills resulting from accidents or vandalism will not have impacts on water quality.
- Use storage buildings that have floors constructed of concrete or other impermeable materials, so that spills are easy to clean up. Storage buildings should contain drains or sills with sumps large enough to contain the contents of the largest container stored in the buildings. Insulate building to keep the temperature between 40°F and 100°F. Keep the area well ventilated by installing an electrically shielded, exhaust-type, ventilating fan.
- Store only pesticides and pesticide equipment on storage facility. Never store pesticides with food, feed or seed.
- Avoid storing pesticides for extended periods in buildings not equipped to contain a complete spill from the largest container being stored.

## Mixing and Loading Operations

# BMP: MIXING AND LOADING OPERATIONS

- ✓ Mix and load pesticides outside of riparian management zones and, where practical, in upland areas.
- Review the label before opening the container to ensure familiarity with current use directions.
- Exercise care and caution during mixing and loading of pesticides.
- Avoid mixing near wells or where pesticide spills could enter open water or wetlands.
- Transport and store hoses used to fill pesticide application equipment in a manner that prevents direct contact with pesticides, gasoline or oils, or surfaces on which these substances have been spilled.
- Fill equipment from water sources before introducing pesticides into mixing or application equipment.
- Replace pour caps and close bags or other containers immediately after use.
- Avoid leaving a spray or mix tank unattended while it's being filled.

- Provide an air gap between the water source and the mixture surface to prevent back-siphoning.
- Avoid filling pesticide mixing or application equipment directly from a public water supply unless the outlet from the public water supply is equipped with a backflow prevention device.
- Avoid filling pesticide mixing or application equipment directly from surface water unless the equipment contains proper and functioning anti-back-siphoning mechanisms.
- Triple rinse all empty plastic and metal pesticide containers and add the rinse water to the spray solution.

#### Pre-Application Activities

- Ensure that pesticide applicators are properly licensed in the appropriate category by the Wisconsin Department of Agriculture, Trade and Consumer Protection when a license is required. See the Resource Directory.
- Protect vegetation that is part of a cultural resource (such as historic homestead sites) if it will be impacted by herbicide applications.
- Mark the boundaries of the area for treatment.
- Refer to label directions before applying any and all pesticides.



Figure 13-6: Triple-rinse all containers and measuring cups, and add the rinse water to the spray solution.



Figure 13-7: Use only properly maintained spray equipment that has been checked for leaks. Make sure the nozzle type produces the largest drops at a given rate and pressure appropriate to the chemical being applied.

### Timing and Weather Considerations

# BMP: TIMING & WEATHER CONSIDERATIONS

- ✓ Apply chemicals only under favorable weather conditions.
- Avoid applying pesticides when the likelihood of significant drift exists.
- Use a drift control agent where appropriate.

- Consider applying pesticides near dawn or dusk, when wind speeds are generally lowest.
- Apply pesticides when wind speeds are six m.p.h. or less for aerial application and 10 m.p.h or less for ground broadcast application.
- Limit broadcast applications (both aerial and ground) to appropriate temperature and relative humidity conditions. High temperatures enhance loss of volatile pesticides and the rate of evaporation of droplets. Relative humidity also influences the rate of evaporation, with the rate increasing with decreases in humidity.

#### Applying Pesticides

## BMPs: A PPLYING PESTICIDES

- ✓ Prevent chemical leaks from equipment. Check all equipment for leaking hoses, connections and nozzles.
- ✓ Calibrate spray equipment to apply chemicals uniformly and in the correct quantities.
- ✓ Follow all EPA label instructions on containers.
- ✓ When conducting aerial applications:
  - Hire a licensed aerial applicator.
  - Identify and avoid riparian management zones and surface water to prevent chemicals not labeled for aquatic use from drifting over open water, or from accidentally being applied directly on the water.
- Applicator Certification/licensing Requirements: Pesticide Applicator Training (PAT), provided by the University of Wisconsin Extension, provides the training and certification to people who want to mix, load, supply or direct the use of restricted-use pesticides. Only a certified applicator may work with restricted use pesticides. Pesticide Applicator Training is also recommended for any person working with pesticides. Participation in this program, certification and licensing may be required for person's involved with pesticides, depending on the activities planned. Contact the Wisconsin Department of Agriculture, Trade and Consumer Protection (see the Resource Directory) to determine whether or not you need to be certified or licensed.

- Other Training Requirements: Employees covered by the Worker Protection Standards (other than members of an agricultural owner's immediate family) must be trained on general pesticide safety principles every five years. This training may be obtained through Pesticide Applicator Training or through training programs in compliance with the EPA.
- Select a nozzle type that produces the largest drops at a given rate and pressure appropriate to the chemical being applied.
- Employ the lowest reasonable equipment pressure when applying pesticides.
- Mix pesticides in upland areas, where practical.
- Avoid applying pesticides on small wetland inclusions in upland areas unless that application is part of the management objective. If unable to avoid pesticide use in these areas, select only pesticides labeled for aquatic use when surface water is present at the time of application.
- Avoid broadcast application methods within riparian management zones (RMZs). Appropriate treatments within RMZs include:
  - Use of pesticides labeled for aquatic use.
  - Manual or mechanical treatments.
  - No treatment.
  - Spot, banded, stump, basal bark, hack and squirt, frill, or injection treatments.
  - Use of less soil-mobile pesticides
  - Increasing filter strip width when using toxic to highly toxic insecticides.

#### **Protecting Water Resources**

# BMPs: PROTECTING WATER RESOURCES

- ✓ Use chemicals in riparian management zones with guidance from a trained natural resource professional.
- ✓ When applying chemicals not labeled for aquatic use in riparian management zones, use spot-injection or stump treatment methods.
- ✓ Avoid applying herbicides in areas where the chemicals can kill stabilizing vegetation on slopes, gullies and other fragile areas subject of erosion that drain into surface water.
- Avoid applying pesticides directly to water except where specifically labeled for application to water. For pesticides not labeled for aquatic or ditch/bank use, avoid riparian management zones, filter strips or shade strips and other reserve areas adjacent to all streams, lakes, wetlands and ditches that contain water at the time of application.
- Prohibit aircraft that are transporting pesticides from crossing open water where practical. Aircraft also should not fly down the course of any recognizable stream. Where stream crossings cannot be avoided, they should be made at right angles to the stream course. Chemical application should be shut off during turns and over water.



Figure 13-8: Apply chemicals with the right equipment during calm weather to avoid unwanted drift. Band or spot applications, such as the operator above is doing in a walnut plantation, are preferred to broadcast spraying.

- Select potential heliport or helipad locations with consideration for two conditions that could affect water quality:
  - Flight patterns in relation to water bodies; and
  - Locations adjacent to water bodies.

#### POST-OPERATIONAL ACTIVITIES

#### Equipment Clean-up

# BMP: EQUIPMENT CLEAN-UP

- ✓ Rinse spray equipment and discharge rinse water only in areas that are part of the application site.
- Avoid cleaning pesticide application equipment in surface waters.
- Clean equipment in areas where pesticide residues will not enter streams, lakes, wetlands, or ground water.
- Clean all mixing and loading equipment thoroughly after each use.
- Rinse mixing apparatus at least three times.
- Apply rinsate in spray form to the area to be treated.

#### Container and Waste Disposal

- Rinse all empty plastic and metal pesticide containers three times, and add the rinse water to the spray solution. To properly triple-rinse containers, follow these instructions below:
  - Empty the pesticide into the spray tank and allow the pesticide container to drain.
  - Fill the container 10 to 20 percent full with water (or solvent, in some cases), rinse, and pour the rinse water into the spray tank.
  - Repeat the above step two more times and apply rinsate to the spray site.
  - Apply all leftover solutions and rinsates to the treatment area.

- Puncture and flatten containers not intended for return to the manufacturer.
- Dispose of triple-rinsed containers in one of four ways:
  - Return them to the dealer for reuse or refilling.
  - Recycle them through the Wisconsin Fertilizer and Chemical Association Plastic Pesticide Container Recycling Program.
  - Bring them to a county Pesticide Clean Sweep program.
  - Dispose of them at an approved landfill.

### It's illegal to bury or burn any pesticide containers in Wisconsin.

 Refer to the product label for additional information on proper disposal.

# BMP: CONTAINER AND WASTE DISPOSAL

✓ Dispose of pesticide wastes and containers according to state and federal laws. Some pesticide wastes are specifically identified as hazardous wastes by law; these must be handled and disposed of in accordance with hazardous waste regulations. For sources of information about proper management of waste pesticides, see the Resource Directory.

### CHAPTER 12 — MECHANICAL SITE PREPARATION

| Cor    | nsiderations                      | 150 |    |
|--------|-----------------------------------|-----|----|
| Planni | ng                                | 1!  | 52 |
| Pla    | nning and Design Considerations   | 152 |    |
| Tim    | ning and Intensity of Activities  | 152 |    |
| Sel    | ecting Application Methods        | 153 |    |
| BM     | IP: Selecting Application Methods | 153 |    |
| Operat | tional Considerations             | 1!  | 54 |
| Ма     | naging Slash and Windrows         | 154 |    |
| Pro    | otecting Resources                | 154 |    |
| BM     | IPs: Protecting Resources         | 154 |    |
| Post-O | perational Activities             | 1!  | 54 |

Site preparation is the practice of altering site conditions to favor the establishment, survival and growth of a desired tree species, browse or other vegetation. Site preparation can be accomplished through mechanical means, prescribed fire, the use of herbicides, or any combination of these approaches.

Mechanical site preparation accomplishes two goals:

- It facilitates planting, direct seeding and natural regeneration.
- It provides partial initial control of vegetation competing with crop trees for light, water and nutrients.

Common mechanical site preparation techniques include patch scarification, row scarification, raking, disking, bedding, roller chopping and shearing. Herbicides are often applied in conjunction with mechanical site preparation, to increase control of competing vegetation.

The guidelines in this section focus on mechanical site preparation. For chemical use in mechanical site preparation method, refer to the guidelines in Chapter 13: Pesticide Use, page 155. For prescribed burning, refer to the guidelines in Chapter 16: Fire Management, page 175.

#### Considerations

 Maintaining good soil condition is critical to accomplishing the goals of site preparation (to favor the establishment, survival and growth of a desired tree species). Practices that result in excessive exposure of mineral soil, compaction or rutting of soil, or removal of surface soil should be avoided. If soils are negatively impacted in the process of site preparation, then the "advantage" of the site preparation is reduced either through poor establishment, poor survival or, more often, lowered growth and productivity.

- Properly planned harvest operations should include consideration of mechanical site preparation needs. Site preparation methods that minimize the potential for surface erosion should be evaluated prior to implementation of site preparation operations.
- Selecting the appropriate technique, intensity and timing of a site preparation activity is important in maintaining the soil productivity of a site. Heavy equipment should be operated on a site when adverse soil impacts are unlikely.



Figure 12-1: A two-row Bracke Scarifier that is towed behind a prime mover to prepare planting scalps in a recently logged area (photo courtesy of Kemp Station).



Figure 12-2: Close-up of a Bracke Scarifier working in pine slash. The machine removes soil only from the small areas where seedlings will be planted (photo courtesy of Kemp Station).



Figure 12-3: Scarified patches by a Bracke Scarifier in a cutover stand. Patch or row scarification reduces competition for the new seedlings, yet has a low impact on the planting site (photo courtesy of Kemp Station).

- Mechanical site preparation techniques and intensity for a given site should be determined by soil/site conditions, the silvicultural requirements of the tree species to be regenerated, and site preparation objectives. Specific site conditions (including soil characteristics, topography, vegetation, access and distance to surface water) dictate what techniques may work best or provide the best operating window for any given site.
   Some sites may be planted with no site preparation other than removing the overstory.
- Practices that result in exposure of mineral soil or soil compaction on erodible slopes should not be used where surface erosion or runoff is likely to result in sedimentation of water or wetlands.
   For sources of information and planning assistance, see the Resource Directory.

- Activities that disturb soil such as disking, scarification, rock raking and shearing, may not be appropriate within cultural resource areas.
- Contour preparation methods can minimize erosion, as well as the cost of remedial action or repair.
- Site preparation methods vary considerably, depending on the desired regeneration species.
- Every site preparation method has a different cost. For any method being considered, costs (both short- and long-term) should be balanced against effectiveness of the method in attaining visual quality objectives.
- Composition and condition of the original stand can impact the regeneration method chosen for a particular site.

### DESIGN OUTCOMES TO MAINTAIN SOIL PRODUCTIVITY

Site preparation activities should be designed and implemented to achieve the following beneficial outcomes regarding soil productivity:

- Soil in a condition that favors the establishment, survival and long-term growth of the desired tree species.
- Displacement of only enough soil as needed to effectively accomplish tree establishment.
- Site preparation techniques employed so surface soils: 1) remain intact; 2) are only displaced a short distance (such as in scalping); or 3) are incorporated (such as in disking).
- Slash dispersed on the site, rather than piled or windrowed, where appropriate.
- Site preparation practices employed so they avoid funneling water (such as furrowing, scarification and scalping on the contour).

#### **PLANNING**



Figure 12-4: A two-row Leno Scarifier set up to create scarified patches in a jack pine clearcut. This approach causes minimal site disturbance, yet provides exposed soil for ideal planting conditions (photo courtesy of Kemp Station).

#### Planning and Design Considerations

- Consider alternative methods of site preparation, such as non-mechanical, or combinations of mechanical and non-mechanical methods, to accomplish site preparation goals while minimizing disturbance.
- Design mechanical treatments of regenerating stands to protect reserve areas and structural habitat components retained in previous stand treatments.
- Favor practices that do not remove surface soils or only remove surface soils from the small areas in which an individual seedling will be planted.
- Favor practices that allow for dispersed slash or slash in small piles on the site, rather than piling or windrowing, in situations where residual slash does not conflict with management objectives or reforestation.



Figure 12-5: A Leno Scarifier that is mounted directly to the prime mover, allowing the operator to turn the machine easier in tight quarters (photo courtesy of Kemp Station).

- Select appropriate species and stocking levels for reforestation, and plan site preparation intensity accordingly.
- Plan for a diversity of tree species where possible.
- Design practices to avoid direct runoff of sediment into water and wetlands.

## Timing and Intensity of Activities

- Enter a site the fewest number of times necessary, and avoid multiple passes of equipment over the same spot.
- Time site preparation activities and use proper equipment to minimize rutting and compaction of soils.
- Avoid shearing and raking operations on organic soils except under frozen conditions.

### REDUCING VISUAL IMPACTS OF MECHANICAL SITE PREPARATION

- Use low-impact site preparation methods, such as patch or row scarification.
- Use spot or strip treatment of herbicides rather than broadcast treatment applications.
- Initiate revegetation efforts as soon as possible.
- Use land contours in site preparations.
- Avoid the effect of linear straight rows and resulting visual penetration immediately alongside travel routes or recreation areas.
- Avoid or screen windrows and slash piles.

## Selecting Application Methods

Common site preparation techniques include scarifying, shearing, raking, disking and roller chopping. Select a technique based on specific site characteristics including soil, topography, vegetation, access and distance to surface waters. Prescribed burning and herbicides are also used for site preparation; BMPs for these management tools are listed in Chapter 13: Pesticide Use, page 155, and Chapter 16: Fire Management, page 175.

# BMP: SELECTING A PPLICATION METHODS

- ✓ Use patch or row scarification as the preferred mechanical site preparation method for artificial regeneration when terrain or soil type necessitates minimal soil disturbance.
- To increase success of oak regeneration, use such pre-and post-harvest techniques as burning, stump sprout thinning or scarification.

- Consider targeted mechanical site preparation methods (low intensity, spot or band) in preference to broadcast applications.
   Regenerating oak, an important mast species, may warrant more liberal application.
- Use equipment that minimizes soil disturbance when moving slash on-site.



Figure 12-6: Close-up of a TTS 35-disc trencher that is used for row scarification in cutover areas prior to tree planting (photo courtesy of Kemp Station).



Figure 12-7: A Marden Duplex Roller Chopper provides area site preparation, crushing logging slash over the entire cutover area (photo courtesy of Kemp Station).

#### OPERATIONAL CONSIDERATIONS

 Conduct on-site meetings with the contractor, landowner and resource manager prior to moving equipment onto a site. Such meetings can help assure an understanding of landowner objectives, contract specifications and site conditions.

#### Managing Slash and Windrows

- Where shearing or windrowing slash is necessary avoid scraping soil material or forest floor into windrows or piles. Preferred practices include:
  - Shearing and raking under frozen conditions
  - Light raking, which only removes slash
- Avoid placing residues into wetland areas from operations on upland sites. Deposit residues in stable upland locations.

- Locate windrows and slash disposal piles to:
  - Avoid cultural resources.
  - Minimize interference with natural drainage patterns.
  - Be outside of riparian management zones. Refer to Chapter 5: Riparian Management Zones and Wetlands, page 73.
  - Follow contours when possible to mitigate the effects of overland flow.

#### Protecting Resources

- Scarify or trench only the area necessary for seedling establishment and growth.
- Avoid operations during periods of saturated soil conditions when such operations may cause rutting, compaction or accelerated erosion.

#### BMPs: PROTECTING RESOURCES

- ✓ Operate mechanical site preparation and tree planting equipment on the contour where necessary to minimize erosion in waterbodies.
- ✓ Avoid operating mechanical site preparation and tree planting equipment on slopes greater than 30 percent where the slopes drain directly into a waterbody.
- ✓ Minimize raking in areas, or under conditions, in which soil could erode and enter waterbodies. Two preferred practices are: (a) shearing and raking when soil is frozen and (b) raking lightly to remove slash only.
- ✓ Suspend operations during wet periods if equipment begins to cause excessive soil disturbance that will increase erosion into waterbodies.
- ✓ Deposit site preparation residues in stable locations outside riparian management zones.
- ✓ Use patch scarification or low-intensity prescribed burns on sites that have steep slopes, erodible soils or saturated soils, and on sites that drain to surface water.

#### POST-OPERATIONAL ACTIVITIES

- Regenerate the site quickly after site preparation.
- Evaluate site preparation methods relative to site conditions and silvicultural prescriptions. Be sure to monitor and manage the site to ensure success of establishment and decrease of operation repeat.
- Site preparation prepares land for planting, direct seeding and/or natural regeneration. Using heavy machinery to accomplish this often exposes soil.
   Proceed carefully to avoid impacts on water quality.

### CHAPTER 11 — TIMBER HARVESTING

| Considerations                                | 134 |
|---|-----|
| Protecting Soil and Water Resources           | 134 |
| Visual Impacts                                | 135 |
| Managing Slash                                | 135 |
| Landings                                      | 136 |
| Snags   | 136 |
| Planning and Design                           | 137 |
| BMP: Planning and Design                      | 137 |
| Operational Activities                        | 140 |
| BMPs: Protecting Sensitive Areas              | 140 |
| BMPs: Landings                                | 140 |
| BMPs: Skid Trails                             | 141 |
| BMPs: Stream Crossings for Skidding           | 141 |
| Minimizing Rutting                            | 142 |
| BMP: Rutting                                  | 142 |
| Managing Slash                                | 142 |
| BMP: Slash                                    | 142 |
| Water Quality and Wetlands                    | 142 |
| Snags (Standing Dead Trees)                   | 142 |
| Leave Trees (Live Trees)                      | 143 |
| Providing Coarse Woody Debris                 | 144 |
| The Timber Sale Contract                      | 145 |
| Understanding the Sample Timber Sale Contract | 146 |
| Post-operational Activities                   | 148 |

#### CONSIDERATIONS

Timber harvesting involves planning harvest and reforestation; cutting trees and moving them to a landing; processing, sorting and loading; and transporting materials.

### Protecting Soil and Water Resources

- Appropriate reforestation goals should be considered before beginning harvest activity.
   The plan should include site preparation techniques, if needed, and species selection prior to harvest. It may include natural regeneration of existing species.
- Special soil conditions and topographic features make some areas of the state more sensitive than others to soil disturbance. Two primary examples of these localized sensitive areas are the red clay soils along Lake Superior, and the steep slopes in the driftless area in southwestern Wisconsin.
- When working in areas with special soil conditions and topographic features that make them more sensitive to disturbance than others, the landowner, resource manager or operator needs to increase the intensity of planning compared to other forested regions of the state. Planning should address long-term development and maintenance needs.
- Soil impacts can be minimized by limiting the soil area impacted by infrastructure (roads, landings and primary skid trails), and by careful consideration of timing, equipment being used, and harvesting methods. Planning considerations include carefully determining appropriate operating seasons for any given soil, as well as using harvest layouts, strategies and equipment that minimize the surface area of a site that is trafficked.

- Appropriate timber harvesting strategies and practices can be employed to ensure that timber harvesting practices do not reduce the productive capacity of forest soils through removal of nutrients or disruptions of nutrient cycles. On most Wisconsin forest soils, nutrient removal through harvest is not a concern. However, guidelines should be applied in specific situations and site conditions, with the goal of balancing the level of nutrients removed through timber harvest with natural nutrient inputs.
- Susceptibility to compaction and rutting on wetlands is dependent on several factors, including level of equipment trafficking, type of equipment used, soil type (mineral soil or peatland), soil water content at the time the silvicultural activity is conducted, and season of activity. In general for mineral soil wetlands, compaction and rutting increase as soil texture becomes finer and soil water content increases. In unfrozen peatland, deep rutting can bring muck to the surface and block normal water flow.
- Wetlands are highly productive sites for a variety of ecological functions, as well as for the enhancement of water quality. All forest management operations in or adjacent to wetlands should be planned and conducted in a manner that protects these functions.
- Using appropriate forest management guidelines for harvesting activities minimizes the potential for sediment, chemical, nutrient, and debris movement into streams, lakes, wetlands, seasonal ponds, and ground water. Guidelines also minimize thermal (heating) impacts on surface waters.
- Employing loggers who have been trained in guideline implementation can aid in proper and efficient application of site-level timber harvesting guidelines.

### DESIGN OUTCOMES TO MAINTAIN SOIL PRODUCTIVITY

Timber harvesting should be designed and conducted to achieve the following beneficial outcomes regarding soil productivity:

- Soil in a condition that favors regeneration and growth of native vegetation and trees.
- No more than one to three percent of the timber harvest area occupied by roads and landings (small or irregularly shaped units may result in higher percentages).
- No more than 10 to 15 percent of the timber harvest area occupied by primary skid trails, with access to the rest of the site (one to two pass trails) occupying no more than an additional 20 to 30 percent of the area (small or irregularly shaped units may result in higher percentages).
- Minimal rutting in primary skid trails, roads and landings; and avoidance of rutting in the general harvest area.
- Minimal change to the hydrologic condition of the site.
- Minimal loss of nutrients on nutrient-sensitive site.
- Bare soil areas stabilized from surface erosion, with soil erosion control measures properly applied and functional on skid trails, roads and landings.



Figure 11-1: Periodic mowing may be necessary to maintain old landings in permanent grass cover.

#### Visual Impacts

- Travel speed affects the apparent field of vision and the observation time, which impact the users' levels of concern.
- Type of harvest (clearcut vs. partial cut, for example) affects user perception of apparent size.
- Stand condition and health should be considered along with visual impacts.
- The length of the regeneration/reforestation period following the harvest should also be considered when evaluating potential visual impacts.
- Proximity to recreational use areas results in enhanced user concerns regarding apparent size of harvest.

#### Managing Slash

- Slash is unavoidable when timber harvesting.
   Slash management plans should be developed prior to beginning the harvest and spelled out in the harvesting contract.
- · Slash treatment has a definite cost.
- Slash near streams, lakes and wetlands is subject to special regulation.
- Slash provides soil nutrients.



Figure 11-2: A skid trail during active timber harvesting.



- Size and number of landings are affected by species, products developed, size of sale and timber sale design.
- Topography can limit both placement and number of landings.
- Proximity of harvest to travel routes or use areas can affect placement of landings.
- Proposed future use of landing area (as a parking area along a recreational trail or as a wildlife opening, for example) can affect size and placement of landing.
- Landing treatment practices may result in saving or adding costs, or may not change any costs.



Figure 11-3: A skid trail seeded to grass following the timber harvest.

#### Snags

- Snags represent a potential safety hazard for logging operations.
- Snags may increase potential risk of lightning fires.
- Snags enhance the quality of wildlife habitats, providing nesting, denning, feeding and roosting sites, as well as escape areas.
- Snags may increase insect and disease problems for regeneration of a new stand.

#### PLANNING AND DESIGN

 Consider water quality concerns as management objectives are established:

# BMP: PLANNING AND DESIGN

- ✓ Limit the length and number of skid trails, and the number of landings and stream crossings to the minimum necessary to conduct the harvest operation and meet the landowners objectives.
- Include provisions for water protection in the timber sale contract.
- Avoid building landings, skid trails and roads in wetlands.
- Consider soil or site conditions that may dictate specific timing, harvest methods or equipment to be used, or that may lead to weather-related or seasonal closure of the operation.
- When designing timber sales (including layout, size and shape):
  - Consider and incorporate forest management goals, harvesting efficiencies and site impacts.
  - Use natural features and avoid artificial patterns where possible. These natural features may correspond to changes in topography, soils, wetland interfaces and timber types.
- If practical and feasible, protect cultural resource areas:
  - Exclude cultural resource areas from timber sale area.
  - Keep roads, skid trails and landings away from cultural resource areas.
- Plan progressive harvesting techniques that avoid trafficking over pre-cut areas when possible.

- Mimic natural disturbance by leaving some live trees, snags and reserve patches in clearcut harvest areas. Consider leaving fingers and fire shadow areas next to wetlands in fire-dependent forest types (see Figure 11-5 page 138, and Chapter 11: Timber Harvesting: Snags and Leave Trees, pages 142 and 143).
- Create a variety of patch sizes within all selection harvests.
- Consider maintaining the diversity of mast sources on the site, as well as some level of current production of mast sources. For example, maintain landings as openings or avoid machinery operation in pockets of fruit-producing shrubs.

## REDUCING VISUAL IMPACTS OF APPARENT HARVEST SIZE

- Leave patches of trees to break up the harvest area.
- Create narrow openings into harvest area to limit view from public roads, lakes and rivers, or recreation areas.
- Utilize natural terrain.
- Shape clearcuts to look more like natural openings where ownership patterns allow.
- Adjust contiguous linear feet of harvest frontage along travel routes relative to travel speed.
- Consider multiple-stage cuts or other management methods such as shelterwood and selective harvesting.



Figure 11-4: This clearcut with a few scattered residual trees is similar in appearance to a seed tree harvest; however, in this case the larger red pine were left to improve the visual impact.



Figure 11-5: The residual trees in this clearcut were left in clumps ("islands" and "fingers") to provide better wildlife cover and travel corridors than would scattered trees.





Figure 11-6 and 11-7: In this jack pine clearcut, seen from both air and ground, residual trees were left in both clumps and as scattered individuals. Such an approach maintains good wildlife habitat and reduces the visual impact of the harvest.





Figure 11-8 Figure 11-9

**Note:** Figures 11-8 through 11-10 are aerial views of part of the Northern Highland State Forest where aesthetic management guidelines have been applied for many years. These mosaics of stands with different species, age classes, densities, and shapes demonstrate how negative visual impacts of timber harvesting can be mitigated.



Figure 11-10



Figure 11-11: A ground-level photo taken in the lower right corner of Figure 11-8. Several timber harvests followed by successful regeneration has produced a variety of forest conditions. In this case, aspen and oak sprouts in the foreground with two age classes of red and jack pine in the background.

#### OPERATIONAL ACTIVITIES

- Conduct on-site meetings with the logger, landowner and resource manager prior to moving equipment onto a site. Such meetings can help assure common understanding of landowner objectives, timber harvest specifications and site conditions.
- If harvest will take place in the area of a cultural resource, employ measures to reduce soil disturbance, including (but not limited to) hand felling, limited-area feller buncher, low ground pressure (LGP) equipment, cut-to-length systems, and temporary protection such as slash, corduroy, tire mats or fill over geotextile.

## BMPs: PROTECTING SENSITIVE AREAS

- ✓ Avoid operating equipment where excessive soil compaction and rutting may cause erosion that affects water quality. The use of low ground pressure equipment may allow operations to continue.
- ✓ Whenever possible, winch logs from steep slopes, if conventional skidding could cause erosion that affects water quality.
- ✓ When harvesting near streams or lakes, follow BMPs for water quality (see Chapter 5: Riparian Management Zones, page 73).
- ✓ Inspect soil-stabilization practices periodically, during and immediately after, harvest operations to insure they are successful and remain functional. Follow BMPs in the Road Maintenance section, Chapter 10: Forest Roads, page 132).
- ✓ For winter harvesting, mark stream channels and existing culvert locations before snowfall.



Figure 11-12: Conduct on-site meetings with logger, landowner and resource manager prior to moving equipment onto a site. Such meetings can help assure common understanding of landowner objectives, timber harvesting regulations, contract specifications and site conditions.

#### **BMPs: LANDINGS**

- ✓ Locate landings outside riparian management zones.
- ✓ Locate landings on frozen ground or firm well-drained soils with a slight slope, or on ground shaped to promote efficient drainage. Landings may need a crown shape to allow for drainage.
- ✓ Use existing landings if possible. Close existing landings in riparian management zones unless construction of new landings will cause greater harm to water quality than using existing landings.
- ✓Locate residue piles (sawdust, field chipping residue, etc.) away from drainages where runoff may wash residue into streams, lakes or wetlands.

#### REDUCING VISUAL IMPACTS OF LANDINGS

- When possible, avoid landings within view of travel routes or recreation areas. If it's not possible to avoid landings within these areas, screen landings from view as long as possible during logging.
- Keep the number of landings to a minimum, and plan them to access future sales.
- · Seed, plant and regenerate landings promptly.

- Remove all products promptly when development of visible landings is necessary.
- Dispose of grubbed stumps and trees so as not to be visible.
- Treat any slash at landings as soon as possible.
- Remove all trash upon completion of harvesting.

#### BMPs: SKID TRAILS

Skid trail restrictions in riparian management zones are described in Chapter 5: Riparian Management Zones).

✓ Where possible, keep skid trail grades less than 15 percent. Where steep grades are unavoidable, break the grade, install drainage structures, and use soil-stabilization practices (as described in Chapter 10: Forest Roads) where needed to minimize runoff and erosion. Grades greater than 15 percent should not exceed 300 feet in length.

✓ Use existing trails if they provide the best long-term access. Consider relocating existing trails if both access and environmental impact can be improved.

### BMPs: STREAM CROSSINGS FOR SKIDDING

- ✓ For skidding across streams, use permanent crossings as described in Chapter 10: Forest Roads: General BMPs for Stream Crossings section, or use temporary crossings such as pole fords and frozen fords.
  - Pole fords may be used in small streams by placing poles (or small logs) side by side on the streambed. Pole fords must be removed immediately after use or before the upstream end becomes clogged with debris and impedes streamflow (see Figure 11-13).
  - Frozen fords are used in small streams when ice is thick enough, or the streambed is frozen enough, to protect the streambed.

**Reminder:** Stream crossing permits are required before installing a crossing on any intermittent or perennial navigable stream.

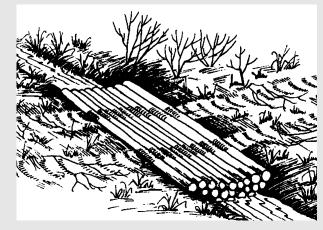


Figure 11-13: Pole ford for small stream crossing. Pole fords must be removed immediately after use or before the upstream end becomes clogged with debris and impedes streamflow. (Adapted from Vermont Department of Forests, Parks and Recreation, 1987.)

#### Minimizing Rutting

#### **BMP: RUTTING**

- ✓ Fill in ruts, apply seed and mulch, and install sediment-control structures and drainage structures on skid trails and landings where needed to prevent erosion and sedimentation into surface waters (see Chapter 10: Forest Roads: Drainage Structures, page 125).
- Minimize rutting in primary skid trails, roads and landings; and avoid rutting in the general harvest area.
- If alternative operating techniques fail to eliminate rutting, stop harvesting operations.

#### Managing Slash

#### BMP: SLASH

- ✓ Do not pile slash in drainage areas where runoff may wash slash into streams, lakes or wetlands.
- Favor practices that allow for dispersed slash on the site, rather than piling slash, where dispersed slash does not conflict with management objectives or reforestation. When piling slash, piles should be kept away from cultural resources.
- If moving slash on-site is desirable, use equipment that minimizes soil disturbance.

#### REDUCING VISUAL IMPACTS OF SLASH

- Encourage maximum utilization of all felled trees in the harvest area.
- Minimize visual exposure to slash piles and windrows.
- Limit slash not screened from view to a reasonable height to avoid a negative visual effect.

#### Water Quality and Wetlands (See Chapter 5: Riparian Management Zones and Wetlands and Chapter 10: Forest Roads, for general BMPs related to wetlands and planning.)

- Minimize the crossing of intermittent or perennial streams and open water wetlands. On both upland and lowland sites, install bridges, culverts, snow or ice bridges, fords or other means, if necessary, to prevent repeated soil and streambank disturbance where no practical alternative exists to crossing a stream.
   IMPORTANT: Such activity may require a permit from the DNR.
- Approach water crossings at or near right angles to the stream direction, and use measures to minimize streambank disturbances.
- Incorporate water diversion devices where needed during timber harvest activity (including waterbars, tops and branches, ditch blocks and lead-offs). Divert surface flow before it enters landings or a water body. Incorporate water diversion devices during construction rather than as a remedial activity (see Chapter 10: Forest Roads, page 128).
- To prevent repeated rutting deeper than six inches on wetlands, shift harvest operations to a stable portion of the harvest area or alter operating techniques. Alternative techniques include:
  - Employing low ground pressure (LGP) equipment
  - Using slash on skid trails as a driving surface
- Minimizing the amount of off-trail equipment operation to reduce the area disturbed by heavy equipment
- Waiting for colder weather to freeze the site or enhancing freezing of site by packing snow and ground vegetation with LGP equipment.

#### Snags (Standing Dead Trees)

 Leave as many snags as possible standing in harvest areas, consistent with exceptions outlined on page 143).

#### Leave Trees (Live Trees)

Two general options are recommended for retaining leave trees. Both options accomplish the management goals of retaining leave trees. Plans for retaining leave trees may utilize one of these options or, when appropriate, they may use the two options in combination.

 OPTION 1: Retain leave trees in clumps, strips or islands in each clearcut harvest unit.

Benefits of clumping leave trees include:

- Potential to meet multiple management objectives simultaneously.
- Visual quality.
- Equipment maneuverability.
- Longevity and durability of leave trees.
- Potential for greater biodiversity within clumps.
- Easier application in larger harvest units.
- Breakup of harvest area and reduction in apparent harvest size.
- Better regeneration of intolerants on the rest of the site.
- Potential to provide nesting sites for some interior forest species when clumps exceed two acres.
- Increased animal feeding efficiency and protection from predators

Clumps, islands or strips should:

- Be distributed throughout a harvest unit.
- Be adjacent to the RMZ for even-age management.
- Vary in size, with a minimum of one quarter acre per clump
- Center around or coincide with such features as: 1) Wetland inclusions and seasonal ponds;
  2) One or more large (greater than 18 inches DBH) active den trees or cavity trees;
  3) Mast trees;
  4) Preferred tree species (such as large white pine);
  5) Raptor nests or rookeries; or
  6) Sensitive communities or sites.
- Minimal harvesting within clumps is acceptable as long as the integrity of the clump or key leave trees is not disturbed.

- OPTION 2: As an alternative or supplement to clumps, employ scattered individual leave trees, especially if they are larger, wind firm specimens of preferred species. Scattered leave trees may be easier to apply to small or narrow harvest units than clumps. Use the following guidelines for scattering individual leave trees:
  - On most clearcut sites where this method is employed, leave six to 12 trees standing per acre, selecting trees preferentially. For preferred characteristics, see Chapter 3: Wildlife Habitat: Retaining Leave Trees.
  - On non-clearcut sites (including selection or partial-cut), be sure that the remaining stand includes a minimum of six cavity trees, potential cavity trees and/ or snags per acre.
  - Distribute leave trees throughout the harvested site as much as possible.

During initial harvest entries of seed tree or shelterwood cuts, select ultimate leave trees using the following guidelines:

- Leave a variety of sizes and species of trees, along with the intended seed/ shelter trees, to be retained during the final harvest.
- Plan for and protect integrity of reserve tree clumps in initial harvest entries.
- Prevent damage to leave trees in initial and follow-up harvest entries.

Exceptions to the previous leave tree and snag guidelines may be made for a number of reasons:

- Operator safety (of loggers, aerial spray applicators and others).
- Public safety (hazard trees near rights-of-way, recreation sites or airport vicinities).
- Specific forest management applications (such as genetic considerations for seed reproduction systems).
- Visual quality.
- Alignment of skid trails.
- Surrounding landscape concerns (e.g., adjacent sites to sharp-tailed grouse management units).
- Forest insects and diseases (such as dwarf mistletoe on black spruce, gypsy moth and pine bark beetles).

#### Providing Coarse Woody Debris

- Avoid having equipment disturb pre-existing large down logs, stumps and uprooted stumps.
- If a snag must be dropped, leave it where it falls whenever possible.
- Create at least two to five bark-on down logs greater than 12 inches in diameter per acre, if fewer than this number already exist. In choosing candidates for leave logs, consider the following:
  - Hollow butt sections or other defective lengths of at least six feet are preferred.
  - Sound logs and six- to 12-inch diameter logs may be used if they represent the best available candidates.
  - Hardwood logs have more hollows or cavities and are favored by certain amphibians.
  - Conifer logs decay more slowly and thus remain present as structure on a site longer than hardwoods.
  - Using pines as down logs, especially in summer, increases the risk of bark beetle damage to adjacent healthy pines.
- Scatter leave logs across the site, including a few near wetlands.
- Exceptions to guidelines for providing coarse woody debris may be made for a number of reasons, including:
  - Alignment of skid trails
  - Specific silvicultural applications (such as insect pests)
  - Visual quality issues



Figure 11-14: One harvesting option is to leave six to 12 scattered cavity trees, potential cavity trees or snags per acre to enhance wildlife habitat.

#### THE TIMBER SALE CONTRACT

A timber sale contract is the most important document involved in timber harvesting process. A well-prepared contract, along with a timber sale map, ensures that all parties have a mutual understanding of the operational considerations previously discussed. This section describes and clarifies the Sample Timber Sale Contract included in Appendix B\*. The Wisconsin Department of Natural Resources, the Wisconsin

Woodland Owners Association, and University of Wisconsin-Extension jointly developed it as part of the Forestry Facts series. The sample contract suggests key elements for inclusion in any private timber sale contract whether a landowner uses the one in the appendix or one from another source. The same concepts are also generally present in timber sale contracts on public land.

#### FIVE STEPS IN A CAREFUL AND SUCCESSFUL TIMBER SALE

Landowners are encouraged to hire a professional forester to help with any of these steps. A *Directory of Foresters (Pub-FR-021)* is available from DNR. *UW Extension Forestry Fact #75: Hiring a Consulting Forester* also contains useful information.

#### STEP 1

Prepare a written forest management plan that that addresses your personal objectives and the desired future condition of the woodland. The plan should explain the harvest technique and any follow up work that may be needed to achieve the preferred results.

#### STEP 2

Develop a harvest plan that describes the practices, locations, and expectations for the harvest. This document should include a map of the harvest site.

#### STEP 3

Develop a comprehensive, written timber sale contract that will be available as part of your timber sale advertisement.

#### STEP 4

Get competitive bids to help secure a fair offer and to find a skilled, careful logger that is experienced with your type of sale.

#### STEP 5

Check references and the performance history of both the consulting forester (if you plan to hire one) and the timber producer you are considering for your timber harvest. The Wisconsin Department of Agriculture and Consumer Protection (DATCP) has a Consumer Protection Hotline at (800) 422-7128 that you can call to check for past complaints. If the forester you select is expected to scale or grade the cut products, make sure the he or she is qualified to perform the work.

<sup>\*</sup> The sample timber sale contract may also be downloaded in digital format from the DNR private forestry web site at: www.dnr.state.wi.us/org/land/forestry/Private/index.htm

### Understanding the Sample Timber Sale Contract

The Sample Timber Sale Contract explained in this section contains a number of options. You will need to select the provisions and language that are appropriate for your harvest. The list of contract provisions is not meant to be exhaustive or necessarily applicable to every situation. You may choose to add or delete (by striking out) provisions. Landowners are encouraged to work with an attorney and professional forester in drafting a timber sale contract. Timber sale contracts usually include provisions that outline who, what, where, when, and how a timber sale will occur. Contracts will also spell out remedies in the event of a dispute. More stringent contracts may result in fewer bidders and, potentially, lower bids. Less restrictive contracts provide for less control. The section titles and provision numbers in the following explanations correspond to the section titles and paragraph numbers in the Sample Timber Sale Contract. Some sections are self-explanatory and not included.

#### **PROVISIONS 1-4**

Contract performance, period, extensions, and termination. Beginning and ending dates of the contract are established. The phrase, "For Time is of the Essence," demands reasonable diligence and completion within the period of the contract. Delays should only be authorized for reasons beyond the control of the Purchaser. This is essential to achieve your management objectives. Some provisions give you the flexibility to protect the land should unanticipated events or conditions occur. The Purchaser's authority to go on your land and conduct operations is through the contract.

#### **PROVISIONS 5-8**

**Down payment, bond, remedies and damages.**Sellers and Purchasers use down payments as earnest money. Down payments are not performance bonds. Performance bonds assure that costs

incurred due to breach can be recovered from the bond, rather than going to court or otherwise recovering costs from the Purchaser. Be aware that many Purchasers may not agree to provide a performance bond unless it is to be held by a consulting forester or an objective third party such as an escrow agent. The Seller's remedies in the event of a breach are not just limited to routine contract damages. Other penalties or remedies may be pursued if the Seller so chooses.

### CONTRACT BREACH: A VERY SERIOUS DECISION

Deciding that the Purchaser has breached a timber sale contract should not be made lightly or over trivial matters. Contract breach is a very serious step that can have ramifications for you and the Purchaser well beyond this one event. Reputation is critical to a timber harvester's livelihood and to your ability to sell or resell your timber. You may also be sued: It's that important. Breach should truly be the final straw. Intermediate steps might include visiting with the Purchaser to hash out differences, having a third party intervene, or shutting the sale down temporarily.

#### **PROVISIONS 9-11**

Products to be removed. Specifications for how trees are marked or designated for harvesting are explained (for example, "trees marked with orange paint," or "all trees within a red marked boundary"). Be certain that your property boundaries are well defined and understood by the Purchaser. If the boundary has not been formally surveyed, you should meet with the adjoining landowners to agree on the location of the property boundary. The Seller retains sole control over the timber until payment is made. Timber cannot be removed from the property until paid for or payment has been arranged.

#### **PROVISIONS 12-13**

Sale type, scaling, hauling, and payments. There are many ways to sell timber. Each affects at what point ownership of cut products moves from the Seller to the Purchaser and who reaps the benefit of product sort and grade. This section defines under what conditions cut products may be removed from the property, how and by whom the cut products are to be measured, and when the Seller receives payment. Scaling procedures include on site scale and mill scale. The Seller should be aware that while some mills are willing to send mill slips to the Seller, others are not. Prior to signing the contract, seek the advice of a tax specialist to determine whether income may be treated as a capital gain or regular income. Spreading the payment over two years may minimize your tax liability in any single year.

#### WHAT IS REASONABLE?

Throughout the Sample Timber Sale Contract, there are references to actions being "reasonable." In legal terms, reasonable means fair, proper, just, moderate, and suitable under the circumstances. The basic question to ask is: Would an outside observer familiar with harvest practices feel the action was adequate and satisfactory?

If you've never harvested timber before or visited a logging site, it is important that you learn about and understand normal logging practices and their impact. Either visit logging sites or hire a consultant forester to help you determine if your expectations of post-harvest conditions are "reasonable."

#### **PROVISIONS 14-17**

Timber products table. The table summarizes the type and volume of timber expected from the harvest and the price the Purchaser agrees to pay by unit. This information is important in all sales, even lump sum sales where the price per unit information can be used for damages or contract adjustments, if necessary. In some cases, the term,

mixed hardwoods, is used to describe products to be removed. Mixed hardwoods are small quantities of hardwood tree species of low relative value or not in sufficient quantity to be marketed in separate species categories. High-value species or products should be identified separately, even if the volume is small. In general, the use of mixed hardwoods should be restricted to pulp.

#### **PROVISIONS 18-28**

Utilization and operations. Detail any timber and site protection measures here. Be specific about erosion control, weather, disease and insect prevention, timing, equipment use (such as width or size limitations, use of a forwarder rather than a skidder, horses, etc.), operations during hunting seasons or other constraints you or your foresters consider necessary. Wisconsin's Forestry Best Management Practices (BMPs) for Water Quality guidelines are designed to protect water resources. If there are critical BMP needs on your property, you should itemize them. Check and document that the Purchaser and timber operators have completed Wisconsin BMPs training. Include consideration for archeological sites or endangered and threatened species where appropriate or required by law. Be aware that some requirements may affect the price that the Purchaser can afford to offer for the timber.

#### **PROVISIONS 29-31**

Notice of intent to cut and compliance with laws. Specify the party responsible for filing cutting notices and reports with the county clerk and the DNR. Notices must be filed at least thirty days before cutting begins. County cutting notices must be renewed on January 1 of each year. If the land is enrolled in a DNR forest tax law program, the landowner will be responsible for paying a five percent (Managed Forest Law–MFL) or 10 percent (Forest Crop Law–FCL) severance tax on the timber cut. Regardless of contract provisions, state statutes hold landowners liable for penalties related to non-compliance with MFL and FCL cutting notice and report laws.

#### **PROVISIONS 32-33**

Title, boundary lines and access. These clauses outline three important duties of you as the Seller. First, you assure that you have the authority to sell the timber and will defend that right in court if necessary. A mortgage or land contract may require that the seller seek permission of creditors before selling. Where there are multiple owners, all should consent. Tax program participants should ensure that the harvest is consistent with the approved forest management plan and that all required notices are submitted. Second, you will mark the boundary of the timber sale prior to harvest. Third, you will acquire written permission to cross a neighbor's land, if necessary.

#### **PROVISIONS 34-36**

Liability and insurance. These provisions protect the Seller from liability arising from the Purchaser's harvesting operation. The Purchaser is required to show proof of workers' compensation and public liability insurance. Be aware that a logger's liability insurance does not normally include damages caused by fire or timber trespass unless purchased as an option.

#### **PROVISION 43**

**Contact information.** This exchange of information between the Purchaser and Seller will ensure that both parties can contact each other easily. If you are using a Seller's agent, you'll want to provide his or her contact information, too.

#### POST-OPERATIONAL ACTIVITIES

- Evaluate the harvest operation and plan future adaptations at post-harvest conferences with the logger and landowner.
- Plan for removal of equipment and cut material from wetland areas at the end of the winter season prior to thawing.
- Avoid removing soil from the general harvest area to rehabilitate roads, landings and skid trails. Use already disturbed soil, if needed, rather than disturbing additional soil.
- Rehabilitate landings and skid trails when necessary to mitigate soil compaction and reduce erosion.

Figure 11-15: A forwarder offloads pulpwood at a woods landing. Forest management objectives may influence equipment choice. Forwarders carry wood, thus causing little soil disturbance. Skidders scarify the soil by dragging trees or logs – a plus for natural regeneration where erosion is not a problem.



### CHAPTER 14 — REFORESTATION

| Considerations             | 168 |
|----------------------------|-----|
| Planning                   | 169 |
| Species Selection          | 169 |
| Operational Considerations | 170 |

Reforestation includes the process of planting (or otherwise regenerating) and establishing a desired forest community on a given site. An important part of reforestation is the selection of an appropriate tree species or forest community to manage.

Common reforestation techniques include both natural and artificial methods:

- Natural regeneration methods include root suckering, stump sprouting or natural seeding.
- Artificial regeneration methods include aerial and ground seeding, machine planting and hand planting.

#### Considerations

- Increasing planting complexity may increase planting costs.
- Management methods associated with natural appearing stands (such as mixed-species planting and randomized spacing) can have increased long-term costs.
- Leaving residual trees can require increased disease-control measures, especially when residuals and regeneration are the same species.



Figure 14-1: Underplanting spruce seedlings by hand in a harvested hardwood stand to augment natural regeneration and provide species diversity.



Figure 14-2: Artificial regeneration methods include machine planting, which is quite appropriate when old farm fields are planted, in this case to red pine.



Figure 14-3: Successful planting requires vigorous seedlings of sufficient size with a healthy root system.

#### **PLANNING**

#### Species Selection

- Select suitable tree species to regenerate.
   Consider such factors as:
  - Site capabilities
  - Existing natural regeneration
  - Historical vegetation
  - Variation in growth rates and seed production
  - Mixing of deciduous and coniferous species
  - Sunlight requirements
- Choose seed or seedlings from a locally adapted source.

## REDUCING VISUAL IMPACTS DUE TO PLANTING LAYOUT AND DESIGN

- Avoid rows perpendicular to travel routes or recreation areas.
- Plant irregular or offset rows to encourage natural-appearing stands.
- Use wider initial spacing to minimize number of re-entries to the site and to encourage establishment of other species.
- Use wider spacing along sensitive boundaries.
- Choose species and plantation design consistent with integrated resource management principles.

# REDUCING VISUAL IMPACTS DUE TO SPECIES SELECTION DURING REFORESTATION

- Promote a mixture of species, both naturally occurring and planted.
- Encourage and maintain diversity within the stand.
- Favor long-lived species where appropriate to minimize frequency of management activities.
- Use species appropriate for site.
- Choose species consistent with integrated resource management principles.



Figure 14-4: These abundant jack pine seedlings naturally following a clearcut harvest that permitted sufficient sunlight to reach the ground, and provide heat to open the cones for seed dispersal.

#### OPERATIONAL CONSIDERATIONS

 Conduct on-site meetings with the contractor, landowner and resource manager prior to moving equipment onto a site. Such meetings can help assure common understanding of landowner objectives, contract specifications and site conditions.

Note: This chapter will be significantly expanded in the Second Edition of this guide to reflect information currently being developed for the WDNR Silviculture and Forest Aesthetics Handbook.



Figure 14-5: These red oak seedlings are natural regeneration following a shelterwood harvest.



Figure 14-6: These red maple stump sprouts are another form of natural regeneration.



Figure 14-7: Promoting a mixture of species encourages and maintains diversity, which also provides wildlife habitat diversity and the positive visual impact of a natural-appearing landscape.



Figure 14-8: Promote natural-appearing stands by avoiding planting rows perpendicular to travel routes, which can result in a negative visual impact.

### CHAPTER 15 — TIMBER STAND IMPROVEMENT (TSI)

| Considerations  | 172 |
|---|-----|
| Planning  | 173 |
| Operational Considerations                              | 173 |
| Specific TSI Guidelines                                 | 174 |
| Release of Crop Trees in Pre-commercial Hardwood Stands | 174 |

Timber stand improvement (TSI) includes activities or treatments that improve the composition, structure, condition, health and growth of even-age or uneven-age stands.

Such activities may include mechanical or chemical treatment of vegetation that competes with desirable trees, removing diseased or dying trees, thinning, pruning, and post-harvest treatments on natural regenerating stands.

These practices are intended to do three things:
1) increase the value of the stand; 2) improve the growth and form of crop trees; and 3) manipulate stand composition.

#### Considerations

- Timing of TSI activities should take into account disease and insect cycles that may be enhanced by the presence of slash.
- Restricted operating hours (to regulate noise near recreation areas) may affect costs of TSI activities.
- Additional slash disposal requirements (to control disease or to enhance visual quality) may affect the cost of TSI activities.



Figure 15-1: This upland hardwood stand received a "heavy" mechanized thinning that removed trees for pulpwood. The remaining poletimber consists of desired "crop tree" species for future growth and harvest.

 TSI, including removal of brush and small suppressed trees, allows people to see into stands.



Figure 15-2: A marked selection thinning in this red pine stand removed the smaller, less vigorous trees and achieved proper spacing for optimum future growth. A buffer strip, left on the windward side of this stand, is designed to minimize wind throw problems with residual trees.



Figure 15-3: A release cut in this upland hardwood stand removed overtopping undesirable trees, thus "releasing" young saplings and small poletimber from competition that reduces growth rate.

#### **PLANNING**

In addition to specific TSI guidelines and related general guidelines provided below, refer to the following forest management activity sections for additional guidelines appropriate to TSI.

| FOR TSI ACTIVITIES INVOLVING Felling Trees | REFER TO THESE<br>GUIDELINES<br>Timber Harvesting<br>(Chapter 11, page 133)                              |
|--|--|
| Application of Pesticides                  | Pesticide Use<br>(Chapter 13, page 155)  |
| Trafficking Sites with<br>Heavy Equipment  | Mechanical Site Preparation<br>(Chapter 12, page 149)<br>and Timber Harvesting<br>(Chapter 11, page 133) |
| Road Building or<br>Access Development     | Forest Road Construction<br>and Maintenance<br>(Chapter 10, page 115)                                    |

## REDUCING VISUAL IMPACTS OF TIMBER STAND IMPROVEMENT

- Avoid TSI operations during periods of peak recreational use whenever possible.
- Treat slash and debris from TSI operations (by lopping, removing, crushing or burning) whenever possible. Keep slash height below two feet (see Chapter 11: Timber Harvesting: Managing Slash, page 142).
- Reduce noise in early morning, late evening and other appropriate times near residences, businesses and outdoor activity areas.
- Inform and educate recreational users regarding the concept and benefits of TSI prior to, during and after TSI activities.
- Use methods and applications consistent with integrated resource management objectives.

#### OPERATIONAL CONSIDERATIONS

- Conduct on-site meetings with the logger, landowner and resource manager prior to moving equipment onto a site. Such meetings can help assure common understanding of landowner objectives, timber harvesting regulations, contract specifications and site conditions.
- Allow for a diversity of species and ages when implementing TSI activities.
- Avoid cultural resources when mechanically strip thinning with heavy equipment.
- Consider leaving cavity trees, potential cavity trees, and/or snags during TSI operations.
   Approximately six trees per acre, well-distributed throughout the site would be optimum. For preferred characteristics, see Chapter 3: Wildlife Habitat: Retaining Leave Trees.
- Rehabilitate landings and skid trails where necessary to mitigate soil compaction and reduce erosion.



Figure 15-4: An improvement cut in this stand removed many poor quality trees that were competing with the more desirable trees.

#### SPECIFIC TSI GUIDELINES

## Release of Crop Trees in Pre-commercial Stands<sup>1</sup>

- Crop tree release is the selection and release of desirable trees by removing adjacent competing trees.
- Crop trees are released in order to increase tree diameter and help ensure survival. Released trees mature sooner and/or attain larger sizes at maturity.
- A crop tree is a tree the landowner wants to retain.
  - For sawlog production, timber crop trees in Pre-commercial stands should be high value species, dominant/co-dominant, straight, free of main stem forks in the lower 17 feet of bole, and vigorous with no sign of top dieback or insect or disease damage.
  - Wildlife crop trees can be den trees and mast producers, such as oaks, hickories, or beech. In areas where there are only a few dominant/co-dominant mast producers, some wildlife crop trees can be in the intermediate crown class.
- Crop trees should be released any time after they have reached a height of about 25 feet.
   This usually occurs between the ages of 10 and 15 years.
- In most cases, 50 to 75 crop trees per acre are released. It's of little value to release timber crop trees that will be removed in future intermediate cuttings. Therefore, never release more than 100 crop trees per acre in Pre-commercial stands.
- Crop trees should be released using the "Crown-touching Release" method. To apply this method all trees (except other crop trees) whose crowns touch the crop tree crown are cut. Normally, it's unnecessary to cut overtopped trees.
- In areas where no suitable crop trees are found, do not cut any trees. Crop tree release is intended to cut only trees that are competing with crop trees. It's not selecting crop trees and then cutting all other trees in the stand.

- Try to pick crop trees about 25 feet apart.
   Occasionally, two crop trees may be left close
   to each other. Treat their crowns as a single
   crown and apply a crown-touching release. Do
   not leave groups of more than two crop trees
   close to each other.
- Generally speaking, using a chainsaw to release crop trees is cheaper than using herbicides (basal spraying or injecting). It takes about three minutes to release a crop tree using a chainsaw. When competing trees are being felled, it's easy to see which trees still need to be cut. Also, herbicides cannot be used to release sprout-origin crop trees.
- Stump sprouts are fast growing and will respond to release. However, stump sprout crop trees must originate at or near ground line so that as the parent stump decays the crop tree will not break off or develop butt rot. Release one or two widely spaced crop trees per clump. Select trees with a U-connection rather than with a V-connection.

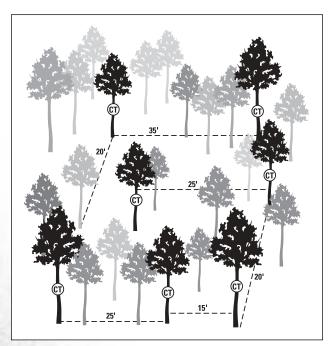


Figure 15-5: Try to space crop trees (CT) 25' apart and you will end up with a sufficient number of trees per acre. Some crop trees can be spaced 15' apart, and others 35' apart.

<sup>1</sup> Lamson, Smith, Perkey, and Wilkins. 1989. How to Release Crop Trees in Pre-commercial Hardwood Stands. USDA Forest Service NE Forest Experiment Station publication NE-INF-80-88.

### CHAPTER 16 — FIRE MANAGEMENT

|      | Considerations                            | 176 |    |
|------|---|-----|----|
| Plar | nning                                     | 1   | 77 |
|      | Burn Plan Development                     | 177 |    |
|      | BMP: Burn Plan Development                | 177 |    |
| Оре  | erational Considerations                  | 1   | 78 |
|      | Pre-Ignition Activities                   | 178 |    |
|      | Managing Fuel Breaks and Accesses         | 178 |    |
|      | BMP: Managing Fuel Breaks and Accesses    | 178 |    |
|      | Protecting Water Quality and Wetlands     | 179 |    |
|      | BMPs: Protecting Water Quality & Wetlands | 179 |    |
| Pos  | t-Operational Activities                  | 1   | 80 |
|      | BMP: Post-Operational Activities          | 180 |    |

The term fire management includes both prescribed burning and fire suppression:

- Prescribed burning is the intentional application
  of fire to wildland fuels (in either their natural or
  modified state) under specified environmental
  conditions. In forests, prescribed burning reduces
  unwanted vegetation and logging debris. It
  prepares sites for tree planting or direct seeding,
  and reduces the potential for destructive wildfires
  by reducing fuel accumulations. Low-intensity
  fires have little effect on water quality. However,
  fires that burn intensely are likely to consume
  forest floor litter and expose soil, which can lead
  to erosion and harm water quality.
- Wildfire suppression is the effort to control, contain or extinguish wildfires in order to protect life, property and resources. Note: When fighting wildfires, preventing harm to people and property should be your top priority. After containing the fire, you need to address land rehabilitation to prevent or minimize nonpoint source pollution of lakes, streams and wetlands.

#### Considerations

- Safety and the protection of life and property are the priority in fire management.
- Other fire management considerations should include protection of cultural resources, forest soils, riparian areas, water quality and wetlands, and wildlife habitat.
- Making fire management personnel aware of cultural resources, through training and advance planning, can help protect cultural resources.
- Slash burning, where fuels are close to the ground, can in some cases reduce soil productivity by consuming the forest floor and superheating the surface of some soils (particularly dry sandy soils). This results in reduced water-holding capacity, volatilization of some nutrients, and allowing other nutrients to become rapidly available for plant uptake, runoff or leaching.
- Because pulp and paper industries cannot accept charred wood, merchantability may be negatively affected by burning in standing timber.

#### **PLANNING**

Burn Plan Development

# BMP: BURN PLAN DEVELOPMENT

- ✓ Before conducting a prescribed burn, apply for a burning permit from the Wisconsin DNR or you local municipal or township authorities.
- Consult with local DNR offices. Always rely on trained and experienced personnel to plan and implement prescribed burns – the BMPs in this chapter are designed to complement professional training. Contact the Wisconsin Department of Natural Resources (DNR) for more information (see the Resource Directory).
- When planning burns in or near wetland areas and seeps, avoid damaging the hydrology on sites during management operations.



Figure 16-1: The goal of this fast-moving prescribed burn was to kill the thin-barked your maples (by super-heating the cambium) that were competing with the more fire-resistant red oak seedlings.

- Include cultural resource information in both wildfire suppression and prescribed burn plans. Important information includes:
  - Locations of known cultural resources.
  - Locations of high probability areas for the occurrence of cultural resources.
- Minimize impacts of fuel break construction by applying one or more of the following guidelines:
  - Consider such alternatives as herbicide use, mowing or other non-erosion-causing practices for fuel break maintenance on areas where prescribed fire will be used on a recurring basis.
  - Use natural or in-place fuel breaks (such as roads, streams, lakes and wetlands) where appropriate, as an acceptable way to minimize the need for artificial fuel break construction.
  - Consider the use of fire retardant or foam in place of plowed fuel breaks where fuel break construction would result in unacceptable soil erosion, water quality degradation or damage to cultural resources.
  - When artificial fuel breaks must be used, place fuel breaks, fueling and maintenance areas outside of filter strips or the RMZ, whichever is wider, whenever practical.
  - Locate fuel breaks on the contour, and avoid straight uphill-downhill placement.
- When conducting prescribed burns use low- or moderate-burning intensity so that the minimum amount of forest floor is consumed consistent with meeting the objectives of the burn, especially for dry sandy soils or shallow soils over bedrock.
- Avoid placement of piles for burning within filter strips or drainage channels adjacent to streams, lakes and wetlands.

#### OPERATIONAL CONSIDERATIONS

 Conduct on-site meetings with the contractor, landowner and resource manager prior to moving equipment onto a site. Such meetings can help assure common understanding of landowner objectives, contract specifications and site conditions.

#### Pre-Ignition Activities

- Delineate cultural resource areas and carefully consider the effects of prescribed burns on them.
- Pre-position fire-fighting personnel and equipment at cultural resources that are susceptible to damage by fire.
- If cultural resources cannot be avoided within prescribed burn areas:
  - Treat above ground features with fire retardant or foam.
  - Protect below ground archaeological sites from compaction and rutting.
- Consider protection of the largest coarse woody debris from prescribed burning, if practical.
- Control the pattern and timing of burn ignition by evaluating existing or developing conditions on the ground.

## Managing Fuel Breaks and Accesses

- Construct fuel breaks outside of cultural resource areas. Use cultural resource professionals or tribal representatives to help determine fuel break location.
- Construct fuel breaks only deep enough and wide enough to control the spread of the fire.

# BMP: MANAGING FUEL BREAKS & ACCESSES

- ✓ Where possible, locate bladed firelines on the contour. Construct water bars as needed to direct surface water off firelines and into undisturbed forest cover. Recommended specifications for building water bars and their spacing can be found in Chapter 10: Forest Roads: Drainage Structures, page 125.
- Avoid construction of fuel breaks for fire management that result in drainage directly into a water body.
- Provide adequate filter strips when constructing fuel breaks that expose bare soil near wetlands.
- Use fuel break construction methods in wetlands that do not expose bare soil whenever practical.
   These may include wet lines, existing constructed or natural barriers, foam or retardants. If techniques result in exposure of bare soil, such areas must be restored if wetland hydrologic functions are impacted.
- Maintain erosion control measures as needed on fuel breaks.
- Employ suitable water diversion structures on fuel breaks, approaches to water crossings, or on roads and trails found within the riparian management zone to divert water off of the right-of-way before it reaches the water body.
- Monitor the effectiveness of cultural resource management practices during prescribed burns and wildfire suppression activities.
- Control access to sensitive cultural resources.

#### BMPS: PROTECTING WATER QUALITY & WETLANDS

- ✓ Carefully select fireline locations and consider weather, fuel, soil and topographic conditions in the burn area to minimize impacts on water quality.
- ✓ Avoid intense burns that remove forest floor litter which may expose soil in riparian management zones and on slopes where eroded soil may drain to surface water.
- ✓ Avoid burning piles of slash in riparian management zones.

- ✓ Use natural or existing barriers (e.g., roads, streams, lakes) where possible, or wet lines for firelines where bladed or plowed firelines will erode soil and degrade water quality.
- ✓ Avoid plowed and bladed firelines in riparian management zones except where necessary to control wildfire.
- ✓ Avoid applying chemical fire retardants over surface water. Prevent chemical fire retardants from flowing into surface water.

## Protecting Water Quality and Wetlands

 Establish unburned zones containing no fuel breaks to protect water quality in situations where steep slopes, highly erodible soils, or the likelihood of substantial organic matter removal are present.

- Follow manufacturer recommendations.
- Avoid cleaning fire-retardant application equipment in lakes or streams.



Figure 16-2: This wide firebreak is well-maintained to provide wildfire protection for the community of Boulder Junction in northern Wisconsin.



Figure 16-3: The same firebreak as seen from the air.

#### POST-OPERATIONAL ACTIVITIES

#### BMPS: POST-OPERATIONAL ACTIVITIES

- ✓ Do not clean chemical-application equipment in surface water or locations that drain directly into surface water.
- ✓ Use erosion control measures for firelines that could erode soil into lakes, streams and wetlands. Erosion control measures include revegetation and installing water bars. Placing sod back into plowed furrows at appropriate intervals can act as water bars (see Chapter 10: Forest Roads: Soil Stabilization, page 128).
- ✓ Maintain soil stabilization practices until the site
  is fully revegetated and stabilized.
- ✓ Use mowing or other practices that do not expose soil as alternatives to blading or disking for maintaining firebreaks where erosion may degrade water quality.

- Assess the condition of cultural resources that may have been affected by prescribed burning or wildfire suppression activities.
- Field inspect the burned area to identify cultural resources that may not have been previously identified but have been newly exposed by the fire.
- Remove temporary fire management features that are inappropriate to the historic character of adjacent cultural resources.
- Restore water source sites used for fire management activities as soon as practical following control, or at the completion of mop-up activities.

### CHAPTER 17 — FOREST RECREATION MANAGEMENT

| Considerations                                 | 182 |
|--|-----|
| Construction of Recreation Areas               | 183 |
| Protecting Cultural Resources                  | 183 |
| Protecting Water Quality and Soil Productivity | 184 |
| Public Use Considerations                      | 184 |
| Recreational Traffic                           | 184 |
| Public Education Opportunities                 | 184 |



Figure 17-1: Multiple-use trail systems are common in many public and industrial forestlands. These areas often receive a lot of traffic and may need special protective measures to guard against soil erosion and other site damage.

The goal of forest recreation management is to select, develop, operate and maintain forest recreation areas to provide quality outdoor experiences for the recreational user.

#### Considerations

- Planning for recreational development should address cultural resource issues in terms of both protection and interpretation. Existing cultural resource inventories should be reviewed early in the planning process. If no information is available, field inspections should be conducted before development plans are finalized to determine presence/absence of cultural resources.
- If cultural resources are present in the development area, it may be possible to modify construction plans to reduce or eliminate damage to the resources. Cultural resource professionals can help determine the best approaches to mitigation of potential damage.

 Recreational developments provide opportunities for education through interpretation of on-site cultural resources.



Figure 17-2: An urban park may provide the only opportunity for some city dwellers to experience a walk or bike ride through a "forest" of towering trees.

### CONSTRUCTION OF RECREATION AREAS

 Conduct on-site meetings with the contractor, landowner and resource manager prior to moving equipment onto a site. Such meetings can help assure common understanding of landowner objectives, contract specifications and site conditions.

#### **Protecting Cultural Resources**

- Select and designate borrow areas and gravel quarries prior to the start of construction to avoid cultural resource locations.
- Select and designate the staging area for equipment prior to the start of construction to avoid cultural resource locations. If avoidance is not feasible or practical:
  - Use "fill-only" construction techniques in the area of the cultural resource.
  - Construct temporary crossings over the cultural resource (including slash, tire mats, or fill over geotextile).

- Do not allow surfaces in archaeologically sensitive areas to erode, slump or wash out.
   Implement temporary stabilization methods to preserve the shape, slope, elevation and contours of archaeological sites and historic features.
   Stabilization should not alter the historic character of the cultural resource.
- If practical and feasible, avoid cultural resource areas when constructing recreational facilities.
- If it's not possible to completely avoid a cultural resource, minimize or eliminate soil disturbance and erosion in the vicinity of the resource by:
  - Minimizing cut sections and following existing contours to the extent possible.
  - Avoiding unnecessary disturbance to the ground surface.
  - Considering data recovery if it's not possible to avoid impacting the resource.



Figure 17-3: Grouse and woodcock hunters search for young stands of aspen provided by clearcutting practices, as ideal habitat for their quarry.



Figure 17-4: A hiker pauses by a woodland stream. recreation managers must decide whether to disperse hiking and other activities, or to concentrate them on developed trails.

## Protecting Water Quality and Soil Productivity

 Install and maintain appropriate erosion control structures to protect water quality and soil productivity. See also appropriate erosion and water control guidelines in Chapter 10: Forest Roads: Alignment and Location and Drainage, page 119.

#### PUBLIC USE CONSIDERATIONS



Figure 17-5: A snowshoer wanders the woodlands of northern Wisconsin.

#### Recreational Traffic

- In areas that will receive a lot of traffic (pedestrian or vehicular), periodically inspect the facility to determine whether the cultural resource is being damaged by public use of the area. If so, special protective measures may be desirable.
- When operating within the riparian management zone, confine recreational off-highway vehicle use and other non-foot traffic to trails that are designed, constructed and maintained using guidelines for skid trails and forest roads. Refer also to appropriate guidelines in Chapter 11: Timber Harvesting: Skidding and Skid Trails, page ? and Chapter 10: Forest Roads, page 115.

#### Public Education Opportunities

- Retain flagging, signs or other markings on cultural resource areas in cases where they might be appropriate long-term protection
- Treat public use areas as opportunities for interpretation of cultural resources, as long as interpretive plans take into account the need to safeguard the resource from deliberate or inadvertent damage. Design interpretive signage and displays in consultation with cultural resource specialists.



Figure 17-6: A winter hiker follows a developed woodland trail.

#### **ADSORPTION**

The inherent ability of a pesticide to bind to surfaces of soil particles. The greater the potential for a pesticide to adsorb to soil particles, the less the potential for the pesticide to move in solution.

#### ALIGNMENT

The horizontal route or direction of an access road. It's made up of straight line tangent sections and curves.

#### **ALL-SEASON ROAD**

A permanent road designed for use all year long, though there may be some restrictions on vehicle weight at times during spring breakup or wet periods. There is a great range in design standards and road surfacing for this type of road, depending on anticipated traffic load.

#### **ANGLE OF REPOSE**

The maximum slope or angle at which a material, such as soil or loose rock, remains stable (stable angle).

#### **ARCHAEOLOGY**

The field of science that studies past human culture through the examination of remaining material evidence.

#### ARCHAEOLOGICAL SITE

A geographic location where archaeological artifacts, features and other materials are found.

#### ARTIFACT

An object manufactured, modified or used by humans.

#### BANK

The land surface abutting the bed of any navigable waterway which, either prior to any project or alterations of land contours or as the result of the proposed project or alteration, slopes or drains without complete interruption into the waterway (NR 340.02(2)).

#### BARRIERS

Obstructions to pedestrian, horse or vehicular traffic intended to restrict traffic.

#### **BASAL AREA (FORESTRY DEFINITION)**

The cross-sectional area of a live tree at breast height (four and on-half feet above ground). Basal area may be measured in square feet per tree or square feet per acre.

## BASAL AREA (BMPs FOR WATER QUALITY DEFINITION)

The cross-sectional area four and one-half feet above ground in square feet of all trees with a diameter of five inches or greater.

#### **BASEFLOW**

The portion of streamflow which comes from groundwater.

#### **BERM**

A low earth fill constructed in the path of flowing water to divert its direction, or constructed to act as a counter-weight beside the road fill to reduce the risk of foundation failure.

#### **BEST MANAGEMENT PRACTICES (BMPs)**

Practical and economically achievable practices for preventing or reducing nonpoint source pollution.

#### **BIODIVERSITY**

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

#### **BOARD FOOT**

A unit of measurement represented by a board one foot wide, one foot long, and one inch thick.

#### **BORROW PIT**

That area from which soil is removed to build up the road bed, sometimes directly adjacent and parallel to a road.

#### **BROAD-BASED DIP**

A surface drainage structure specifically designed to drain water from an access road while vehicles maintain normal travel speeds.

#### **BRUSH BARRIER**

A sediment control structure created of slash materials, piled at the toe slope of a road or at the outlets of culverts, turnouts, dips, and water bars.

#### **BUFFER AREA**

A designated area around a stream or waterbody of sufficient width to minimize entrance of forestry chemicals (fertilizers, pesticides, and fire retardants) into the waterbody.

#### **BURIAL MOUND**

An earthwork constructed to cover or enclose one or more human burials. In Minnesota, construction of burial mounds was a common cultural practice between about 2500 and 800 years ago.

#### **CACHE PIT**

A cultural feature, usually excavated into the ground, that was used to store foodstuffs or other items. Cache pits are often found in areas where resources such as maple sap and wild rice have been gathered.

#### **CAVITY TREE**

A hollow tree used by wildlife for roosting and reproduction by wildlife.

#### **CEDED LANDS**

Public lands within original reservation boundaries on which American Indian treaty rights can be exercised.

#### **CEMETERY**

Any location at which there are one or more human interments.

#### **CHECK DAM**

A small dam constructed in a gully to decrease the flow velocity, minimize channel scour, and promote deposition of sediment.

#### **CLEARCUTTING**

A silvicultural system in which all merchantable trees are harvested within a specified area in one operation to create an even-age stand.

#### **COARSE WOODY DEBRIS**

Stumps and fallen trunks or limbs of more than six-inch diameter at the large end.

#### **CO-DOMINANT TREE**

A tree whose crown helps to form the general level of the main canopy in even-age stands or, in uneven-age stands, the main canopy of the tree's immediate neighbors, receiving full sunlight from above and comparatively little from the sides.

#### CONNECTIVITY

The degree of linkage among similar habitat patches across a landscape.

#### **CONTOUR**

An imaginary line on the surface of the earth connecting points of the same elevation. A line drawn on a map connecting the points of the same elevation. The steeper the slope, the closer the contour lines will be.

#### COPPICE REPRODUCTION

Clumps of sprouts from parent stumps, generally resulting from a cutting operation or fire. Usually results in a defective tree following decay of the parent stump.

#### CORD

A unit of measurement of stacked wood. A standard cord occupies 128 cubic feet within its outside dimensions of four feet by four feet by eight feet, or four feet by four feet by 100 inches.

#### CORDUROY

Logs placed over a wetland to reinforce the natural root mat for the purpose of stabilizing the road foundation.

## CROWN (BMPs FOR WATER QUALITY DEFINITION)

A convex road surface that allows runoff to drain to either side of the road prism.

#### **CROWN (FORESTRY DEFINITION)**

The part of a tree bearing live branches and foliage.

#### **CROWN CLOSURE**

The degree to which the forest floor is shaded by tree crowns when the sun is immediately overhead. Complete crown closure occurs when the crowns of trees touch and effectively block sunlight from reaching the forest floor.

#### CULL

Deduction made from gross volume of timber to correct for defect. Also refers to highly defective standing timber that should be removed during timber stand improvement operations.

#### **CULL LOGS**

Logs that do not meet merchantability standards.

#### **CULTURAL RESOURCE**

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

#### **CULVERT**

A metal, wooden, plastic or concrete conduit through which water can flow under or across roads.

#### **CUMULATIVE EFFECT**

The impact on the environment that results from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such action.

#### **CUT-AND-FILL**

Earth-moving process that entails excavating part of an area and using the excavated material for adjacent embankments or fill areas.

#### **CUTTING SCHEDULE**

Interval of time between harvests within a stand or compartment (also called a cutting cycle).

#### DIAMETER AT BREAST HEIGHT (DBH)

The diameter (outside bark) of a tree at breast height (four and one-half feet above ground level).

#### **DISKING (HARROWING)**

A mechanical method of scarifying the soil to reduce competing vegetation and prepare a site to be seeded or planted. (See scarification.)

#### DOMINANT TREE

A tree whose crown extends above the general level of the main canopy of even-age stands or, in uneven-age stands, above the crowns of the tree's immediate neighbors and receiving full sunlight from above and partial light from the sides.

#### DRAINAGE STRUCTURE

Any device or land form constructed to intercept or aid surface water drainage.

#### **DRIFT**

The movement of pesticides through the air to non-target areas, either as solid or liquid particles, or as vapor.

#### DRAINAGE STRUCTURE

Any device or land form constructed to intercept and/or aid surface water drainage.

#### DUFF

The accumulations of needles, leaves, and decaying matter on the forest floor.

#### **ECOLOGICAL CLASSIFICATION SYSTEM**

An approach to categorizing and delineating, at different levels of resolution, areas of land and water having similar characteristic combinations of the physical environment (such as climate, geomorphic processes, geology, soil and hydrologic function) and biological communities (plants, animals, microorganisms and potential natural communities).

#### **ECO-REGION**

A land area characterized by similar geology, climate, topography, plant communities, soil types and other factors.

#### **ENDANGERED SPECIES**

A species threatened with extinction throughout all or a significant portion of its range.

#### **ERODIBLE SOILS**

Soils that are likely to have high soil loss when exposed to water runoff. Soils having a Natural Resources and Conservation Service (NRCS) erosion hazard rating of "moderate" or "severe" should be considered erodible. Erosion hazard ratings for different soil types are listed in "Woodland Suitability" tables in NRCS soil survey manuals. Generally, forest soils occurring on 15 to 35 percent slopes have a moderate rating and soils occurring on greater than 35 percent slopes have a severe rating. Contact your local NRCS office for more information.

#### **EROSION**

The process by which the surface of the earth is worn away by the action of wind or water in the form of rain drops, surface runoff, and waves.

#### **EVEN-AGE MANAGEMENT**

A system of management used in sun-loving types which will not regenerate in their own shade. All trees in the stand are very near the same age. Harvesting is done by removing all the trees in the stand in one cut (clearcut) or a number of cuts (shelterwood cut) when the stand is mature. A new stand is then regenerated through suckering, seeding, or planting.

#### EXTENDED ROTATION

Substantially increasing the rotation age of a forest stand beyond the current optimum economic rotation age.

#### FEATURE (ARCHAEOLOGICAL)

Any non-portable archaeological evidence. Examples include cellar depressions, building berms, foundations or trash heaps.

#### **FELLING**

The process of cutting down standing trees.

#### FIBER-FACTORY EFFECT

The artificial, man-made appearance of some plantations, especially those planted in straight rows, perpendicular to the roadway.

#### FILL SLOPE

The surface formed where earth is deposited to build a road or trail.

#### **FIREBREAK**

Naturally occurring or human-made barrier to the spread of fire.

#### **FIRELINE**

A barrier used to stop the spread of fire constructed by removing fuel or rendering fuel less flammable by use of retardants.

#### FIRE RETARDANT

Any substance except plain water that by chemical or physical action reduces the flammability of fuels or slows their combustion rate.

#### **FLOODPLAIN**

Land which has been or may be covered by flood water during the regional floods (floods expected to occur once in every 100 years).

#### **FORD**

Submerged stream crossing where the streambed may need to be reinforced to bear intended traffic.

#### FOREST COMMUNITY

All organisms within and dependent on a forest ecosystem for all or part of their needs.

#### **FOREST COVER TYPE**

A tract of forest land characterized by a predominance of one or more key species that make up 50 percent or more of the volume in saw timber or pole timber stands, or 50 percent or more of the number of trees in seedling and sapling stands.

#### FOREST ECOSYSTEM

A community of plants, animals and microorganisms, and the physical environment they inhabit, in which trees are the dominant life form.

#### **FOREST FILTER STRIP**

Area between a steam and construction activities that achieves sediment control by using the natural filtering capabilities of the forest floor and litter.

#### **FOREST FLOOR**

All dead vegetation on the mineral soil surface in the forest, including leaf litter and unincorporated humus.

#### **FOREST MANAGEMENT**

The multiple-use management of forest resources for sustained yields of wood, water, forage, wildlife and recreation. Multiple-use includes timber management, watershed management, range management, wildlife management, fisheries management and recreation management.

#### **FOREST ROAD**

A temporary or permanent road connecting the most remote parts of the forest to existing public roads. They provide access to forest lands for timber management, fish and wildlife habitat improvement, fire control and a variety of recreational activities.

#### **FORMULATION**

The pesticide product as purchased, usually consisting of a mixture of active and inert ingredients.

#### **FORWARDING**

The operation of moving timber products from the stump to a landing for further transport.

#### **FUEL BREAK**

(See fireline.)

#### **FUNCTIONS**

The physical, chemical and biological processes in a forest, including photosynthesis, decomposition and nutrient cycling.

#### **GEOTEXTILE**

A product used as a soil reinforcement agent and as a filter medium. It's made of synthetic fibers manufactured in a woven or loose non-woven manner to form a blanket-like product.

#### **GRADE (GRADIENT)**

The slope of a road or trail expressed as a percent of change in elevation per unit of distance traveled.

#### **GROUND WATER**

The subsurface water supply in the saturated zone below the level of the water table.

#### HABITAT

The sum total of environmental factors (including food, water and cover) that a species needs to survive and/ or reproduce in a given area.

#### HABITAT TYPE CLASSIFICATION SYSTEM

A method of site classification that uses ground flora as an integrated indicator of the environmental factors that affect species reproduction, competition, and plant community development.

#### HALF-LIFE

The time it takes for a pesticide in soil to be degraded so that its concentration decreases by one-half.

#### HARVESTING (TIMBER HARVESTING)

The felling, skidding, processing, loading and transporting of forest products.

#### HARVEST PERIOD

That period of years before rotation age when a stand is operable, plus that period of years after rotation age during which a stand can be carried without incurring an unacceptable loss in volume due to disease or mortality. The harvest period will vary by species and site.

#### **HIGH WATER MARK**

(See ordinary high-water mark.)

#### HISTORIC AREA

An area in which there are features (structures, archaeological sites, or a combination of the two) that reflect historic uses. Examples include roads and trails, formal plantings, parks and building complexes.

#### HISTORIC BUILDING

Any complex construction created and used by people to shelter their social, cultural and economic activities. Common types of historic buildings in forested areas include houses, barns, sawmills, churches, hotels and schools. (See historic structure.)

#### HISTORIC STRUCTURE

A functional construction built for a purpose other than providing shelter. Examples include fire towers, rail grades, bridges, dams, silos, kilns and canals. (See historic building.)

#### **HOMOGENEOUS STAND**

A stand that has approximately the same basic features throughout and requires the same silvicultural treatment.

#### INFILTRATION

The process by which water passes through the soil surface.

#### **INFRASTRUCTURE**

The network of access roads, approaches, trails and landings used to move equipment onto and around a forest management site.

#### INTERMEDIATE CUT

A cut made in a stand past the sapling stage for the purpose of improving the stands composition and character by removing trees of less desirable species, form and condition in the main crown canopy.

#### **INTEGRATED PEST MANAGEMENT (IPM)**

Selection, integration and use of management actions based on scientific knowledge of forest systems, including insects and pathogens, in order to achieve desirable economic, ecological and sociological forest management goals.

#### **INTERMITTENT STREAM**

A stream that flows only after rainfall or snowmelt and, therefore, is dry most of the year.

#### LABEL

The information printed on or attached to the pesticide container or wrapper.

#### LAKE

A still waterbody which (1) is navigable, (2) has an ordinary high water mark and (3) has a bed that indicates "reasonably permanent" surface water.

#### LANDING (LOG DECK)

A place where trees and logs are gathered in or near the forest for further processing or transport.

### LARGE WOODY DEBRIS (BMPs FOR WATER QUALITY)

Large logs, generally at least 12 inches in diameter with an anchored root ball, that have fallen into streams creating stable structures and a diversity of cover conditions and habitat for aquatic organisms.

#### **LEACHING**

Downward movement of a pesticide or other soluble material through the soil as a result of water movement.

#### **LEAVE LOG**

All or part of a felled live tree that is deliberately left on a site to provide fresh coarse woody debris. (See coarse woody debris.)

#### **LEAVE TREES**

Live trees selected to remain on the site to provide present and future benefits, including shelter, resting sites, cavities, perches, nest sites, foraging sites, mast and coarse woody debris.

#### **LOGGING DEBRIS**

(See slash.)

#### MANAGEMENT ALTERNATIVES

The range of possible management objectives for a given site.

#### MANAGEMENT OBJECTIVE

Decision as to the forest type and products to grow on a site; it may be by natural maintenance or natural conversion or forced type conversion to one cutting cycle.

### MANAGEMENT PRESCRIPTION OR RECOMMENDATION

The specific treatment or style of cutting that should be performed on a given stand over the next 10 years based on the management objective.

#### **MAST**

Nuts, seeds, catkins, flower buds and fruits of woody plants that provide food for wildlife.

#### **MATERIAL SAFETY DATA SHEET (MSDS)**

The basic hazard communications tool that provides details on chemical and physical dangers, safety procedures and emergency responses for a particular chemical.

#### **MERCHANTABILITY**

Trees of size and quality suitable for commercial marketing and utilization.

#### **MULCH**

A natural or artificial layer of plant residue or other materials covering the land surface that conserves moisture, holds soil in place, aids in establishing plant cover, and minimizes temperature fluctuations.

#### **MULCHING**

Providing any loose covering for exposed forest soils, such as grass, straw, bark, or wood fibers, to help control erosion and protect exposed soil.

#### NATIONAL REGISTER OF HISTORIC PLACES

A nationwide program which recognizes sites, structures, objects, buildings and districts that are significant in national, regional, state or local history, architecture or archaeology.

#### NATURAL COMMUNITY

A group of native plants and animals that interact with each other and their environment in ways not greatly altered by modern human activity.

#### **NAVIGABLE**

A waterway is navigable if it has bed and banks, and it is possible to float a canoe or other small craft in the waterway on a regular reoccurring basis – even if only during spring runoff.

#### NONPOINT SOURCE POLLUTION

Occurs when rainfall or snowmelt runoff moves across the ground, carrying pollutants into streams, lakes, wetlands, and groundwater. For example, soil can become a pollutant when water runoff moves across a road and carries large amounts of soil into a waterbody.

#### **NUTRIENT CYCLING**

The process by which nutrient elements move into, out of, and within an ecosystem.

#### **NUTRIENTS**

Mineral elements in the forest ecosystem, such as nitrogen, phosphorus or potassium, that are naturally present or may be added to the forest environment by such forest practices as application of fertilizer or fire retardant. Nutrients are necessary for the growth and reproduction of organisms. In water, nutrients are those substances that promote growth of algae and bacteria (chiefly nitrates and phosphates).

#### **OPERABILITY**

Level of merchantable volume per acre.

#### ORDINARY HIGH-WATER MARK

The point on the bank or shore up to which the presence and action of the water is so continuous as to leave a distinct mark either by erosion, destructions of terrestrial vegetation, or other easily recognized characteristic.

#### ORGANIC DEBRIS

Particles of vegetation or other biological material that can degrade water quality by decreasing dissolved oxygen and by releasing organic solutes during leaching.

#### **OUTSLOPE**

To shape the road surface to cause drainage to flow toward the outside shoulder.

#### **OVERSTORY**

Trees comprising the main stand or canopy, usually described as the primary timber type.

#### PERENNIAL STREAMS

A stream that flows throughout most (i.e. greater than 50 percent) of the year.

#### **PERSISTENCE**

The time it takes for a pesticide in soil to degrade to the point where it's no longer active.

#### **PESTICIDE**

A chemical compound or biological agent used for the control of undesirable plants, animals, insects or diseases.

#### POLE TIMBER

Hardwood trees ranging in size from five to 11 inches DBH, and conifers ranging in size from five to nine inches DBH.

#### POTENTIAL CAVITY TREE

A tree at least six inches in diameter showing signs of physical injury or decay and susceptible to excavation by birds.

#### PRESCRIBED BURNING

The controlled application of fire to wildland fuels in either their natural or modified state, under specified environmental conditions. These conditions allow the fire to be confined to a predetermined area, while at the same time producing the fire intensity and rate of spread required to attain planned resource management objectives.

#### **PRIMARY TYPE**

Forest type named after the tree species that is being managed for a harvest cycle and usually comprises over 50 percent of the stand.

#### **RAKING**

A mechanical method of removing stumps, roots and slash from a future planting site.

#### **RECON**

Compartment reconnaissance. A system of mapping timber stands and recording silvicultural data and management needs on a stand basis.

#### REGENERATION

The process of replacing older trees removed by harvest or disaster with young trees.

#### **REGIONAL FLOOD**

A flood which is expected to occurs on a particular lake, river or stream once in every 100 years (also called the 100-year flood).

#### **RESERVE AREA**

A portion of the management area set aside for a special purpose or use or to protect specific resources.

#### RESIDUALS

Trees selected to remain on the site to provide present and future benefits.

#### RIPARIAN AREA

The area of land and water forming a transition from aquatic to terrestrial ecosystems along streams, lakes and open water wetlands.

#### RIPARIAN MANAGEMENT ZONE (RMZ)

Land and vegetation areas next to lakes and streams where management practices are modified to protect water quality, fish and other aquatic resources. These areas are complex ecosystems that provide food, habitat and movement corridors for both aquatic (water) and terrestrial (land) communities as well as helping to minimize nonpoint source pollution impacts to surface water.

#### **RIPRAP**

Rock or other large aggregate that is placed to protect streambanks, bridge abutments, outflow of drainage structures, or other erodible sites from runoff or wave action.

#### RISK

Refers to the mechanical stability of a tree. It's the estimate of the chance or degree of probable loss within the next cutting cycle.

#### **ROTATION (ROTATION AGE)**

The period of years required to grow timber crops to a specified condition of maturity.

#### RUT

Depressions made by the passage of a vehicle or equipment.

#### **SAPLINGS**

Trees ranging from one to five inches in DBH.

#### **SAWTIMBER (LARGE)**

Trees larger than 15 inches DBH.

#### **SAWTIMBER (SMALL)**

Hardwood trees ranging in size from 11 to 15 inches DBH, and conifer trees ranging in size from nine to 15 inches DBH.

#### **SCARIFICATION**

The process of removing the forest floor or mixing it with the mineral soil by mechanical action preparatory to natural or direct seeding or the planting of tree seedlings.

#### **SEDIMENT**

Soil that has eroded from the land surface, often by overland water flow, and is then transported and deposited away from its original location.

#### **SEEDLINGS**

Trees from germination to one inch DBH.

#### **SEED TREE CUTTING**

Operation that leaves a residual of scattered trees after cutting to provide a seed source for regeneration.

#### **SELECTION CUTTING**

Cutting system whereby single trees or groups of mature trees are removed at regular intervals

#### SHADE TOLERANCE

(See tolerance.)

#### **SHEARING**

A site preparation method that involves the cutting of brush, trees, or other vegetation at ground level using tractors equipped with angled or V-shaped blades.

#### SHELTERWOOD CUTTING

A cut leaving a residual of trees that provides seed source for regeneration and protection for seedlings.

#### SILT FENCE

A temporary barrier used to intercept sediment-laden runoff from small areas.

#### SILVICULTURE

The theory and practice of controlling forest establishment, composition, structure and growth. Silvicultural practices consist of the various treatments that may be applied to forest stands to maintain and enhance their utility for any purpose.

#### SITE PREPARATION

A silvicultural activity to remove unwanted vegetation and other material, and to cultivate or prepare the soil for regeneration.

#### SITE

An area evaluated for capacity to produce a particular forest or other vegetation based on the combination of biological, climatic and the soil factors present.

#### SKID (SKIDDING)

Short-distance moving of logs or felled trees from the stump to a point of loading.

#### **SKID TRAIL**

A temporary, nonstructural travel way for logging equipment, called skidders, to drag felled trees or logs to the landing for further processing, loading, and transport to a mill.

#### **SLASH**

Any tree tops, limbs, bark, abandoned forest products, windfalls or other debris left on the land after timber or other forest products have been cut.

#### **SLOPE**

Degree of deviation of a surface from the horizontal, measured as a numerical ratio, as a percent, or in degrees. Expressed as a ratio, the first number is the horizontal distance (run) and the second number is the vertical distance (rise), as 2:1. A 2:1 slope is a 50 percent slope. Expressed in degrees, the slope is the angle from the horizontal plane, with a 90 degree slope being vertical (maximum) and a 45 degree slope being a 1:1 slope.

#### SNAG

A standing dead tree.

#### SOIL COMPACTION

The increase in soil density resulting from loads applied to the soil surface.

#### SOIL PRODUCTIVITY

The capacity of soil, in its normal environment, to support plant growth.

#### SOLUBILITY

The ability of a pesticide to dissolve in water or other solvents. The greater the solubility in water, the greater the chance that the pesticide will leach to ground water or move in solution to surface water.

#### **STAND**

A contiguous group of trees sufficiently uniform in species composition, arrangement of age classes, and condition to be a homogeneous and distinguishable unit.

#### **STREAM**

A watercourse that (1) has an ordinary high-water mark; (2) has bed and banks; (3) flows at least periodically; (4) has an easily identifiable beginning and end; (5) does not lose its character as a watercourse even though it may break up and disappear temporarily and reappear downstream.

#### **SUCCESSION**

Gradual replacement of one plant community by another. Succession progresses from shade intolerant species to increasingly shade tolerant species.

#### **SUCKERS**

Numerous sprouts originating from the rood system of stump of the parent tree, generally following a cut or fire.

#### SUSTAINABILITY

Meeting the needs of the present without compromising the ability of future generations to meet their own needs.

#### SUSTAINABLE FOREST MANAGEMENT

Development, protection and use of forest resources for achievement of economic and social well-being without damaging the forest resource base or compromising the ability of future generations to meet their own needs.

#### **TAKE**

To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, root up, cut, sever, or to attempt to engage in any such conduct upon an animal or plant. A term used with discussions on endangered and threatened animal or plant species.

#### THREATENED SPECIES

A species likely to become endangered in the foreseeable future throughout all or a significant portion of its range.

#### **TIMBER HARVESTING**

The felling, skidding, processing, loading and transporting of forest products, roundwood or logs.

#### **TIMBER STAND IMPROVEMENT (TSI)**

Forest management practices intended to either improve growth and form of intended crop trees or manipulate stand composition.

#### **TOLERANCE**

Capacity of a tree to develop and grow in the shade of and in competition with other trees.

#### TOXICITY

The measure of the capacity of a pesticide to cause injury.

#### **TRANSPIRATION**

Evaporation which enter the atmosphere from the soil through plants.

#### TURNOUT (BMPs FOR WATER QUALITY)

A drainage ditch that drains water away from roads and road ditches.

#### **UNDERSTORY**

Any plants growing under the canopy formed by others. Trees growing under the overstory layer; also called the secondary timber type.

#### **UNEVEN-AGE MANAGEMENT**

A system of management used in types which will regenerate under their own shade. All ages, from seedlings to mature trees, are mixed together in the same stand. Harvesting is done by removing selected mature trees at regular intervals (selective cutting). The harvested trees are replaced by growth on the younger trees left in the stand.

#### **VIGOR**

The measure of the growth potential of an individual tree. It describes the tree and it's ability to grow at a rapid rate and increase net volume.

#### **VISUAL QUALITY**

A subjective measure of the impact that viewing an object, landscape or activity has on a person's perception of attractiveness.

#### **WATER BAR**

A shallow trench or diversion dam which diverts roadside ditch and surface water runoff from roads (inactive or closed), firebreaks, or skid trails (active or inactive) into a dispersions area. Water bars are used to minimize erosion and provide conditions for natural or artificial revegetation.

#### WATER QUALITY

The chemical, physical and biological characteristics of water, usually in respect to its suitability for a particular purpose.

#### WATERSHED

The surrounding land area that drains into a lake, river or river system.

#### WETLAND

An area where water is at, near or above the land surface long enough to be capable of supporting aquatic or hydrophytic (water loving) vegetation and which has soils indicative of wet conditions.

#### **WET LINE**

A wet line is a line of water, or water and chemical fire retardant, sprayed along the ground, and which serves as a temporary fireline from which to ignite or stop a low-intensity fire.

#### WILDFIRE

Uncontrolled fire occurring in forest land, brushland and grassland.

#### WILDLIFE

All forms of life that are wild, including plants, animals and microorganisms.

#### WINDFIRM

The ability of a tree to withstand strong winds and resist windthrow (blowdown) and major breakage.

#### WINDROW

Logging debris and unmerchantible woody vegetation that has been piled in rows to decompose or to be burned: or the act of constructing these piles.

#### WINDTHROW

A tree or trees uprooted by the wind (also known as blowdown timber).

#### **YARDING**

Method of transport from harvest area to storage landing.

#### APPENDIX A: MARKING GUIDELINES

The tables in this Appendix are taken from the WDNR Silviculture and Forest Aesthetics Handbook 2431.5. They illustrate a system for evaluating risk and vigor primarily for timber management considerations. Trees that are surplus to target stocking levels can be marked – or crop trees can be selected – according to the priorities in these tables.

Readers should refer to the *Silviculture and Forest Aesthetics Handbook* for additional marking criteria relative to wildlife, aesthetics and water quality.

Marking Priority Guide Risk refers to the mechanical stability of the tree. It's the estimate of chance or degree of probable loss within the next cutting cycle.

**Vigor** is the measure of growth potential of an individual tree. It describes the tree, and its ability to grow at a rapid rate and increase in net volume.

To properly apply these marking guides, classify the tree first by risk and then by vigor (assign each 1, 2, or 3, from the lowest to the highest) using the

|      | VIGOR |     |     |
|------|-------|-----|-----|
| RISK | 1     | 2   | 3   |
| 1    | 10th  | 9th | 6th |
| 2    | 8th   | 7th | 5th |
| 3    | 3rd   | 2nd | 1st |
| Cull | -     | 4th | -   |

"Tree Risk and Vigor Grading Rules." The next step is to determine how the tree ranks in terms of cutting priority by referring to the above "Marking Priority Guide."

A tree classified as Risk 2 and Vigor 3 would be ranked fifth in marking priority. A Risk 3/Vigor 3 tree would receive the highest marking priority whereas a Risk 1/Vigor 1 tree would receive the lowest marking priority. Risk 3 trees receive a higher priority than cull trees because of the potential for higher value loss.

Frequent initial reference to this tree classification system will quickly establish familiarity with the system and proper marking habits.

### Tree Risk Grading Rules

|   | GOOD GROWING<br>STOCK   | FAIR GROWING<br>STOCK   | POOR GROWING<br>STOCK   | CULL   |
|---|---|---|---|--------|
| TREE RISK<br>QUALIFICATIONS                         | Risk 1  | Risk 2  | Risk 3  | Risk 4 |
| Risk of mortality<br>after moderate<br>partial cuts | Good mechanical stability; roots firm; lower and upper bole sound; all large, high crotches strong; not windfall or main stem breakage anticipated. | Average mechanical stability; roots firm; moderate rot in lower trunk has no effect on risk of loss, large high crotches strong; loss of tree not likely within 10 years. | Poor mechanical stability; roots sprung; large high weak crotches; weak, butter-churn butts; excessive dieback; epidemic disease or insect damage; loss of tree likely within five to 10 years. | Cull   |

### Tree Vigor Grading Rules

| TREE VIGOR<br>QUALIFICATIONS        | Vigor 1   | Vigor 2   | Vigor 3  | Vigor 4 |
|-------------------------------------|---|---|--|---------|
| Crown Class                         | Head dominant;<br>dominant;<br>co-dominant.   | Dominant;<br>co-dominant;<br>intermediate;<br>free to grow if<br>overtopped.  | Suppressed;<br>suppressed not<br>free to grow are<br>always Vigor 3  | Cull    |
| Crown Size                          | In hardwoods,<br>a full crown<br>concentrically.<br>In conifers, a good<br>crown-length ratio.                | In hardwoods, a _ to _ full crown concentrically.  In conifers, a fair to good crown-length ratio.                          | In hardwoods,<br>a crown less<br>than half full<br>concentrically.<br>In conifers, a poor<br>crown-length ratio.                                       | Cull    |
| Crown Density and<br>Leaf Condition | Good silhouette;<br>healthy leaf;<br>occasional dead<br>branch in outer<br>crown; permits<br>natural pruning. | Fair silhouette; fair leaf condition; some dead branches in outer crown; large branch stubs on upper bole.                  | Poor silhouette;<br>leaves small,<br>yellowing;<br>considerable<br>dieback and many<br>branch stubs on<br>upper and middle<br>bole.                    | Cull    |
| Bole Length<br>and Form             | Useable length<br>commensurate with<br>site; DBH-length<br>ratio good; no<br>usable length<br>stoppers.       | Useable<br>length fairly<br>commensurate with<br>site; DBH-length<br>ratio fair; usable<br>length stopper on<br>upper bole. | Useable length far short of the average for the site; DBH-length ratio poor; trees permanently sub-merchantable in length are always Vigor 3 or worse. | Cull    |
| Rot and Decay                       | Cull loss never<br>exceeds 10%;<br>slight crook or<br>sweep will cut out.                                     | Cull loss never<br>exceeds 20%;<br>moderate crook<br>or sweep will not<br>cut out.  | Cull loss never<br>exceeds 60%;<br>heavy crook or<br>sweep will not<br>cut out.  | Cull    |

| APPENDIX B: SAMPLE TIM   | BER SALE CONTRACT  |
|--|--|
| This Contract is entered into, by and between  |  |
| this agreement. (Pur   | chaser). Contact information is listed in par. 43 of   |
| The Seller hereby authorizes the Purchaser to enter uppurposes of cutting and removing timber marked or oth  |  |
| County:  | Town Name:   |
| Town:; Section;  | Legal Description(s):  |
| Town:; Section;  | Legal Description(s):  |
| Those Premises are further described on the map(s) or o  | diagram(s) attached to and made a part of this Contract.   |
| FOR AND IN CONSIDERATION of the following terms ar   | d conditions, the Seller and Purchaser mutually agree:   |
| of harvest. Notification under this paragraph may b  | by both parties and only after submission and so required under it.  Burchased under this Contract shall be conducted in workmanlike manner with reasonable diligence to ntract period specified in par. 2. The Purchaser hours prior to commencing harvest of the timber ng. In the event that the harvest is temporarily er agrees to notify the Seller or the Seller's Agent 's Name) both upon discontinuance and resumption |
| <ul> <li>a. All work under this Contract shall be completed bet and (contract ending data amendments or extensions may not be relied upon performance under this Contract.</li> <li>b. The Seller may temporarily suspend operations under the conditions or at other reasonable<sup>2</sup> times upon the conditions.</li> </ul> | hte), FOR TIME IS OF THE ESSENCE. Contract by the Purchaser for the purpose of completing ler this Contract due to excessive property damage,  |

<sup>1</sup> Where options are listed with "OR," strike the option(s) that does not apply.

<sup>2 &</sup>quot;Reasonable" in this contract is defined as fair, proper, just, moderate, and suitable under the circumstances, not arbitrary or capricious.

| 3. Contract Extensions. If extensions of this Contract are deemed reasonable by the Seller, the stumpage price agreed upon herein shall be adjusted as follows:  a. First six-month extension: 0% increase b. Second six-month extension: 5% increase c. Additional six-month extensions: 10% increase d. Other applicable charges or fees:   |
|---|
| <b>4. Termination.</b> The Seller may terminate this Contract by oral or written notice to the Purchaser upon its breach. Upon such notice, the Purchaser shall cease all operations on and immediately leave, and not return to, the Seller's property unless otherwise provided by the Seller.  |
| <ul> <li>DOWNPAYMENT, BOND, REMEDIES, AND DAMAGES</li> <li>5. Downpayment. The Purchaser has given the Seller a down payment in the form of cash, a certified check, or other form acceptable to the Seller in the amount of \$</li></ul>   |
| 6. Bond. The Purchaser has deposited cash, a surety bond, a certified check, or other form acceptable to the Seller in the amount of \$ (if none, enter "zero") as a performance bond to assure proper performance. The performance bond is to be held by the Seller until the Purchaser has completed or complied with all contract conditions. Upon breach of any condition of this Contract, the performance bond shall be applied to actual damages incurred by the Seller. The performance bond (or any balance after damages are deducted) shall be returned to the Purchaser within 60 days of the completion of the harvest consistent with the contract, if the Purchaser notifies the Seller in writing that the harvest is finished. |
| 7. Remedies. If timber or other forest products not specifically described in this Contract or designated by the Seller for cutting are cut, unreasonably damaged or removed by the Purchaser, the Seller may pursue any and all remedies for the unlawful use of the Seller's property and the cutting, unreasonable damage or removal of property without consent, including the seeking of criminal or civil charges for theft, timber theft or criminal damage to property, in addition to any Contract remedies for breach.  |
| 8. Damages. The damages to be paid to the Seller upon the Purchaser's failure to perform this Contract  |
| include, but are not limited to:  a. The difference between the Purchaser's bid value of timber not cut and removed under this Contract and the value returned to the Purchaser. The Seller agrees to mitigate the damages for breach by offering the timber for resale within 12 months if the Seller determines the timber is salable based upon its volume or quality.   |
| b. Triple average stumpage rate established in NR 46.30, Wisconsin Administrative Rules, for timber cut, removed or unreasonably damaged without authorization under or in violation of this Contract. The Seller's decision to assess triple damages as provided here and to allow the Purchaser to continue performance   |
| under this contract shall not be construed as a waiver of other contract performance requirements. c. All costs of sale area cleanup or completion of performance not completed by the Purchaser.   |
| d. All costs of resale of timber not cut and removed as required under this Contract.   |
| <ul><li>e. The Purchaser agrees if the timber identified in this Contract for cutting is to be resold due to a breach of this Contract, the Seller is not obligated to give oral or written notice to the Purchaser of the resale.</li><li>f. Additional damage provisions:</li></ul>   |
|   |

#### PRODUCTS TO BE REMOVED

- 9. No forest products may be removed from the Premises until the Purchaser pays for the products or guarantees payment for the products to the satisfaction of the Seller.
- 10. Title to stumpage and any forest products cut under this Contract shall remain with the Seller until payment is received. Title to stumpage and cut products that are not cut and removed before the end of the contract period, even though paid for, shall revert to the Seller, and the Seller shall be under no obligation to return payments to the Purchaser.

| 11. During the period of this contract, the Purchaser is authorized and shall cut, remove and pay for the |  |
|---|--|
| timber or forest products marked or designated as follows:  |  |
| <u> </u>  |  |
|   |  |

### SALE TYPE, SCALING, HAULING AND PAYMENTS

12. Sale Type<sup>3</sup> (select one of the following three choices and strike the others).

LUMP SUM SALE: The Purchaser agrees to pay Seller an amount of \$\_\_\_\_\_\_, to be paid in full prior to the commencement of timber cutting, based on the volume estimates and unit values in Par. 14 Timber Products Table. The Seller is not obligated to return the payment or any portion of it in the event the Purchaser fails to remove all timber or forest products authorized for removal.

#### -OR-

#### -OR

SCALED PRODUCTS SALE: GRADED PRODUCT METHOD. The payment as established by the Price per Unit in Par. 14 shall be based on the volume of graded products including fuel wood, pulpwood, sawbolts, sawtimber by grade, veneer by grade and piece products (such as posts and utility poles) by grade. In addition to product dimension, the price paid depends upon the quality or intended use of the cut product or type of processing facility the cut product is destined. The volume and grade shall be determined by \_\_\_\_\_\_ (Name), an agent of the Seller/Purchaser/primary processing facility (the Mill or its agent) to whom the Purchaser delivers the product and to whom the cut product is sold (strike the choices that do not apply).

<sup>3</sup> Lump sum and scaled products-flat rate methods are the most commonly accepted sale types. Landowners may have difficulty in finding purchasers willing to enter into graded product method sales, which are more difficult to administer.

<sup>4</sup> For example, cordwood delivered to a paper mill would be paid for as pulpwood. Cordwood delivered to a sawmill would be paid for as sawbolts or sawlogs.

- 13. Hauling Procedure<sup>5</sup> and Payment Schedule for Scaled Sales. (Select one of the following two choices and strike the other.)
- ➤ ON SITE SCALE. No products may be hauled from the Seller's property until scaled and paid for or payment has been arranged to the Seller's satisfaction in writing. Removing products otherwise shall be a violation of this contract and considered theft.

#### -OR-

➤ MILL SCALE. The Purchaser shall keep a record of each load removed and its destination. Addresses of the Mills where wood products are to be delivered shall be given to the Seller before cutting begins. The Purchaser shall provide Mills with the Seller's name and address for each load and request Mills to provide copies of the mill scale slips to the Seller within \_\_\_\_ days of receipt of the wood products. Failure to keep a record of any load and its destination shall be a violation of this contract and considered theft. Payments shall be made according to the following schedule (pick one of the following three choices and strike the others):

The Purchaser shall pay the Seller for the products delivered to the Mill, as measured on the mill scale slip, within \_\_\_\_ days of delivery. The Purchaser shall include copies of the mill scale slips with payments.

#### -OR-

➤ Payment to the Seller shall be made in advance of hauling, with the value of the measured volume on the mill scale slips deducted from the Purchasers stumpage payment balance. The Seller agrees that advance stumpage payments shall not be used for any purpose other than the stumpage account and that any excess payments will be returned to the Purchaser within 60 days after the last load is hauled from the Seller's property.

#### -OR-

- → The Mill shall make payments for delivered products directly to the Seller within \_\_\_\_ days of delivery by the Purchaser. Copies of the mill scale slips shall be included with payments to the Seller.
- 14. **Timber Products Table.** The Purchaser agrees to pay the Seller the unit price for the volume of product by species that is harvested. In the case of lump sum sales, the unit prices shall be used for sale add-ons or calculation of damages.

| Species to be<br>Harvested | Product (Sawtimber,<br>Cordwood, Posts,<br>Poles, etc. | Estimated<br>Volume | Price per Unit (MBF <sup>5</sup> ,<br>Cord, Piece, etc.) | Total Value<br>of Estimated<br>Volume |
|----------------------------|--|---------------------|--|---------------------------------------|
|                            |  |                     |  |                                       |
|                            |  |                     |  |                                       |
|                            |  |                     |  |                                       |
|                            |  |                     |  |                                       |
|                            |  |                     |  |                                       |
|                            |  |                     |  |                                       |
|                            |  | _                   | Total Estimated Value:                                   |                                       |

<sup>5</sup> Information about an additional "Ticket System" for log hauling is also available from DNR, but is seldom used on private lands.

<sup>6 &</sup>quot;MBF" means "thousand board feet."

- 15. Sawtimber volumes shall be determined by the Scribner Decimal C system (required for land enrolled under the Managed Forest Law or Forest Crop Law programs in Wisconsin).
- 16. Cord means 128 cubic feet of wood<sup>7</sup>, air and bark assuming careful piling. Peeled cordwood and chips shall be converted to standard cords using the Wisconsin DNR conversion specifications published in chapter NR 46.30 (1) c and e, Wisconsin Administrative Code.
- 17. The volumes of timber indicated in this Contract or other appraisal or cruise documents of the Seller are estimates. The Seller gives no warranty or guarantee respecting the quantity, quality or volume of marked or otherwise designated timber or forest products on the sale area.

#### UTILIZATION AND OPERATIONS

- 18. **Stump Height**; **Tops**. Tree stumps shall be cut as close to the ground as practical, otherwise maximum stump height shall not exceed stump diameter; and for stumps ten or more inches in diameter, stumps shall not exceed 10" in height. For sales including cordwood products, trees shall be utilized to a 4" minimum top diameter. Title to tops shall remain with the Seller and may not be utilized by the Purchaser, or at the Purchaser's direction, unless otherwise specified in this Contract.
- 19. **Waste**. The Purchaser agrees to complete all operations and performance as described in this Contract without waste or nuisance on the sale area or any other property of the Seller or adjoining land used in conjunction with the harvest and use reasonable care not to damage trees not designated or marked for cutting. Young trees bent or held down by felled trees shall be promptly released.
- 20. **Zone Completion.** The Purchaser agrees to complete all operations on each portion of the sale area or each zone as designated on the sale area map, or other attachments or in the cutting requirements before beginning cutting in the next portion or zone, unless agreed to otherwise by the Seller.
- 21. Roads, Landings, Mill Sites, Campsites, Erosion Control, Best Management Practices (BMPs).
  - a. When not otherwise designated by the Seller, the location of roads, landings, mill sites and campsites on Seller's property are subject to advance approval and under the conditions established by the Seller. All restoration, cleanup or repair of roads, bridges, fences, gates, landings, mill sites and campsites, or the cost of the cleanup, if not completed by the Purchaser to the reasonable satisfaction of the Seller, is the responsibility of the Purchaser.
  - b. Logging debris accumulated at landing areas shall be scattered within the sale area to the reasonable satisfaction of the Seller.
  - c. Berms constructed on the Seller's property shall be leveled to restore the area to the Seller's satisfaction unless they are constructed at the direction of the Seller under sub d.
  - d. Roads and landings shall be graded or closed upon the request of and to the Seller's satisfaction upon completion or termination of this Contract.
  - e. Other restoration requirements (e.g., seeding, gravel, rutting, culvert removal, etc.):\_\_\_\_\_
  - f. The Purchaser agrees to comply with the Best Management Practices (BMP) guidelines as described in *Wisconsin's Forestry Best Management Practices for Water Quality* published by the Wisconsin Department of Natural Resources, publication FR-093. Identify BMPs of particular concern:\_\_\_\_\_\_

<sup>7</sup> Mills may measure cordwood with a 4" trim allowance, resulting in 133 cubic feet.

- 22. **Other Approvals.** Logging roads that intersect town, county or state roads or highways must have the intersections approved by the proper authorities prior to construction and cleared of all unsightly debris at the time of construction. The Purchaser agrees to apply for and obtain all approvals. The Purchaser also agrees to fully comply with all terms and conditions of intersection approvals.
- 23. **Survey Monuments.** The Purchaser agrees to comply with s. 59.635, Wis. Stats., regarding perpetuation of landmarks and pay for the cost of repair or replacement of property or land survey monuments or accessories which are removed, destroyed or made inaccessible.
- 24. **Forest Fire Prevention.** The Purchaser agrees to take reasonable precautions to prevent the starting and spreading of fires. Those precautions include, but are not limited to:
  - a. A minimum of one fully charged five pound or larger ABC fire extinguisher with a flexible spout shall be carried on each off-road logging vehicle.
  - b. All chainsaws and all non-turbocharged off-road logging equipment used in the operation shall be equipped with spark arrestors that have been approved by the U.S. Forest Service. Such arrestors may not be altered in any manner or removed and shall be properly maintained.
  - c. If a fire occurs, the Purchaser agrees to promptly report the fire and cooperate in the control and suppression of the fire.
  - d. The Purchaser shall comply with requests regarding forest fire prevention and suppression made by the Seller and take all reasonable precautions to prevent, suppress and report forest fires. Those requests may include ceasing or modifying operations.
  - e. The Purchaser shall be responsible for damage and forest fire suppression costs, including that provided in ss. 26.14 and 26.21, Wis. Stats., caused by their operation under this Contract. f. Other:

| 25 | Slash Removal. Slash as defined in s. 26.12, Wis. Stats., shall be disposed of as follows:  a. Slash falling in any lake or stream, in a right-of-way or on land of an adjoining landowner shall be                         |
|----|---|
|    | immediately removed from the waters, right-of-way or adjoining land. Tops from felled trees may not be left hanging in standing trees. All trees shall be completely felled and not left leaning or hanging in other trees. |
|    | b. Other:   |

### 26. Cleanup and Use of Sale Area.

- a. The Purchaser shall remove equipment, tools, solid waste and trash remaining on the sale area or Seller's property or adjoining land used in conjunction with the harvest upon completion of performance under this Contract, termination of this Contract due to breach by the Purchaser or when requested by the Seller.
- b. No residence, dwelling, permanent structure, or improvement may be established or constructed on the sale area or other property of the Seller.

- 27. **Hazardous Materials.** The Purchaser agrees to properly use and dispose of all petroleum and hazardous products, including but not limited to oil, oil filters, grease cartridges, hydraulic fuel and diesel fuel. Any on-site spillage must be properly reported, removed and cleaned up by the Purchaser in accordance with applicable statutes and rules of the State of Wisconsin.
- 28. Additional Utilization and Operation Requirements and Instructions:
  - a. Pine products that are harvested must be removed from the site within two weeks if cut between April 15 and August 15.
  - b. Oak wilt prevention: where residual oak trees will be left, no cutting is allowed between April 15 and August 15.
  - c. No trees or products over 16 feet in length may be skidded within the cutting area without written permission of the Seller.

| d. Other (If none, state None.) |  |
|---------------------------------|--|
| ,                               |  |
|                                 |  |

### NOTICE OF INTENT TO CUT AND COMPLIANCE WITH LAWS

- 29. The Seller/Purchaser (select one) shall file required cutting notices and cutting reports to the responsible DNR forester for lands that are under the Forest Crop Law and Managed Forest Law programs.
- 30. The Seller/Purchaser (select one) shall file a declaration annually<sup>8</sup> with the county clerk in any manner acceptable to the county of his or her intentions to cut forest products pursuant to section 26.03, Statutes, and comply with all other notice requirements, laws and ordinances with respect to work under this Contract.
- 31. The Seller and Purchaser shall work together on acquiring other necessary permits (such as wetland or stream crossing permits).

### TITLE, BOUNDARY LINES AND ACCESS

- 32. The Seller guarantees title to the timber and to defend it against any and all claims and to have the boundaries marked with paint or other suitable means before any timber is harvested.
- 33. The Seller agrees to secure entry and right-of-way to the Purchaser on and across the area covered by this contract, including access via land owned by a third-party if necessary.

### LIABILITY AND INSURANCE

34. The Purchaser agrees to protect, indemnify and save harmless the Seller and the Seller's employees and agents from and against all causes of action, claims, demands, suits, liability or expense by reason of loss or damage to any property or bodily injury to any person, including death, as a direct or indirect result of timbering operations under this Contract or in connection with any action or omission of the Purchaser, who shall defend the Seller in any cause of action or claim.

<sup>8</sup> County cutting notices expire by law on December 31 and so must be renewed annually.

- 35. Unless the Purchaser is exempted by the Seller from this coverage requirement as an independent contractor, as defined in s. 102.07(8)(b), Stats., and as determined by the Seller based on an affidavit submitted to it, the Purchaser agrees to elect to maintain worker's compensation insurance coverage for the cutting operation under this Contract and any and all employees engaged in cutting on the Seller's land during the period of this Contract regardless of any exemptions from coverage under chapter 102, Wis. Stats. The Purchaser must provide an original certificate of insurance naming the Seller as a certificate holder so the insurance carrier can notify the Seller should the insurance expire.
- 36. The Purchaser agrees to furnish the Seller with a certificate of public liability insurance covering the period of logging operations on the Seller's property for:
  - a. \$1,000,000 single limit liability for personal injury or \$1,000,000 bodily injury per person and \$1,000,000 per occurrence; and
  - b. \$100,000 property damage.

### **GENERAL**

- 37. The Purchaser is an independent contractor for all purposes including Worker's Compensation and is not an employee or agent of the Seller. The Seller agrees that the undersigned Purchaser, except as otherwise specifically provided herein, shall have the sole control of the method, hours worked, time and manner of any timber cutting to be performed hereunder. The Seller reserves the right only to inspect the job site for the sole purpose of insuring that the cutting is progressing in compliance with the cutting practices established under this Contract. The Seller takes no responsibility for supervision or direction of the performance of any of the harvesting to be performed by the undersigned Purchaser or it's employees. The Seller further agrees to exercise no control over the selection and dismissal of the Purchaser's employees.
- 38. The Seller agrees to initially designate the timber to be sold and may make inspections for the purposes of ascertaining whether the timber has been cut and the Contract has been complied with. All work shall be performed in a workman-like manner. Work shall be performed in accordance with the requirements of the contract. The parties stipulate that in fulfillment of the terms of this timber sale Contract, the Seller warrants that the Seller has clear and unencumbered title to the stumpage subject to this Contract.
- 39. This Contract or work under it may not be assigned or subcontracted in part or in whole without prior written approval from the Seller and may be changed or amended only in writing. The Purchaser agrees to notify the surety, if any, of any such change or amendment.
- 40. This Contract, together with specifications in the request for bids as well as reference to parts and attachments, shall constitute the entire agreement and any previous communications or agreements pertaining to this Contract are hereby superseded. Any amendments to this Contract shall be in writing, signed and dated by both parties.
- 41. Neither party shall be liable for defaults or delays due to acts of god or the public enemy, acts or demands of any government or governmental agency, strikes, fires, flood, accidents or other unforeseeable causes beyond its control and not due to its fault or negligence. Each party shall notify the other in writing of the cause of such delay within five days after the beginning thereof. If such uncontrollable circumstances continue for 30 days and prevent either party from complying with the terms of this agreement, either party shall have the option of terminating upon ten days notice to the other.

- 42. This contract shall be governed by the laws of the State of Wisconsin. The Purchaser shall at all times comply with all federal, state, and local laws, ordinances and regulations in effect during the contract period.
- 43. **Contact Information.** (Note: Separate from this form, the Seller and Purchaser are encouraged to provide one another with their Social Security Number or Federal Employer ID Number, needed to file tax returns or other financial documents.)

| Seller<br>Name:            | Purchaser Name:                           |  |
|----------------------------|---|--|
| Address:                   | Address:                                  |  |
|                            | Phone:                                    |  |
| Cell Phone:                | Cell Phone:                               |  |
| We have read and understan | d the entire contract comprised of pages. |  |
| Date:                      | Cignotium of College                      |  |
|                            | Signature of Seller                       |  |
| Date:                      | Signature of Purchaser                    |  |
|                            | SIGNATURE OF PURCHASEL                    |  |

### APPENDIX C: MFL ENTRY REVIEW CHECKLIST

| Land Owner Name:                            | Order No:                                  |              |           |          |
|---|--|--------------|-----------|----------|
| LAND ELIGIBILITY (ALL ANSWERS M             | UST BE TRUE)                               |              | TRUE      | FALSE    |
| Each parcel is at least 10 contiguous acre  | <del>2</del> S.                            |              |           |          |
| Each parcel is at least 80 percent produc   | tive.                                      |              |           |          |
| Land is not in a city.                      |  |              |           |          |
| Land is not part of a recorded plat.        |  |              |           |          |
| Land meets width requirement (120 ft. or    | 4:1 ratio).                                |              |           |          |
| ENTRY PACKET COMPLETE                       |  |              |           |          |
| Check: ☐ Land Listing                       | ☐ Map (original)                           | ☐ Land Exa   | m (origi  | nal)     |
| ☐ Plan (original and 1 copy)                | ☐ Other pertinent documents/letters        |              |           |          |
| ☐ Complete application (including           | g deeds, tax bills, other important docume | nts submitte | ed by lan | d owner) |
| APPLICATION (ORIGINAL):                     |  | YES          | NO        | N/A      |
| Original application (as received from Ma   | ndison).                                   |              |           |          |
| Signed by all owners listed on the deed(s   | ) plus spouse(s) if applicable.            |              |           |          |
| Lien holder and life estate holder signatur | re present.                                |              |           |          |
| Land contract holder signature present.     |  |              |           |          |
| Indicated if new entry or addition.         |  |              |           |          |
| Indicated choice of contract lengths.       |  |              |           |          |
| Indicated choice for open or closed acrea   | age.                                       |              |           |          |
| Deed(s) represent the acreage being enter   | ered and includes 100 percent of ownersh   | nip. 🗆       |           |          |
| Deed(s) show that all land being entered    | under same ownership.                      |              |           |          |
| No timber cutting restrictions on deed, or  | appropriate steps taken.                   |              |           |          |

| PLAN: (SEE PLAN CHECKLIST TOO)  | YES | NO      | N/A      |
|---|-----|---------|----------|
| Plan addresses everything on Plan Checklist   |     |         |          |
| Contract period correct.  |     |         |          |
| County and municipality listed correct.   |     |         |          |
| Legal description (Tn, Rng, Sec) matches land listing, land exam and map.   |     |         |          |
| Acreage (total) matches land listing, land exam and plan.   |     |         |          |
| Addition: acres being added are clearly identified.   |     |         |          |
| Pages numbered and includes correct order number on all pages.  |     |         |          |
| Landowner objectives completed.   |     |         |          |
| Gypsy Moth consideration included.  |     |         |          |
| NHI reviewed and mentioned.   |     |         |          |
| All landowner and spouses signatures present and original.  |     |         |          |
| Forester's signature present and original.  |     |         |          |
|   |     |         |          |
| LAND LISTING: Contact Landowner and address matches land exam   | YES | NO      | N/A<br>□ |
| LAND LISTING: Contact Landowner and address matches land exam.  All owners names listed in owner/address block or further down on form (Other Owners:).   | YES | NO<br>□ | N/A      |
| Contact Landowner and address matches land exam.  All owners names listed in owner/address block or further down on   |     |         |          |
| Contact Landowner and address matches land exam.  All owners names listed in owner/address block or further down on form (Other Owners:).   |     |         |          |
| Contact Landowner and address matches land exam.  All owners names listed in owner/address block or further down on form (Other Owners:).  Owners listed match deed(s).   |     |         |          |
| Contact Landowner and address matches land exam.  All owners names listed in owner/address block or further down on form (Other Owners:).  Owners listed match deed(s).  Order # matches and on all pages of the entry packet.  |     |         |          |
| Contact Landowner and address matches land exam.  All owners names listed in owner/address block or further down on form (Other Owners:).  Owners listed match deed(s).  Order # matches and on all pages of the entry packet.  Legal description (Tn, Rng, Sec, Descrip) matches map, land exam and plan.  |     |         |          |
| Contact Landowner and address matches land exam.  All owners names listed in owner/address block or further down on form (Other Owners:).  Owners listed match deed(s).  Order # matches and on all pages of the entry packet.  Legal description (Tn, Rng, Sec, Descrip) matches map, land exam and plan.  Parcel I.D. numbers listed.   |     |         |          |
| Contact Landowner and address matches land exam.  All owners names listed in owner/address block or further down on form (Other Owners:).  Owners listed match deed(s).  Order # matches and on all pages of the entry packet.  Legal description (Tn, Rng, Sec, Descrip) matches map, land exam and plan.  Parcel I.D. numbers listed.  Certified Survey Map listed if applicable (Lot, CSM #, Vol, Page).   |     |         |          |
| Contact Landowner and address matches land exam.  All owners names listed in owner/address block or further down on form (Other Owners:).  Owners listed match deed(s).  Order # matches and on all pages of the entry packet.  Legal description (Tn, Rng, Sec, Descrip) matches map, land exam and plan.  Parcel I.D. numbers listed.  Certified Survey Map listed if applicable (Lot, CSM #, Vol, Page).  Description codes correct (Handbook Appendix).   |     |         |          |
| Contact Landowner and address matches land exam.  All owners names listed in owner/address block or further down on form (Other Owners:).  Owners listed match deed(s).  Order # matches and on all pages of the entry packet.  Legal description (Tn, Rng, Sec, Descrip) matches map, land exam and plan.  Parcel I.D. numbers listed.  Certified Survey Map listed if applicable (Lot, CSM #, Vol, Page).  Description codes correct (Handbook Appendix).  Acreage (open/closed/total) matches map, land exam and plan. |     |         |          |

| MAP (ORIGINAL):   | YES | NO | N/A      |
|---|-----|----|----------|
| <sup>1</sup> / <sub>2</sub> inch blank margin at top, <sup>1</sup> / <sub>2</sub> inch clear margin on sides and bottom.  |     |    |          |
| Neat, legible and proper scale (8" = 1 mile).   |     |    |          |
| One section per map.  |     |    |          |
| Non standard sections – section corners and <sup>1</sup> / <sub>4</sub> corners identified.   |     |    |          |
| Correct order number.   |     |    |          |
| Correct county and municipality listed.   |     |    |          |
| Appropriate type, size and density for each stand.  |     |    |          |
| Area(s) being entered highlighted with approved highlighter.  |     |    |          |
| Adjoining lands identified.   |     |    |          |
| Buildings, area excluded form entry, etc. are clearly identified.   |     |    |          |
| Closed area identified and within acreage limits.   |     |    |          |
| Acreage (open/closed/total) matches land listing, land exam and plan.   |     |    |          |
| Legal description (Tn, Ran, Sec, Descrip) matches land listing, land exam and plan.   |     |    |          |
|   |     |    |          |
| LAND EXAM (ORIGINAL):   | YES | NO | N/A      |
| LAND EXAM (ORIGINAL): Landowner info matches land listing (only contact landowner will be listed).  | YES | NO | N/A<br>□ |
| •   |     |    |          |
| Landowner info matches land listing (only contact landowner will be listed).  |     |    |          |
| Landowner info matches land listing (only contact landowner will be listed).  Correct Order number.   |     |    |          |
| Landowner info matches land listing (only contact landowner will be listed).  Correct Order number.  Correct county and municipality listed.  |     |    |          |
| Landowner info matches land listing (only contact landowner will be listed).  Correct Order number.  Correct county and municipality listed.  Legal description (Tn, Rng, Sec) matches land listing, land exam and plan.  |     |    |          |
| Landowner info matches land listing (only contact landowner will be listed).  Correct Order number.  Correct county and municipality listed.  Legal description (Tn, Rng, Sec) matches land listing, land exam and plan.  One Section per page.   |     |    |          |
| Landowner info matches land listing (only contact landowner will be listed).  Correct Order number.  Correct county and municipality listed.  Legal description (Tn, Rng, Sec) matches land listing, land exam and plan.  One Section per page.  Acreage (total) matches land listing, land exam and plan.  |     |    |          |
| Landowner info matches land listing (only contact landowner will be listed).  Correct Order number.  Correct county and municipality listed.  Legal description (Tn, Rng, Sec) matches land listing, land exam and plan.  One Section per page.  Acreage (total) matches land listing, land exam and plan.  New entry or addition checked.  |     |    |          |
| Landowner info matches land listing (only contact landowner will be listed).  Correct Order number.  Correct county and municipality listed.  Legal description (Tn, Rng, Sec) matches land listing, land exam and plan.  One Section per page.  Acreage (total) matches land listing, land exam and plan.  New entry or addition checked.  Landowner objective entered.  |     |    |          |
| Landowner info matches land listing (only contact landowner will be listed).  Correct Order number.  Correct county and municipality listed.  Legal description (Tn, Rng, Sec) matches land listing, land exam and plan.  One Section per page.  Acreage (total) matches land listing, land exam and plan.  New entry or addition checked.  Landowner objective entered.  Stand information complete.   |     |    |          |
| Landowner info matches land listing (only contact landowner will be listed).  Correct Order number.  Correct county and municipality listed.  Legal description (Tn, Rng, Sec) matches land listing, land exam and plan.  One Section per page.  Acreage (total) matches land listing, land exam and plan.  New entry or addition checked.  Landowner objective entered.  Stand information complete.  Scheduled practices and codes match plans stand description. |     |    |          |

### APPENDIX D: PESTICIDE LAWS AND RULES

### Federal Laws

Commercial Driver's License (CDL) Standards, Code of Federal Regulations, Title 49, Part 383.

Comprehensive Environmental Response Compensation and Liability Act (CERCLA), Code of Federal Regulations, Title 40, parts 300-302. For information on CERCLA, call 1-800-424-9346.

Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), Code of Federal Regulations, Title 40, parts 152-186, For information on FIFRA, call 703-305-5805.

Hazard Communication Standard (HCS), Code of Federal Regulations, Title 29, part 1910.1200. For information on HCS, call OSHA's regional office at 312-353-2220.

Hazardous Materials Transportation and Training, Code of Federal Regulations, Title 49, parts 171-177. For information on hazardous material transportation or training requirements, call 202-366-6121.

Resource Conservation and Recovery Act (RCRA), Code of Federal Regulations, Title 40, parts 260-281. For information on RCRA, call 1-800-424-9346.

Superfund Amendments and Reauthorization Act (SARA), Code of Federal Regulations, Title 40, parts 350-372. For information on SARA, call 1-800-424-9346.

Workers Protection Standard (WPS) for Agricultural Pesticides, Code of Federal Regulations, Title 40, part 170. For information on WPS, call 703-305-7666.

Copies of federal acts (either complete CFR volumes or single copies of daily Federal Registers) can be purchased from: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402, phone 202-512-1800. Complete CFR volumes also can be acquired from: U.S. Government Bookstore, Suite 150, Reuss Federal Plaza, 310 W. Wisconsin Avenue, Milwaukee, WI 53203. Phone 414-297-1304.

State Laws

### WISCONSIN DEPARTMENT OF TRADE AND CONSUMER PROTECTION

Wisconsin Pesticide Law (Wisconsin Statutes, Sections 94.67-94.71).

Pesticide Review Board and Pesticide Advisory Council. (Wisconsin Statutes, Section 140.77).

Wisconsin Groundwater Law. (Wisconsin Statutes, Chapter 160).

Pesticide Use and Control. (Wisconsin Administrative Code, Chapter ATCP 29).

Pesticide Product Restrictions. (Wisconsin Administrative Code, Chapter ATCP 30).

Groundwater Regulatory Rule. (Wisconsin Administrative Code, Chapter ATCP 31).

Pesticide Bulk Storage, (Wisconsin Administrative Code, Chapter ATCP 33).

Copies of the above laws are available from: Wisconsin Department of Agriculture, Trade and Consumer Protection, 2811 Agriculture Drive, P.O. Box 8911, Madison, WI 53708-8911. Phone 608-224-4500.

### WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Use of Pesticides on Land and Water Areas of the State of Wisconsin. (Wisconsin Administrative Code, Chapter NR 80).

Aquatic Plant Management. (Wisconsin Administrative Code, Chapter NR 107).

Implementation of Groundwater Quality Standards. (Wisconsin Administrative Code, Chapter NR 140).

Hazardous Waste Management. (Wisconsin Administrative Code, Chapter NR 600 Series).

Wisconsin Spill Law. (Wisconsin Statutes, Chapter 144.76).

Hazardous Substances Discharge Notification and Source Confirmation Requirements. (Wisconsin Administrative Code, Chapter NR 706).

Use of Pesticides to Control Wild Animals. (Wisconsin Statutes, Sections 29.29, 29.596, and 29.60).

Copies of the above laws and rules are available from: Wisconsin Department of Administration, Document Sales Unit, P.O. Box 7840, Madison, WI 53707-7840. Phone 608-266-3358.

### WISCONSIN DEPARTMENT OF EMERGENCY GOVERNMENT

Wisconsin SARA Law. (Wisconsin Statutes, sections 166.20 - 166.22).

Copy of this law is available from: Wisconsin Department of Emergency Government, 2400 Wright Street, Madison, WI 53704. Phone 608-242-3232.

### WISCONSIN DEPARTMENT OF TRANSPORTATION

Wisconsin Commercial Driver's License Law. (Wisconsin Act 105)

Copy of the CDL manual is available from: Wisconsin Department of Transportation, Division of Motor Vehicles, Bureau of Driver Services, P.O. Box 7917, Madison, WI 53707-7917. Phone 608-266-2237. Wisconsin CDL hotline is 1-800-242-2514.

# APPENDIX E: REGULATIONS RELATING TO FOREST MANAGEMENT AND WATER QUALITY

Below is a list of regulations relating to forest management and water quality that you should be aware of. Other regulations may also apply to your operations. For more information, contact a Wisconsin DNR water management specialist. This is only a summary of laws and their provisions for your information. Please refer to actual law for their complete requirements to assure compliance. Local zoning laws may be available at county zoning or DNR offices.

#### Federal Laws

### Section 404 of the Clean Water Act.

Under section 404, the US Army Corps of Engineers requires permits for the alteration wetlands and for the discharge of dredged or fill material into the waters of the United States (33 CFR 323.3). (Waters of the United States includes wetlands. There is a general exemption from section 404 for "normal farming, silvicultural, and ranching activities including plowing, seeding, cultivating, minor drainage, and harvesting for the production of food,

fiber, and forest products, or upland soil and water conservation practices" (33 CFR 323.4). This is not a blanket exemption. There are 15 BMPs for "construction and maintenance of farm roads, forest roads, or temporary roads..." These 15 BMPs are listed in Chapter 10: Forest Roads. This exemption also does not allow for activities that would convert a wetland from one use to another.

### **Occupational Safety and Health Standards**

29 CFR OSHA 1910.120 HAZWOPER - Hazardous waste operations and emergency response.

Paragraph (q) covers competency levels people need to conduct various response actions to a spill.

#### State Laws

### WISCONSIN STATE STATUTES

Chapter 26, Stats. - Protection of Forest Lands.

S. 26.03, Stats. - Cutting Forest Products, requires that before any person cuts a forest product in any private forest, a cutting notice must be filed with the county clerk.

S.26.12(6), Stats. - Forest Protection Areas, Organization, Emergency Fire Wardens, County Cooperation, Setting Fire – Slash Disposal. All slash, which during the process of cutting timber or taking out other forest products, falls into or is deposited in any lake or stream or on the land of an adjoining owner, shall be immediately removed therefrom by the timber owner or cutting operator when in the opinion of the department such removal is in the public interest.

### Chapter 28, Stats. - Public Forests.

- S. 28.05(1), Stats. Timber Sales; State Forests, requires that cutting shall be limited to trees marked or designated for cutting by a forester.
- S. 28.11(6)(b)2, Stats. Administration of County Forests, requires that timber sale presale appraisal methods and procedures shall be approved by the Wisconsin DNR.
- S. 28.21, Stats. In a municipal forest registered with the Wisconsin DNR, no trees shall be cut except those marked or designated for cutting by a Wisconsin DNR forester.

#### Chapter 29, Stats. - Fish and Game.

- S. 29.601(3), Stats. Noxious substances, regulates the deposit of deleterious substances, such as sand, stone, garbage and sawdust, into navigable waters.
- S. 29.604, Stats. Endangered and threatened species protected. No person shall take, transport, possess, process, or sell within this state any animal specified by the DNR's Endangered and Threatened Species List. In addition, it is illegal to remove, transport, carry away, cut, root up, sever, injure, or destroy a wild plant on the Wisconsin Endangered Species List on public lands. Forestry practices are exempted for the taking prohibitions of listed plant species.

# Chapter 30, Stats. - Navigable Waters, Harbors and Navigation.

This chapter requires permits or approvals from the state of Wisconsin for certain activities.

S. 30.12, Stats. - Permits to place certain structures in navigable waters. This section regulates stream fords, which are usually gravel or concrete planks.

- S. 30.123, Stats. Bridge Construction and Maintenance. This section requires permits for construction and maintenance of bridges and culverts for crossings of navigable waters. A "bridge" means a structure to convey people, animals and vehicles over navigable waters and includes pipe arches and culverts.
- S. 30.18, Stats. Diversion of water from lakes and streams. This section requires a permit for diverting water from a stream.
- S. 30.19, Stats. Enlargement and protection of waterways or constructing a pond within 500 feet of the OHWM of a navigable waterway. This section requires a permit for grading and/or removal of top soil from the bank of any navigable water where the area exposed will exceed 10,000 square feet.
- S. 30.195, Stats. Changing of stream courses. Permits are required to change the course of or straighten a navigable stream.
- S. 30.20, Stats. Removal of material from beds of navigable waters. This section regulates the removal of material from the beds of navigable lakes and both navigable and non-navigable streams.
- S. 30.26, Stats. Wild Rivers. This section designates certain rivers as wild rivers, thereby preserving them in a free flowing condition and protecting them from development. It also directs the DNR to provide active leadership in the development of a practical management policy and to work with local governments, US Forest Service, timber companies, county foresters and private landowners in implementing land use practices to accomplish these management objectives.
- S. 30.27, Stats. Lower St. Croix River preservation. This section codifies the 'national wild and scenic river' designation to the Lower St. Croix River between the dam near St. Croix Falls and its confluence with the Mississippi River. This section also provides authority for the DNR to adopt guidelines and standards for local zoning ordinances in order to protect the banks, bluffs, and bluff tops of the lower Saint Croix River.

S. 30.29, Stats. - Operation of motor vehicles in waters prohibited. This section prohibits the operation of a motor vehicle in or on any navigable water or the exposed bed of a navigable water. However, exempted activities include (1) agriculture activities (which includes forest management) and (2) operating a motor vehicle on the surface of any navigable water which is frozen.

## Chapter 30.40 - 30.49, Stats – Lower Wisconsin State Riverway.

S. 30.44(3), Stats. - Forestry. This section requires a permit for timber cutting and harvesting on land in the Lower Wisconsin State Riverway. The cutting and harvesting of timber shall comply with the rules regulating timber cutting and harvesting promulgated by the DNR under s.30.42(1)(d) or by the LWSR Board under s.30.43(3).

### Chapter 94, Stats. - Pesticides.

Chapter 94 regulates the sale, handling, and use of pesticides. For more information, refer to Chapter 13: Pesticide Use or ATCP 29 administrative code - Pesticide Use and Control.

### Chapter 281, Stats. - Water and Sewage.

S. 281.20, Stats. - Department of Natural Resources, Powers and Duties.

- (1)(a) This section states that the DNR, in consultation with the Department of Agriculture, Trade and Consumer Protection, may order or cause the abatement of pollution which the DNR has determined to be significant and caused by a nonpoint source, as defined in S.281.65(2)(b), including pollution which causes the violation of a water quality standard and pollution which significantly impairs aguatic habitat or organisms.
- (3)(a)1 If the DNR determines under sub. (1)(a) that significant pollution is caused by a nonpoint source, the department shall send a written notice of intent to issue an order to abate the pollution to the person whom the DNR determines to be responsible for the nonpoint source. The notice shall include a date by which that person is required to abate the pollution.

### Chapter 287, Stats. - Solid Waste.

S. 287.07(1m)(b), Stats.- Prohibits the dumping of waste oil on the ground. S. 287.15 defines waste oil as any oil after use or which is contaminated through storage or handling before that oil is recycled.

### Chapter 292, Stats. - Remedial Action.

S. 292.11, Stats. – Hazardous substances spills. This section requires that a person who causes the discharge of a hazardous substance to immediately notify state and local authorities unless the discharger holds a valid permit and discharges the substances within the limits authorized by the permit. A hazardous substance is a substance which may pose a substantial present or potential hazard to human health or the environment because of its quantity, concentration or physical, chemical or infectious characteristics (292.01(5)). For more information, refer to Chapter 9: General Operational Guidelines or NR 158 Administrative Code – Contingency Plan for Emergency Actions in Response to the Discharge of Hazardous Substances.

Chapter 348, Stats. - Vehicles: Size, Weight and Load. SS.348.17, 349.15 and 349.16, Stats. - Special or Seasonal Weight Limitations. No person shall operate a vehicle in violation of special weight limitations imposed by state or local authorities on particular highways, highway structures, or portions of highways when signs have been erected giving notice of such weight limitations.

# WISCONSIN ADMINISTRATIVE CODES (ADMINISTRATIVE RULES)

Chapter ATCP 29, Wis. Adm. Code - Pesticide Use and Control.

This code regulates the registration, licensing, certification, manufacturing, use, storage, and sale of pesticides in Wisconsin.

### Chapter NR 27, Wis. Adm. Code - Endangered and Threatened Species

Most forestry activities are exempted from regulations on impacts to endangered or threatened *plant* species. However, consideration for these species is encouraged by the DNR (per DNR NHI Screening Guidance). The presence of aquatic endangered species at stream crossings will be reviewed when applying for a stream crossing permit.

# Chapter NR 37, Wis. Adm Code - Lower Wisconsin State Riverway Aesthetic Management Specifications for Cutting and Harvest of Timber.

The rules establish management specifications for timber harvesting in the Lower Wisconsin State Riverway to minimize impacts on the scenic beauty and natural value of the riverway.

NR.37.04, Wis. Adm. Code - Timber management cutting and harvesting specifications. This section limits timber cutting and harvesting to times where the ground is frozen or dry. Also, erosion bars or culverts will be installed as necessary to prevent erosion. The Lower Wisconsin State Riverway Board is located at 202 N. Wisconsin Street, P.O. Box 187, Muscoda, WI 53573. Telephone 800-221-3792.

### Chapter NR 103, Wis. Adm. Code - Water Quality Standards for Wetlands.

NR 103 establishes wetland water quality standards, criteria, and implementation procedures for the application of these standards. NR 103's qualitative standards are based upon affects to wetland functional values. In addition, standards consider the need for a project to be located in a wetland (wetland dependency) and require the consideration of "practicable alternatives" to avoid wetland impacts. NR 103 applies to all Wisconsin DNR decisions in regulatory, planning, resource management, liaison and financial aid determinations that may affect wetlands and require a water quality certification and determination. Note: The best management practices in Chapter 5: Riparian Management Zones and Wetlands and Chapter 10: Forest Roads do not meet all NR 103 standards.

For forest management activities requiring state chapter 30, or a federal section 404 permit, the state of Wisconsin must determine if the activity meets the wetland water quality standards in NR 103. If the activity does not meet NR 103 standards, then the chapter 30, or section 404 permit can not be issued.

- Forest management activities on state lands must consider NR 103 standards.
- Forest management activities on private lands must comply with NR 103 when a chapter 30, or section 404 permit is required. On private lands that do not require a permit, NR 103 standards are not required.
- Forest management activities on county lands must follow NR 103 standards:
  - (1) when a chapter 30, or section 404 permit is required
  - (2) for county forest ten-year comprehensive land use plans and
  - (3) for county forest withdrawals.

# Chapter NR 115, Wis. Adm. Code - Wisconsin's Shoreland Management Program.

S. NR 115.05(3)(c), Wis. Adm. Code - Counties are required to adopt minimum standards for the cutting of trees and shrubbery in unincorporated areas to be included in county shoreland ordinances to protect the natural beauty, control erosion and reduce the flow of effluents, sediments and nutrients from the shoreland area. This section includes the following three restrictions:

- In the strip of land 35 feet wide inland from the ordinary high-water mark, no more than 30 feet in any 100 feet shall be clear cut.
- In shoreland areas more than 35 feet inland, trees and shrub cutting shall be governed by consideration of the effect on water quality and consideration of sound forestry practices and soil conservation practices.
- The tree and shrubbery cutting regulations required by this paragraph shall not apply to the removal of dead, diseased or dying trees or shrubbery.

Many counties have adopted more protective regulations than required by Chapter NR.115.

Counties have the option to adopt language to allow submittal of a special cutting plan to allow greater cutting that permitted by the standards in Chapter NR 115. If a county has adopted this language, their shoreland zoning ordinance will authorize the Planning and Zoning Committee (PZC) or the Board of Adjustment (BOA) to issue conditional use permits or special exception permits to exceed the shoreland cutting regulations. The PZC or BOA may grant a permit only if it finds that the cutting plan will not cause undue erosion or destruction of scenic beauty. The cutting plan must also provide for substantial visual screening from the water of dwellings, accessory structures and parking areas. If the plan calls for replacement planting, the county may require submission of a performance bond to quarantee performance of the replacement trees and shrubs. Not all counties have adopted this provision.

Counties are also required by Chapter NR 115 to limit permitted uses in shoreland-wetlands. Shoreland-wetlands are those wetlands, located within the shoreland zone, which are five acres in size or larger. Some counties regulate shoreland-wetlands under five acres and may also regulate isolated wetlands. Silvicultural activities are generally allowed in shoreland-wetlands provided precautions are taken in the construction and maintenance of logging roads. A zoning permit is required to construct logging roads in shoreland-wetlands.

It remains the responsibility of the logger or landowner to conform and comply with all zoning requirements.

# Chapter NR 116, Wis. Adm. Code - Wisconsin's Floodplain Management Program.

Lands subject to hazards from the 100-year flood (also called the regional flood or the one percent chance flood) are mapped and regulated under county, city and village zoning ordinances. NR 116 does not have specific references to forest management practices, however, several sections do apply.

It's illegal to store logs and slash in the floodplain because they would be an obstruction to flood flow.

S. NR 116.12(1)(c), Wis. Adm. Code - states that municipalities shall prohibit the storage of materials that are buoyant, flammable, explosive, or injurious to human, animal, plant, fish, or other aquatic life in floodway areas (lands necessary to convey flood flows without obstruction; generally associated with moving water).

S. NR 116.12(2), Wis. Adm. Code - states that all uses and structures (for loggers this would generally refer to stream crossings or culverts) must pass the 100-year flood event without causing an increase of 0.01 feet or greater in the regional flood elevation. In the event they do not, easements may be required from affected upstream landowners for the increased flooding.

S. NR 116.13(6), Wis. Adm. Code - states that for flood fringe areas (floodplain areas outside of the floodway which are covered by flood water during the 100 year flood), the storage of any materials which are buoyant, flammable or explosive, or which in times of flooding could be injurious to property, water quality, or human, animal, plant, fish, or aquatic life, shall be either floodproofed or placed at or above the flood protection elevation. Adequate measures shall be taken to assure that these materials will not enter the river or stream during flooding.

# Chapter NR 117, Wis. Adm. Code - Wisconsin's City and Village Shoreland-Wetland Protection Program.

This administrative code requires cities and villages with wetlands greater than five acres in size in the shoreland-wetland zone, to adopt shoreland-wetland zoning ordinances. Some communities regulate shoreland-wetlands under five acres and may also regulate isolated wetlands. Silvicultural practices are generally allowed in shoreland-wetlands provided precautions are taken in the construction and maintenance of logging roads. A zoning permit or conditional use permit may be required to construct logging roads in shoreland-wetlands. Cities and villages do have the option however, to prohibit silvicultural activities.

It remains the responsibility of the logger or landowner to conform and comply with all zoning requirements. Contact your city or village for more information.

# Chapter NR 118, Wis. Adm. Code - Wisconsin's Lower St. Croix National Scenic Riverway Program.

This code prescribes minimum development standards for the Wisconsin side of the lower St. Croix Riverway. The regulations guide development away from sensitive areas such as shorelines, wetlands, steep slopes and unstable soils.

S. NR 118.06(11), Wis. Adm. Code - states that on lands within 200 feet of the ordinary high-water mark, and 40 feet landward of the bluffline: removal of trees and shrubs is not permitted; however, the removal of diseased or damaged trees, the pruning of trees, cutting of shrubs or grasses, or harvesting of non-wood fiber crops is allowed; Also, forestry practices are allowed on woodland tax law or forest crop law lands as long as it is done in a manner that protects the scenic beauty of the river. Vegetative cutting elsewhere in the Lower St. Croix River District may be conducted only where it's accessory to a permitted or conditionally permitted activity.

S. NR 118.06(12), Wis. Adm. Code - Grading and filling of the natural topography in excess of that normally required for the construction of a structure or for normal yard maintenance must comply with applicable state laws. The application for a permit must include a detailed plan and schedule of the earth moving activities including a plan that shows how vegetative cover will be reestablished at what density and within what timeframe.

Some municipalities have ordinances meeting or exceeding the state minimum standards.

### Chapter NR 158, Wis. Adm. Code - Notification of the Discharge of Hazardous Substances

S. NR 158.05, Wis. Adm. Code - Discovery and Notification Requirements. The discharger of a hazardous substance shall immediately notify the department or the designated statewide 24-hour emergency number provided by the division of emergency government. The discharger shall immediately initiate actions necessary to halt the discharge and to restore the environment to the extent practical and shall minimize the harmful effects from any discharge to the air, lands or waters of the state.

# Chapter NR 302, Wis. Adm. Code - Management of Wisconsin's Wild Rivers.

This administrative code protects three legislatively designated wild rivers from development: the Pike River in Marinette county, the Pine River in Florence and Forest counties, and the Popple River in Florence and Forest counties. Section NR 302.03(1)(e) states that on lands owned by or under control of the DNR by lease, easement or agreement, timber harvesting is not permitted within 150 feet of the bank on either side of the wild river, except as necessary for erosion control or natural restoration. Beyond 150 feet, timber cutting in accord with guidelines established in the DNR silvicultural and forest aesthetics handbook shall be practiced.

### Chapter NR 320, Wis. Adm. Code - Bridges In or Over Navigable Waterways.

This code includes provisions to protect water quality from the construction and maintenance of bridges, including those used for forest roads. Erosion control, floodflow, clearance and navigation requirements are addressed.

### APPENDIX F: PERMITS

In addition to the BMPs described in this manual, you should be aware of existing municipal, county, state and federal regulations relating to forest management and water quality. Many of these regulations are listed in Appendix E: Regulations. Other laws and regulations may apply. Chapter 2: Permits summarizes several permits related to the regulations in Appendix E. For more information, contact your county zoning office or a Wisconsin DNR water management specialist when conducting forest management activities near streams, lakes, or wetlands.

Legal definitions of a lake, a stream (intermittent and perennial), navigability, and ordinary high-water mark are listed in Chapter 5: Riparian Management Zones and the Glossary.

Permits for Water Quality Several regulations in Appendix E state that certain operations in or near streams, lakes, floodplains or wetlands require a permit.

If you are planning an activity near a waterbody or a wetland, you should investigate the need for a permit at least 90 days in advance of the activity.

### STREAM CROSSINGS

A stream crossing permit is required to construct a ford or install a culvert or bridge across a navigable perennial or intermittent stream (Chapter 30, Wis. Stats.). When planning to construct a stream crossing or modify, repair or expand an existing stream crossing, call a water management specialist at a Wisconsin DNR office for information and to apply for a permit. For stream crossings that are not designed to pass the 100-year flood without causing backwater, you will need to obtain flooding easements from affected upstream property owners.

### **GRADING**

Grading and/or removal of top soil from the bank (defined in glossary) of any navigable stream, lake or other body of navigable water where the area exposed will exceed 10,000 square feet requires a Chapter 30 permit. Call a water management

specialist at a Wisconsin DNR office to apply for a permit. Also, check with your county zoning office for local grading and excavation permits that may be required; county zoning may require permits for exposed areas less than 10,000 square feet.

### WETLANDS AND FLOODPLAINS

Activities in wetlands and floodplains are often subject to municipal, county, state and federal regulations and permit requirements. Your sequence of contacts when you suspect your project may involve a wetland or floodplain and want to know what regulations apply is: 1) your county zoning office, 2) a Wisconsin DNR water management specialist, and 3) the U.S. Army Corps of Engineers.

Maps from the Wisconsin Wetland Inventory can help you make a preliminary determination as to whether your project will affect wetlands. Wisconsin Wetland Inventory maps may be reviewed at DNR offices and county or municipal zoning offices or purchased from the Wisconsin Geological and Natural History Survey.

### TIMBER HARVESTING NEAR WATER

All cutting practices near lakes and navigable streams (i.e. generally within 100 feet) must be consistent with local county shoreland zoning ordinances. A special exception permit or conditional use permit may be required. Contact your local county zoning office for more information before harvesting near shoreland.

#### Other Permits

### **TIMBER HARVESTING**

Before harvesting timber on private land, a cutting notice must be filed with the County Clerk in the county in which the harvesting occurs (s. 26.03 Wis. state stats.). In addition, if land is entered under the Forest Crop or Managed Forest Law, you must file a notice of intent to cut with the Wisconsin DNR prior to harvesting.

Before timber may be harvested on county forest land, the DNR must be notified (s. 28.11(6)(b)2 Wis.

### APPENDIX G: REFERENCES CITED

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### APPENDIX H: RESOURCE DIRECTORY

The Resource Directory provides contacts for assistance with many forest management activities. The directory is organized by topic, with a brief description of assistance available from various agencies and organizations. This directory is not exhaustive. Links to other sources of information are available from the Internet sites listed here.

Forest Management
Guidance and Education
To locate professional resource management
assistance, check the telephone book for the
closest DNR Service Center or get a copy of the
annual Directory of Foresters published by DNR.
The directory lists:



To locate professional resource management assistance, check the telephone book for the closest DNR Service Center or get a copy of the annual Directory of Foresters published by DNR. The directory lists:

 Foresters employed by the State of Wisconsin who assist private landowners. DNR service foresters are stationed in every county. They focus on initial guidance and management planning to get landowners started with sustainable forestry. They administer forest tax and cost sharing incentive programs. DNR foresters can also help get information for landowners from forest health specialists, wildlife biologists and other resource managers at DNR.  Private enterprise foresters (consulting foresters and industrial foresters) that have signed a Cooperating Forester Agreement with the Department. Cooperating Foresters voluntarily agree to observe DNR standards and rules whenever they assist with land management planning and timber harvesting. Cooperating Foresters also agree to attend continuing education courses to stay current in the services they offer. Consulting foresters serve or represent private landowners on a contract or fee basis, which the landowner pays. Industrial foresters are employed by wood-using industries that provide advice and assistance to private landowners to promote forestry practices approved by the companies.

Pick up a copy of the Directory of Foresters from DNR Service Centers and Ranger Stations or request one by writing or calling:

Wisconsin Department of Natural Resources
Division of Forestry
P.O. Box 7921

Madison, Wisconsin 53707

Phone 608-267-7495

The directory may be viewed on-line or downloaded from the DNR Internet site: www.dnr.state.wi.us/org/land/forestry/



The University of Wisconsin-Extension is a source of bulletins about forest management, forest insect and disease pests, wildlife and many other topics of interest to landowners. Visit your local UW Extension Office or check the UW-Extension's Forest Management publications on their web sites: forest.wisc.edu/extension/forfact.htm or www1.uwex.edu/ces/pubs/.

University of Wisconsin Extension offers two extended educational opportunities for woodland owners and managers. One is an eight-course **Master Woodland Stewards** program, patterned after the Master Gardeners training. County Extension Agents and others sponsor the eight sessions, from three to four hours each, in communities around the state. They teach skills to manage private woodlands including:

- Understanding forest ecology
- · Managing for wildlife
- Managing for aesthetics

- Enhancing recreation values
- · Financial and tax considerations
- Tips on timber harvesting
- Available cost-share programs
- Dealing with forest pests and problems
- Legal issues of woodland ownership
- · .... and more.

After graduating from this course, participants are asked to volunteer a minimum of 30 hours as a forestry stewardship resource in their communities.

The second opportunity is the Wisconsin Woodland Leadership Institute. Each year, about 30 people interested in being active in forestry organizations are selected to attend three seminars of two to three days each. The seminars are held in central, northern and southern Wisconsin where participants learn about forestry issues through field trips and discussions. A variety of instructors from the U.S. Forest Service, state and local government, the University and private organizations conduct the classes.

Information about both opportunities is available from the UWSP Forestry Outreach Specialist, College of Natural Resources, Stevens Point, Wisconsin 54481-3897.

### TREE FARM® SYSTEM

The American Tree Farm® System is a nation-wide program encouraging private forest owners to do an effective job of growing trees as a crop. You may have seen a green and white Tree Farm sign on your travels around Wisconsin. Tree Farm is sponsored by professional foresters working for government agencies, industry, and as consulting foresters. Tree Farm inspectors must meet minimum education and experience requirements.

If you are interested in becoming a Tree Farmer, contact the Wisconsin Tree Farm Committee or your local DNR forester. They will arrange to have a state, private or industrial forester look at your property to prepare a Tree Farm management plan. Once certified as a Tree Farm, you can

display the sign and subscribe to the American Tree Farmer magazine. You receive notices of conferences, conventions, field days, and study tours on forestry. Certified Tree Farm landowners are also eligible to compete in annual Outstanding Tree Farmer competitions. For information on tree farming in Wisconsin, contact:

Wisconsin Tree Farm Committee P.O. Box 1375 803 Lincoln Street Rhinelander, WI 54501-1375

Phone: 715-369-3475

Email: wfpc@newnorth.net



### COMMUNITY FORESTRY RESOURCE CENTER

The Community Forestry Resource Center (CFRC), a program of the Institute for Agriculture and Trade Policy, promotes responsible forest management by encouraging the long-term health and prosperity of small, privately owned woodlots, their owners, and their communities.

The CFRC works with private landowners in Wisconsin and other parts of the country to meet their goals for forest management. Specifically, the CFRC assists landowners that are interested in forming an association or cooperative or in becoming certified through the Forest Stewardship Council (FSC). The CFRC assists with all aspects of establishing forest owner groups, including business and market planning,

management planning, and membership development. The CFRC also hosts workshops and training sessions for landowners, resource managers and loggers.

For more information about the Community Forestry Resource Center, contact:

Community Forestry Resource Center 2105 First Avenue South Minneapolis, MN 55404 Phone: 612-870-3407

Email: forestrycenter@iatp.org

To locate a wood cooperative or other local forestry association in your area, see the Community Forestry Resource Center web site at: www.forestrycenter.org.

#### WISCONSIN FAMILY FORESTS

Wisconsin Family Forests is a grassroots, community-based organization for private woodland owners that focuses on strengthening local communities through their shared interest in sustainable land management. Community connections are strengthened as neighbors work with neighbors to gain knowledge about sustainable forestry. Local resources are made available as neighbors share their forest management experiences and work together to complete joint management projects on private lands.

The local WFF alliances, usually formed at the township level, are the substance of Wisconsin Family Forests. Each alliance operates

independently at the local level as it focuses on issues of common interest to its own members. The sole function of WFF, Inc., the statewide organization, is to support established alliances as well as to offer assistance to landowner groups interested in forming alliances in their own communities. Thus, the focus of Wisconsin Family Forest remains at the local community level. For information on the WFF alliance nearest you or for assistance in forming an alliance in your community, contact:

Wisconsin Family Forests P.O. Box 682 Wisconsin Rapids, WI 54495-0682

Phone: 715-213-1618

Internet: www.wisconsinfamilyforests.org

### THE WISCONSIN FOREST PRODUCTIVITY COUNCIL

The Wisconsin Forest Productivity Council, through education, helps Wisconsin's woodland owners take the first steps toward sustainable forestry. The Council is best known for the county workshops they sponsor and the resource catalogs they publish. Both help landowners become aware of the technical, financial, and educational assistance available to them in managing their timber properties. The resource catalogs, which are specific for most counties in the state, are free upon request.

The staff of the Council is available to answer general or specific questions Wisconsin woodland owners may have about managing their forests. Additionally, they can provide landowners with names of people or companies to contact in their

area for assistance. The Executive Director is available to speak on forestry issues to clubs or other organizations.

Tax guidance is also available for Wisconsin woodland owners through the Wisconsin Forest Productivity Council. This free service is designed to answer general questions on the application of the Internal Revenue Code to timber investments.

For more information from the Forest Productivity Council, contact:

Wisconsin Forest Productivity Council P.O. Box 1375 803 Lincoln Street Rhinelander, WI 54501-1375 Phone: 715-369-3475

Email: wfpc@newnorth.net

Internet: www.wisconsinforests.org

# WISCONSIN WOODLAND OWNERS ASSOCIATION (WWOA)

WWOA is a non-profit [501(c)3], educational association for private woodland owners in Wisconsin. WWOA offers year-round educational opportunities for novice and experienced private woodland owners who want to become better stewards of their woodlands. WWOA publishes the quarterly, award-winning magazine Woodland Management and sponsors workshops, conferences, field days and an annual meeting each year in September. Local WWOA chapters, located throughout Wisconsin, are a great way to learn more about local issues and meet neighboring woodland owners. WWOA also has statewide committees on Education, Legislation, Marketing, Science, and Publications to help keep members up-to-date on information in these areas. The WWOA Foundation is developing the Seno Woodland Management Center in Southeastern Wisconsin as an educational facility for youths and adults. WWOA works to bridge the gap between woodland owners and natural resource professionals. For a free information packet on WWOA, please contact:

### RESOURCE MANAGEMENT INFORMATION ON THE WEB

The Internet has a vast selection of forestry publications from organizations around the country. If you have an Internet browser, you may want to start at A Forest Landowner's Guide to the Internet:

### www.na.fs.fed.us/pubs/misc/ir/index.htm.

It includes links to publications in the following categories: Recreation, Wildlife/Hunting, Income Tax and Estate Planning, Tree Identification/Species Information, Forest Health and Protection, Seedling Suppliers, Tree Planting, Silviculture, Timber Sales, Special Forest Products, Riparian Forest Management, Glossaries of Forestry Terms, etc.

Wisconsin Woodland Owners Association P.O. Box 285 2000 Maria Drive Stevens Point, WI 54481-0285 Phone: 715-346-4798 Email: nbozek@uwsp.edu Internet: www.wisconsinwoodlands.org

# Sources of Maps and Planning Tools: Soil Surveys, Soil Interpretations and Erosion Control

### WISCONSIN NATURAL RESOURCES CONSERVATION SERVICE

Published soil survey reports for most Wisconsin counties are available through local NRCS or county Land Conservation Department offices. Soil survey reports include:

 Detailed soil maps on an aerial photo background

- · Descriptions of the soils
- · Soil use and management information
- Soil property and interpretation information in table format

More information about soil survey reports is available from NRCS on the Internet at: www.wi.nrcs.usda.gov/soil/soilsurvey.asp

### Sources of Maps and Planning Tools: Aerial Photographs

DNR: Wisconsin DNR coordinates an aerial photography project for forestry planning. Flights are repeated at least once every ten years for each county. High-resolution prints and enlargements are available for purchase. Ordering information is available from local DNR foresters or from the central office (Division of Forestry, P.O. Box 7921, Madison, Wisconsin 53707; phone 608-267-7495). Ordering forms are also available on the DNR Internet site:

www.dnr.state.wi.us/org/land/forestry/airphoto/index.htm

The DNR Internet site includes a link to digital orthophotos, which may be viewed on-line.

**USDA**: Landowners working with the Farm Service Agency (FSA) on farm programs have access to aerial photographs maintained by the USDA. Contact your local FSA Office (in the telephone directory) for details.

USGS and Commercial Vendors: There is a growing supply of digital aerial photography and other Geographic Information System (GIS) data available over the Internet. An excellent list of resources is available at GeoCommunity, including links to free software for viewing digital imagery. GeoCommunity distributes free geographic data and maps from the USGS through the GIS DataDepot\*: www.gisdatadepot.com/

Sources of Maps and Planning Tools: Wisconsin Wetland Inventory Maps

Wisconsin Department of Natural Resources
Bureau of Fisheries Management and Habitat Protection, FH/3
P.O. Box 7921
Madison, WI 53707-7921

Phone: (608) 266-8852

### Sources of Maps and Planning Tools: Topographic Maps

### **US GEOLOGICAL SURVEY**

The United States Geological Survey (USGS) provides science for a changing world by delivering reliable and impartial information that describes the Earth, its natural processes, and its natural species. This information is used to manage water, biological, energy, and mineral resources; and to enhance and protect our quality of life. The USGS is at work in every State of the Nation, cooperating with more than 2,000 organizations to provide information for resource managers in the public and private sectors.

USGS: (800) USA-MAPS Internet: mapping.usgs.gov

### **LOCAL RETAILERS**

Topographic maps are available in a number of retail locations throughout the state, including local sporting goods stores, outfitters, bookstores

and engineering supply stores (Check the Yellow Pages under "Maps").

# WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

The WGNHS, a part of the University of Wisconsin-Extension, is an interdisciplinary organization that conducts natural resources surveys and research to produce information used for decision making, problem solving, planning, management, development, and education.

Wisconsin Geological and Natural History Survey 3817 Mineral Point Road

Madison, WI 53705-5100 Map Sales: 608-263-7389 Information: 608-262-1705

### **LOCAL LIBRARIES**

Check with local libraries for availability of maps.

Financial Incentive Programs Wisconsin offers landowners two important categories of financial incentives to help reduce the expenses of owning and caring for woodlands:

- State forest tax laws that help reduce property taxes.
- Cost sharing programs that are available from both state and federal sources, which reimburse landowners for allowable conservation project expenses.

### **FOREST TAX PROGRAMS**

Statewide, about 2,600,000 acres are enrolled in the forest tax programs. Around 27,000 landowners participate. The Managed Forest Law (MFL) is open to enrollment of tracts of land ten acres and larger in size. The application forms are available from your local DNR forester.

Under the MFL, a landowner selects a 25 or 50 year contract period. He or she receives a forestry plan covering mandatory and recommended practices for the chosen time period. The incentive for following the plan is that MFL property taxes average 80 percent less than regular property taxes. Participating landowners pay \$1.74 per acre in annual property taxes (less if the owner elects to have the land open to public access) and a five percent tax on harvested timber.

Earlier forest tax programs (now closed to enrollment) with similar provisions included the Forest Crop Law and the Woodland Tax Law. If you are buying forestland, you may come across a parcel enrolled in one of the earlier programs.

### **COST SHARING PROGRAMS**

The Wisconsin Landowner Grant Program provides \$1,250,000 annually for stewardship practices on private land. A wide array of practices is eligible for cost sharing including management plan development, wetland restoration, tree planting, and forest improvement and prairie restoration. A portion of the eligible costs can be refunded to you upon completion of the work. Landowner Grant applications are accepted continuously and approved on a first-come, first-served basis. Contact your local DNR forester for details.

The DNR foresters also help landowners with the following federal cost sharing programs:

- Conservation Reserve Program (CRP)
- Environmental Quality Incentives Program (EQUIP)
- Forest Land Enhancement Program (FLEP)
- Wildlife Habitat Incentives Program (WHIP)

Wisconsin Department of Natural Resources Division of Forestry P.O. Box 7921 Madison, Wisconsin 53707

Phone: 608-267-7495

More information is available from the DNR Internet site: www.dnr.state.wi.us/org/land/forestry/

### Cultural Resource Assistance

### STATE ARCHAEOLOGIST

Robert A. Birmingham State Archaeologist Wisconsin Historical Society 816 State Street Madison, WI 53706 Phone: 608-264-6495

### **DNR ARCHAEOLOGIST**

Victoria Dirst, PhD 952 Tacoma Beach Road Sturgeon Bay, WI 54235 Phone: 920-743-2083

### **BURIAL SITES PRESERVATION**

Leslie Eisenberg, PhD WHS: Burial Sites 816 State Street Madison, WI 53706 Phone: 608-264-6503

### HISTORIC STRUCTURES

Joe DeRose WHS: Historic Preservation 816 State Street Madison, WI 53706 Phone: 608-264-6512

# TRIBAL HISTORIC PRESERVATION OFFICERS

David Grignon
Menominee Indian Tribe
of Wisconsin
P.O. Box 910
Keshena, WI 54135-0910

Kelly Jackson Lac du Flambeau P.O. Box 67 Lac du Flambeau, WI 54538 Lisa Bresette

Red Cliff Band of Lake Superior Chippewas 88385 Pike Road, Highway 13 Bayfield, WI 54814 Phone: 715-779-3648

Will Gilmore

Lac Courte Oreilles Band of Lake Superior Chippewa 13394 W. Trepania Road Hayward, WI 54843 Phone: 715-634-8934

# WISCONSIN ARCHITECTURE AND HISTORY INVENTORY

www.shsw.wisc.edu/ahi/ welcome.asp

# ARCHAEOLOGICAL CONSULTANTS

www.shsw.wisc.edu/arch/preser ve/index.html

### Fish and Wildlife Habitat, Wetland Protection

The DNR and other agencies and organizations can help you manage and restore fish and wildlife habitat and protect wetlands. DNR offices can also provide current listings of designated trout streams (and their tributaries) and designated trout lakes.

# DNR WILDLIFE BIOLOGISTS: STATE-WIDE CONTACTS FOR STAFF AT DNR SERVICE CENTERS

### · South Central Region

- Madison, 608-275-3266
- Dodgeville, 608-935-3368
- Horicon, 920-387-7860
- Janesville, 608-743-4800
- Poynette, 608-635-8110

### · Southeast Region

- Milwaukee, 414-263-8500
- Hartford (Pike Lake), 262-670-3400
- Kettle Moraine State Forest (North), 262-626-2116
- Kettle Moraine State Forest (South), 262-594-6200
- Plymouth, 920-892-8756
- Sturtevant, 262-884-2300

### West Central Region

- Eau Claire, 715-839-3700
- Baldwin, 715-684-2914
- Black River Falls, 715-284-1400
- La Crosse, 608-785-9000
- Wausau, 715-359-4522
- Wisconsin Rapids, 715-421-7800

### · Northern Region

- Antigo, 715-627-4317
- Cumberland, 715-822-3590
- Park Falls, 715-762-3204
- Rhinelander, 715-365-8900
- Spooner, 715-635-2101
- Woodruff, 715-356-5211
- Superior, 715-392-7988

### Northeast Region

- Green Bay, 920-492-5800
- Oshkosh, 920-424-3050
- Peshtigo, 715-582-5000
- Sturgeon Bay, 920-746-2860

### Army Corps of Engineers

Army Corps of Engineers, Regulation Branch St. Paul District 190 Fifth Street East St. Paul, MN 55101-1638 Internet: www.mvp.usace.army.mil/

### Natural Resources Conservation Service

United States Department of Agriculture Natural Resources Conservation Service 6515 Watts Road, Suite 200 Madison, WI 53719

Phone: 608-264-5341

Internet: www.wi.nrcs.usda.gov/news/

### U.S. Department of Agriculture's Conservation Reserve Program

USDA, Farm Service Agency 6515 Watts Road, Suite 100 Madison, WI 53719

Phone: 608-276-8732

Internet: www.fsa.usda.gov/wi/news/

### · U.S. Fish and Wildlife Service

- USFWS Region 3: Great Lakes-Big Rivers Federal Building

1 Federal Drive

Fort Snelling, MN 55111-4056 Internet: midwest.fws.gov/

- U.S. Fish and Wildlife Service: Partners for Fish and Wildlife

and whome

State Coordinator for Wisconsin

Jim Ruwaldt

4511 Helgesen Drive

Madison, WI 53718-6747

Phone: 608-221-1206

#### Wisconsin Waterfowl Association

Wisconsin Waterfowl Association 614 West Capitol Drive

Hartland, WI 53029

Phone: 262-369-6309

Internet: www.wisducks.org/

# Integrated Pest Management and Pesticide Use

Contact a DNR forest health specialist, pest specialist, forest entomologist, or forest pathologist.

Shane Weber, Forest Entomologist Department of Natural Resources 810 West Maple Spooner, WI 54801 Phone: 715-635-4156

Kyoko Scanlon, Forest Pest Specialist Department of Natural Resources 107 Sutliff Avenue Rhinelander, WI 54501 Phone: 715-365-8934

Linda Williams, Forest Health Specialist Department of Natural Resources 1125 North Military Road Green Bay, WI 54307

John Kyhl, Forest Entomologist
Department of Natural Resources
2300 North Drive Martin Luther King, Jr. Drive
P.O. Box 12436
Milwaukee, WI 53212
Phone: 414-263-8744

Todd Lanigan, Forest Pest Specialist Department of Natural Resources P.O. Box 4001 1300 West Clairemont Avenue Eau Claire, WI 54702 Phone: 715-839-1632 Jane Cummings Carlson, Forest Pathologist Department of Natural Resources 3911 Fish Hatchery Road Fitchburg, WI 53711 Phone: 608-275-3273

### PESTICIDE APPLICATOR TRAINING AND LICENSING FOR STATE CERTIFICATION

Department of Agronomy University of Wisconsin Pesticide Applicator Training 1575 Linden Drive Madison, WI 53706-1597 Phone: 608-262-7588

# NOTIFICATION OF PESTICIDE SPILLS: REPORT ALL SPILLS TO THE WISCONSIN DEPARTMENT OF NATURAL RESOURCES

**24-hour Emergency Hotline Number: 1-800-943-0003** When answered, press "1" for spills.

### Petroleum Spills

Notification of petroleum spills: Report all Spills to the Wisconsin Department of Natural Resources.

# 24 HOUR EMERGENCY HOTLINE NUMBER: 1-800-943-0003

When the phone is answered, press "1" for spills.

### Prescribed Burning

### **OBTAINING A BURNING PERMIT**

On lands under DNR protection, contact local DNR Service Centers, Ranger Stations and DNR Emergency Fire Wardens. On lands under USFS protection, contact USFS District Ranger Stations or USFS Fire Wardens. On lands outside of DNR or USFS protection, permits might be required from the local township (see government listings in local telephone directories).

# ESTABLISHING GOALS AND CONDUCTING PRESCRIBED BURNS

See the *Directory of Foresters* for the names of consultants available to conduct prescribed burns.

### Water Crossings

### PERMIT REQUIREMENTS AND DESIGN STANDARDS; INSTALLATION OF BRIDGES AND CULVERTS, CONTACT

The nearest DNR Water Management Specialist. The DNR Internet site has complete information about waterway and wetland permits: www.dnr.state.wi.us/org/water/fhp/waterway/

### FOR DESIGN ASSISTANCE, CONTACT

Natural Resources Conservation Service (NRCS)
Wisconsin State Office

6515 Watts Road, Suite 200 Madison, WI 53719-2726 Phone: 608-264-5341

Internet: www.wi.nrcs.usda.gov/news/

# Endangered, Threatened or Special Concern Species

# Wisconsin DNR, Bureau of Endangered Resources

101 South Webster Street Madison, WI 53707-7921 Phone: (608) 266-7012

# U.S. Fish and Wildlife Service Division of Endangered Species

BHW Federal Building 1 Federal Drive Fort Snelling, MN 55111-4056 Phone: (612) 713-5360

Wisconsin Internet Site

www.dnr.state.wi.us/org/land/er/

Federal Internet Site endangered.fws.gov/wildlife.html

### APPENDIX I: ACKNOWLEDGEMENTS AND CREDITS

The Wisconsin Division of Forestry would like to thank the Minnesota Forest Resources Council and Mike Phillips of the Minnesota DNR for their pioneering work in the development of voluntary site level guidelines. Their willingness to share the fruits of three years of hard work was of enormous value to our efforts in Wisconsin. Having a solid core of quality information to build on and the guidance of Mike Phillips to help start us off on the right path made it possible to do in months what would have otherwise taken years. Thanks a lot neighbor!

The Division of Forestry would also like to thank **Dr. John Kotar** for his continuing work to provide the tools needed to constantly improve the quality of the forest management in Wisconsin. His publication, *Approaches to Ecologically Based Forest Management on Private Lands* was used heavily in the silviculture and forest management planning chapters of the guide and is just one example of his ability to bring together both ecology and silviculture for the benefit of both.

### **DEVELOPMENT TEAM FOR THE GUIDELINES**

**Darrell Zastrow**, Chief, Forestry Science Section, Team Leader

Paul Pingrey, Private Forestry Specialist

Joe Kovach, Ecologist/Silviculturalist

Mike Lietz, Forest Tax Law Field Specialist

Dale Gasser, Forest Hydrologist

Ken Sloan, Forester (retired), Contract Writer

This team was charged with development of an initial draft for review and the incorporation of comments received from reviewers. They were supported by a number of internal DNR functional experts that took the lead in revising portions of the *Minnesota Guidelines* to reflect Wisconsin needs.

### INTERNAL DNR FUNCTIONAL EXPERTS

Wildlife

John Huff, Wildlife Biologist
John Kubisiak, Wildlife Biologist (retired)

**Endangered Resources** 

Randy Hoffman, Endangered Resources Management Specialist

Cultural Resources

Victoria Dirst, PhD, Archaeologist

Forest Soils

Eunice Padley, Forest Ecologist/Silviculturalist

Water Quality

**Dick Wedepohl**, Chief, Floodplain/Shoreline Section **Jim Baumann**, Watershed Management

Pesticide Use

Jane Cummings-Carlson, Forest Pathologist

### **EXTERNAL REVIEWERS**

The Division of Forestry thanks the following people for their willingness to review the draft guidelines and provide comments that greatly improved the quality and utility of the final guidelines.

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Peter Wagner, Association of Consulting Foresters

Nancy Bozek, Wisconsin Woodland Owners
Association

Mark Rickenbach, University of Wisconsin Extension, Department of Forest Ecology

**John Kotar**, University of Wisconsin, Department of Forestry

**EXTERNAL REVIEWERS (CONTINUED)** 

**Mike Kroenke**, University of Wisconsin Basin Educator

**Geary Searfoss**, Wisconsin Forest Productivity Council

Dick Hall, Governors Council on Forestry

Jan Harms, Society of American Foresters

**Collette Mathews**, Wisconsin County Forests Association

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**Don Peterson**, Wisconsin Timber Producers Association

Alan Haney, Wisconsin Family Forests

DESIGN, GRAPHICS AND LAYOUT

Jackie Bowe, JLB Design, LLC

**Jeff Martin**, J-Mar Photography

Kenneth Sloan, Technical Writer

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Reproduction of this Guidebook is encouraged.

Any modifications, however, must first be approved by the Wisconsin Department of

Natural Resources, Division of Forestry.