A Guide to Harvesting Practices to Regenerate a Natural Forest

MANITOBA MODEL FOREST NETWORK
RÉSEAU DE FORÊTS MODÈLES

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Disclaimer

The results and conclusions in this publication are those of the authors and no official endorsement of the Manitoba Model Forest, the Canadian Forest Service, Pine Falls Paper Co., or Manitoba Conservation is intended or should be inferred.

Foreword

These operator guidelines were developed for use in that region of eastern Manitoba that is bounded the Manitoba/ Ontario border on the east, Highway 304 on the west, the Winnipeg River on the south and the Bloodvein River on the north. The wildfire disturbance regime is similar throughout this region.

Scientific research from the area was used to develop the guidelines. Landscape design guidelines were based on the statistical analysis of the patterns created by large wildfires. Six large wildfires from 1955 to 1983 with a combined area of about 75,000 ha were mapped in a GIS from 1:15,840 aerial photos. Information on post-fire and

post-harvest recovery pathways was from research conducted during the first year of the project and three years of previous research conducted by James Ehnes. Results from the landscape and site scale research are presented in two Model Forest reports.

All photographs were provided by James Ehnes unless otherwise noted.

To Contents

Acknowledgements
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The format and some of the content of this manual was inspired by a similar manual produced by Alberta Pacific Forest Industries of Alberta. Many thanks to Dr. Stan Boutin and Shawn Wasel for their input on operator guidelines.

I am very grateful to Dr. Peter Miller for his collaboration and support over the past five years. The operational goals for logging and other types of large scale development are based on ideas presented in a jointly authored book chapter.

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Table Of Contents

Ecosystem Based Management

Manitoba and many other places in North America are starting to use a new way of managing our forests called ecosystem based management. Ecosystem based management recognizes that forests are valuable for more than just pulpwood and timber. Food, firewood, medicines, spiritual activities, recreation, cottages, nature watching and trapping are just a few of the things that people get from the forest. If we want these and other forest benefits to be there for our children and grandchildren then we cannot use more than the forest can provide. Its like having to live off the interest from your investments. If you start cashing in your investments, eventually you won't have enough money to live on. We need to keep forests healthy while we use them.

The Forest Provides Many Benefits.

Jobs Culture Canoeing Fresh Air & Clean Water Nature Viewing

Fishing **Ecosystem based management means several things. Most importantly, ecosystem based management means using our lands and waters in ways that keeps them healthy so that they keep providing all the things that people want- not just for us but also for other living things and the other generations that come after us.**

To Contents

What Is Forest Ecosystem Health?

When ecosystem based management is applied to forested regions it is sometimes called sustainable forest management. In 1995, federal and provincial cabinet ministers in charge of forests (Canadian Council of Forest Ministers) developed the Criteria and Indicators of Sustainable Forest Management to help us understand what it means to maintain forest ecosystem health. We keep forests healthy by:

- Conserving natural biological diversity.
- Maintaining ecosystem condition and productivity.
- Conserving soil and water resources.
- Maintaining contributions to global ecological cycles.

People are part of the forest too. The Canadian Criteria and Indicators also include two social and economic criteria:

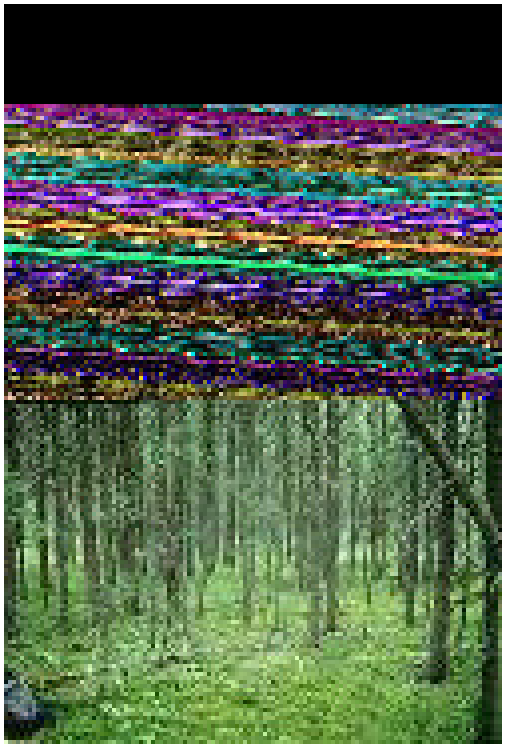
- Sustaining multiple benefits to current and future generations.
- Acceptance of society's responsibility for sustainable development.

Keeping forests healthy means maintaining biodiversity, ecosystem condition and productivity, soil and water resources and contributions to global ecological cycles.

To Contents

What Does It Mean To Conserve Biodiversity?

Biodiversity is a name for something fairly complicated. It includes all the living things in an area; from mosses, lichens and mushrooms to blueberries, ferns and spruce trees; from bacteria, ants, hummingbirds and toads to turtles, hawks, moose and bears and everything in between. Biodiversity also includes genes- the things that shape what plants and animals will look like and how they react to each other and their habitat. No two individuals from a species are exactly the same (except identical twins) because they have different genes. Biodiversity also includes the ways that plants often group together to create the types of forests, grasslands and wetlands that we see when we look down from a small plane. Maintaining biodiversity means keeping all the living pieces (the genes, plants, animals and plant communities) where and when they are found naturally.



Biodiversity is the living pieces that make up the forest. It is the collection of plants and animals found in an area, the genes that make those plants and animals what they are, and the ways that the plants and animals group together to create the patchwork of different types of plant communities that we see from the air. Conserving biodiversity means keeping all the living pieces, that is, the genes, plants, animals, and communities in the places they are found naturally.

To Contents

What Does It Mean To Maintain Ecosystem Condition And Productivity?

Most of the plants and animals found in eastern Manitoba have been around for tens of thousands of years. They moved into this area some time after the last glacial ice sheet and lakes retreated about 9,000 years ago. These plants and animals still live here now because they have recovered from whatever nature has thrown at them for thousands of years. The plants and animals that are found in an area can cope with the natural stresses in the region.

Plants, animals, microorganisms, soils, water, etc. are the parts of the forest.	When we add up the total amount of each part of the forest and how much it changes in a year, we are measuring ecosystem condition and productivity.

Our activities affect plants, animals and the other parts of the forest (including waters) in different ways than nature. Maintaining ecosystem condition and productivity means not pushing the forest beyond its ability to absorb. This is critically important because nature is our life support system.

Maintaining forest ecosystem condition and productivity means managing our activities so that the forest can recover from the stresses that we put on it. In other words, we have to live off the interest and not the capital.

To Contents

What Does It Mean To Conserve Soil And Water Resources?

Soil and water are the foundation of all life in the forest. Living things cannot survive very long without water. Most plants get their nutrients and water from the soil. Animals use plants for food and shelter. In one way or another, plants and animals depend on soil and water.

Conserving soil and water resources means not changing the quantity or quality of soil or water. Water quality is affected by activities that introduce pollutants or change the amounts of nutrients or oxygen in the water. Adding nutrients can be just as harmful as removing them from aquatic ecosystems. For example, a large addition of nutrients from fertilizer runoff can lead to an algal bloom which kills off other plants and some water animals by taking most of the oxygen out of the water.

Conserving water resources means keeping water quantity and quality near natural levels.

Soil quality, or fertility, determines plant productivity. Plant productivity is how much additional plant material is produced each year. There are many ways to reduce soil fertility. Some examples of ways that soil fertility can be reduced are when machines create ruts or compress the soil or when too much plant material is removed from the site.**Conserving soil resources means not taking land out of production or changing soil fertility (i.e. the soil's ability to produce)**.

To Contents

What Does It Mean To Maintain Contributions To Global Ecological Cycles?

Forests provide oxygen, clean air, clean water and many other things that are essential for our survival on earth. Every small piece of this earth is connected with other small pieces to form a bigger area. These bigger areas are connected to other bigger areas to form even bigger areas. Combining areas into larger areas is like a snowball rolling down a hill. Eventually the pieces grow large enough to cover the earth. In combination, every little area is ultimately interconnected with every other area and involved in supporting all life on earth. Its like a spider web- touch one strand and the spider can feel it anywhere in the web. Because whatever we do somehow has an impact on everything else, we need to consider how our activities- no matter how small- can quickly create a major impact when added up over all the people and companies that are doing the same thing.

Think globally, act locally.

Maintaining contributions to global ecological cycles means making sure that the combined results of all the activities in an area do not affect the earth's life support system.

Natural Disturbance Approach To Maintaining Forest Ecosystem Health
The Challenge

Up until 75 years ago, we didn't have to worry about keeping forests healthy while we used them. Back then we didn't need large amounts of wood, paper and other products from the forest and we didn't have machinery that was able to use large areas in a short time. Back then the forest had no problem absorbing the demands that people placed on it. Things have changed a lot because of commercial logging, hydroelectric development, roads, hunting, etc.

Today it is a big challenge to figure out how to keep forests healthy while we use them. Aboriginal elders teach us that everything is connected to everything else. Just like a spiderweb or our bodies, the forest has many pieces that work together in a complicated way. Unfortunately, scientists understand as much about how forests operate as doctors understand about the human body. Almost nothing is known about some of the less noticeable living things such as insects, fungi and bacteria even though they play a very important role in maintaining healthy forests. Tiny soil animals, bacteria and fungi break down the dead material that falls to the forest floor and release the nutrients so they can be reused by plants. Those plants become food or shelter for animals.

This mushroom is the exposed part of a fungus. Most of a fungus is buried in the forest floor and is busy breaking down dead plant material and feeding nutrients to plants

To Contents

Learning From Nature

One approach to keeping forests healthy while we use them is to develop guidelines for the species that we think are important. However, most species are important in one way or another because everything is connected to everything else. Managing for one species sometimes means that another species becomes worse off. What is good for moose may not be good for woodland caribou. We need to find a balance. The one created by nature is the one that has the smallest chance of creating serious problems.


What is good for moose may not be good for woodland caribou.

The natural disturbance approach does not try to develop management guidelines based on the needs of a few plants and animals because it is too complicated and risky. Instead, the natural disturbance approach assumes that plants, animals and healthy forests can be maintained if people affect the forest in a way that is as close as possible to the way that natural disturbances affect the forest. If we can achieve this then we expect that whatever species would be found naturally in the region will still be there after we use the forest.

Adopting the natural disturbance approach doesn't mean that we ignore species completely. We will always pay special attention to some plants and animals because they are rare or have special importance for us.

The natural disturbance approach tries to keep forests healthy while we use them by trying to affect the forest like natural disturbances.

To Contents

Keeping Forests Healthy By Acting Like A Large Wildfire

Historically and even today, wildfires disturb much more area in eastern Manitoba than any other type of natural or human disturbance. But its not just any kind of wildfire. Most of the area burned is burned by a few large wildfires.

Fires between 1929 and 1989 in eastern Manitoba.
Dark blue = water, black = roads, hydro lines, township lines.
Other colors are year of fire. Only the most recent fire is shown. If we want to affect forests like natural disturbance then we have to use forests in ways that affect them like a large wildfire.

Applying the natural disturbance approach to commercial logging in eastern Manitoba means we should log in ways that affect the forest like a large wildfire.

To Contents

Using A Region Within Its Natural Ability To Absorb

Regardless of how hard we try, there will still be some big differences in the ways that commercial logging and wildfire affect forests.

Roads are needed for any kind of development but they change natural areas.

Fire leaves 100% of the trees.

How much can a commercial logging operation leave and still stay in business?

Short term differences between commercially logged and natural forests are unavoidable. An area is called a divergent site during the time when it is not like a natural forest of the same age. Our approach assumes that the land, water and forests of a region have the ability to absorb a small amount of stress

without risking a major change in what they provide or how they operate. Operationally this means that we should keep the combined area of divergent sites low enough for the region to absorb. We minimize divergent area by minimizing the initial differences between how logging and fire affect areas and by minimizing the time it takes for logged areas to look, feel and operate like a natural forest. In scientific language, we should maintain regional ecological functions within their ranges of natural variability.

Some differences between logged and natural forests cannot be avoided. One of our goals is to keep the total amount of areas like this within the level that the regional ecosystem can absorb.

To Contents

Maintaining Soil Fertility And Sensitive, Rare Species And Ecosystems

Some plants only grow in a few places.

Even though we accept that there will be some short-term differences between logged and natural forest, there are parts of the forest that should not be allowed to differ because the risks are too high. Nature's pieces have taken thousands of years to develop. Some of these pieces will be difficult or impossible to replace if we lose them during logging, road building, hydro-electric development or any other type of development. The pieces of nature that should not be put at risk are rare species and rare ecosystems that are sensitive to disturbance, soil fertility and water quantity and quality.

Fertile soil produces good tree growth.

To Contents

What Are The Operational Goals For Logging And Other Activities?
Before we can develop practices that keep forests healthy we need to develop guidelines that can be translated into practices. Before we can develop guidelines for planners and operators, we need to translate the overall goal of keeping forests healthy (see p. 4) into operational goals. By applying the natural disturbance approach to what is meant by forest ecosystem health (see p. 5), we come up with the following operational goals for logging:

In cut-blocks:
1. Minimize the: a) Differences in the ways that logging and wildfire initially affect plants, soils and soil animals; b.) Time required for a cut-block to look, feel and operate like a natural forest. An area is called a divergent site during the time when it is not like a natural forest of the same age.

Throughout the region, maintain:
2. The total area of divergent sites low enough for the regional ecosystem to absorb.
3. Soil fertility at every site that is not a permanent road.
4. Healthy populations of rare native species that are sensitive to disturbance.
5. All rare native ecosystems that are sensitive to disturbance.
6. Water quantity and quality.

Other types of activities such as hydro-electric development would have the same operational goals except that the cut-block goals would be adapted to suit the type of activity.

Operational goals for logging and other commercial activities are established by applying the natural disturbance approach to the overall goal of keeping forests healthy while we use them.

To Contents

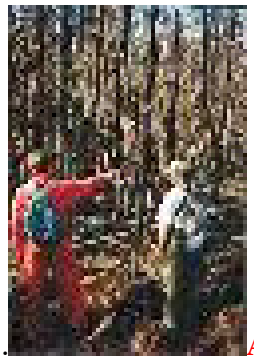
Acting Like Fire

Think of a landscape as what you see looking down from a small plane. You need to get up in a small plane to appreciate how large a wildfire can be. Some fires are so large that you cannot see all of the fire at one time from a small plane. A large wildfire affects an area that goes from the landscape down to a spot on the ground.

A large wildfire affects forests from . . .

1998 Bernic Lake Fire

the landscape . . .

...down to the site.  **A large wildfire affects forests from the landscape down to the site.**

To Contents

What Kind Of Landscape Is Created By A Large Wildfire?

Fires become large because they are pushed quickly by strong winds during dry spells. During a drought, coniferous forest provides a fire with lots of very flammable fuel. In eastern Manitoba, the combination of high winds and abundant fuel creates large fires that burn most everything directly in their paths.

15 year old fire- tall trees show areas skipped over by fire

2,600 ha 1955 fire showing areas skipped by the fire**>** A large fire burns about 70% of the area that it sweeps through. Large fires are often more than 1 km across and are several km long.

> Some of the areas skipped by fire connect the inside of the fire to the surrounding forest.

> Areas skipped over by fire provide refuges and travel corridors for plants and animals while the burn patches are regenerating. If moose or caribou need to cross a ten year old burn, they probably follow the corridors left by fire.**A large wildfire does not burn everything in its path- it skips over some areas leaving connections to the forest outside the fire (corridors) and undisturbed islands inside burned patches.**

To Contents

How Do Large Wildfires Maintain Natural Species Diversity?

The moss-like plant Marchantia, Bicknell's geranium and jack pine seedlings (too small to see in picture) growing well one year after fire.The most common plants in eastern Manitoba are the ones that can cope with a fire every 25 - 50 years. Fire maintains the species diversity part of forest ecosystem health by wiping out fire intolerant plants and creating excellent conditions for the regeneration of post-fire pioneers, especially fire followers. Tree cover in eastern Manitoba is dominated by jack pine and black spruce because these two plants cope very well with frequent fire.

Balsam fir killed by spruce budworm.
Source: Pine Falls Paper Co.Some plants cannot cope with frequent fire. These fire intolerant plants become more widespread and abundant when we suppress fire or log in a way that doesn't remove them from sites. Fire intolerant plants then affect other plants, animals or parts of the ecosystem. They can change the way the forest develops from what would happen naturally. For example, if we leave understory balsam fir during logging, we gradually increase the amount of balsam fir found in the forest. This provides more food for spruce budworm and makes it easier for budworm outbreaks to start.

Large wildfires get rid of plants that cannot cope with fire and create very good regeneration conditions for the plants that we commonly find in the forest.

To Contents

Affecting A Landscape Like Fire- Designing An Operating Area

Affecting a landscape like fire means placing cut-blocks in the places that a large fire usually burns and keeping all activities out of the places that fire usually skips over.
A large fire usually burns most outcrops and drier upland soils.A large fire usually burns most outcrops and drier upland soils.A large fire usually skips over the wettest areas and deep, narrow ravines.About 50% of treed peatlands are skipped over.About 40% of deep, wet mineral soils are skipped over.

Affecting a landscape like fire means placing cut-blocks and retention areas in the same places that fire would leave them. It also means keeping roads and other activities out of retention areas.

To Contents

How Does Fire Affect The Forest You See When Standing On The Ground?
Fire Intensity

Fire temperature can vary quite a bit as it passes through a burn patch. Fire intensity basically tells us how hot the fire was when it passed through. Through most of the burn patches in a large fire, the fire is hot enough to kill everything in its path. In some places, the fire is so hot that needles, leaves, twigs and small branches are burned up. This is called high intensity fire.

In other places, the fire is hot enough to kill exposed plants parts but not hot enough to burn up tree needles and fine branches. This is called moderate intensity fire.

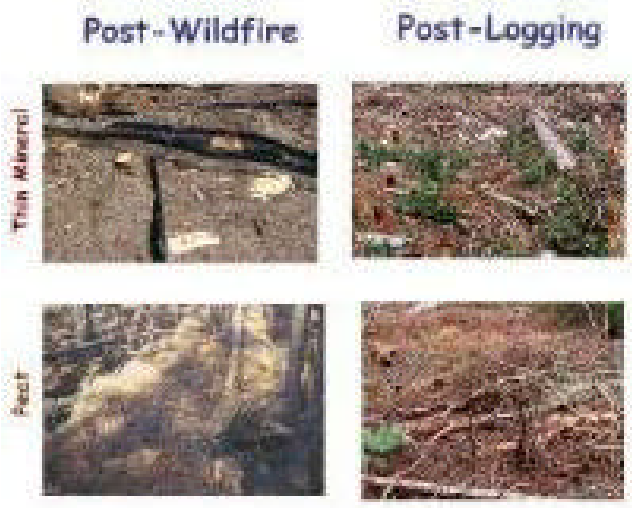
*Moderate intensity burn- all exposed plant parts killed but tree needles not burned up.*Fire converts trees into snags. Snags fall down over time and become downed woody material. Downed woody material is broken down by soil plants and animals and eventually becomes part of the soil. Once decomposed woody material becomes part of the soil it is called soil organimc matter. Soil organic matter is what makes earth black. Soil organic matter is very important for soil fertility because it holds water and nutrients like a sponge.

Within most of the burn patches, the fire usually is hot enough to kill the exposed parts of all plants. The recovering forest is even-aged and initially made up of fire tolerant species.

To Contents

Fire Severity

Fire severity basically measures how long and hot the fire burned in one spot. An easy way to tell how severe a fire was is to measure how deep the fire burned into the forest floor. Large wildfires are usually low to moderate severity which means that some of the forest floor burns up but most roots and buried seeds survive. Because of that, many of the plants that were there before the fire sprout quickly. Other plants sprout from seeds that have been lying dormant in the soil for as many as 100 years waiting for the next fire to come.



Fire kills exposed plant parts, burns up fine branches and burns into the forest floor. Winter logging leaves plants except trees and has little impact on the forest floor.

Within most of the burn patches, fire usually burns long and hot enough to create an excellent seedbed but not enough to kill roots or destroy buried seeds.

To Contents

Fire Rejuvenates Forests

The soil in a coniferous forest becomes less fertile as a natural part of aging. This basically happens for two reasons. First, nutrients are taken out of circulation as tree trunks grow larger, a moss layer develops and more dead branches and leaves fall than can be broken down by soil plants and animals. Second, soil characteristics change so that fewer nutrients are available for plants. For example, the soil becomes more acidic as a natural by-product of plants taking up nutrients and micro-organisms composting the forest floor.

It is hard for new plants to establish in an old forest. Established plants already have a good foothold, the thick, moss-covered forest floor is a poor seedbed and nutrient availability is low. Fire breaths new life into the forest by killing competing plants, releasing nutrients, increasing soil fertility and creating an excellent seedbed for most of the plants commonly found in eastern Manitoba.

Vigorous Post-Fire RecoveryOn PeatlandsOn Uplands

Fire rejuvenates coniferous forests. Fire stops the decline in soil fertility that happens naturally in coniferous forest. Fire creates very good growing conditions for the plants that are commonly found in the forest. Fire releases seeds in the cones of some kinds of plants and stimulates the sprouting of some dormant buried seeds.

To Contents

Affecting A Cut-Block Like Fire- The Operator's Role

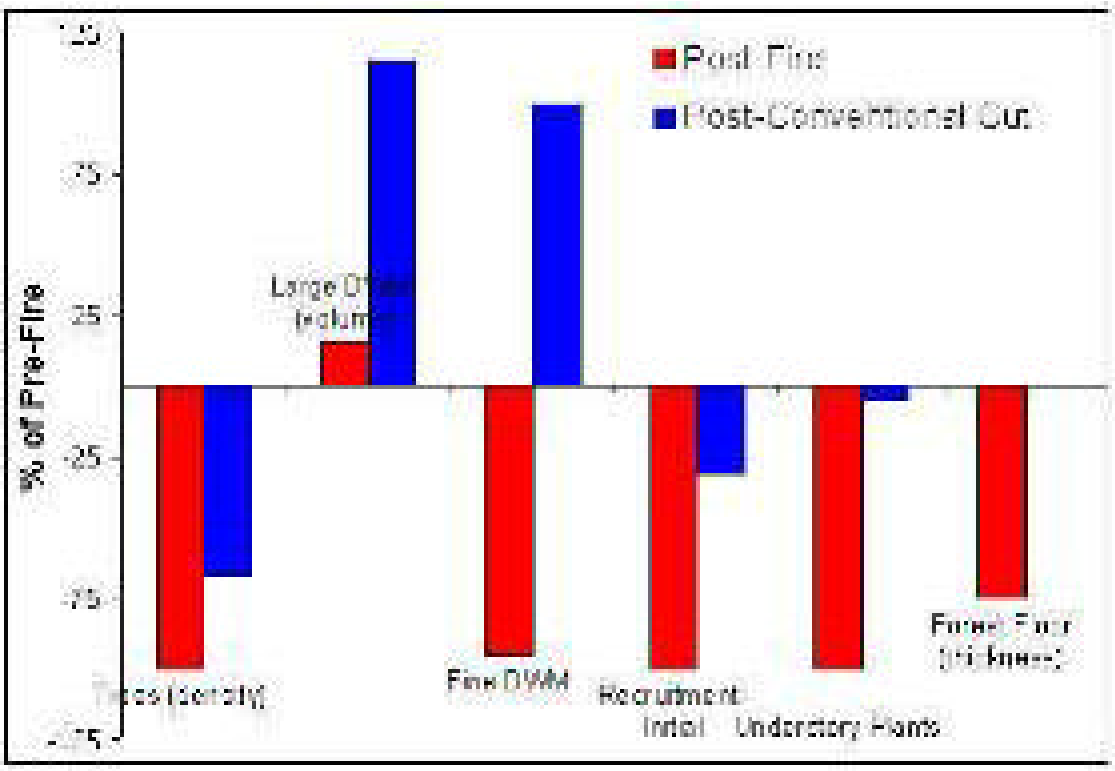
The operator is key to successfully achieving the overall goal of keeping the forest healthy while logging. The operator's goal is for cut-blocks to look, feel and operate like a natural forest as quickly as possible. We do this by operating in ways that leave cut-blocks and retention areas as close as possible to the way that fire would leave them. Of course, recently logged areas will be very different from burned areas in some ways. However, with modified practices that include follow-up activities such as prescribed burning and seeding we think that cut-blocks will look, feel and operate like a natural forest within ten years for most of the forest's pieces. Up to twenty years may be required for large downed woody material. Long-term monitoring will tell us how good of a job we are doing.

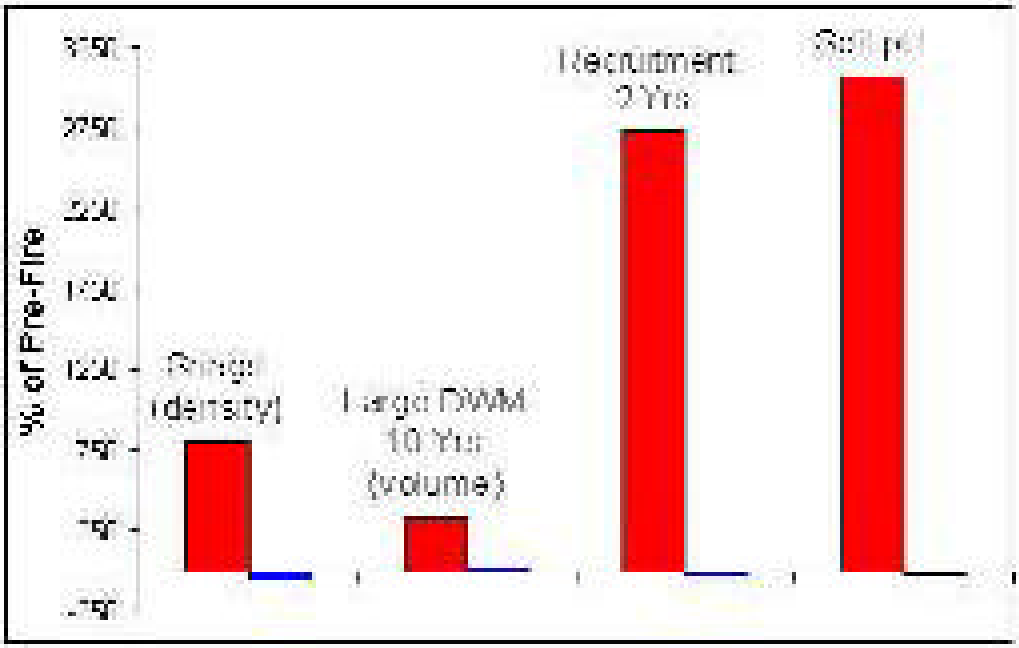
Our Goal: A cut-block should look, feel and operate like a natural forest as soon as possible after logging.

To Contents

What Are The Major Differences Between The Effects Of Wildfire And Current Logging Operations?

These graphs show how much wildfire and logging change some parts of the forest.
(based on information collected in the region)





What Does This Mean On The Ground?

The ways that the operator helps logged areas recover to something like a natural forest are to:

(1) Clear-cut all merchantable trees except scattered jack pine and black spruce trees.

- Clear-cutting creates an even age structure within stands and exposes the forest floor to the sun.
- Retention trees absorb nutrients released by logging, provide large downed woody material, provide a seed source and provide some shade for tree seedlings

(4) Scatter slash and tree tops around the cut-block. This keeps most of the nutrients in the trees on the site.

(5) Leave aspen and birch standing except on harvest trails. This helps to minimize suckering and sprouting.
(6) Kill all balsam fir, white spruce and tamarack either by cutting them down, knocking them down or killing them during post-harvest silviculture. This prevents a shift in overstory composition towards fire intolerant species and outbreaks of insects and diseases.
(7) Leave snags standing where possible.
(8) Avoid trampling black spruce seedlings and saplings. This helps retain nutrients on the site and bring regeneration closer to a natural density.
(9) Disturb only the duff layer of the soil, where possible.
(10) Avoid rutting and compaction.
(11) Avoid sensitive ecosystems.

Scattered retention of commercial trees with protection of small black spruce regeneration.

To Contents

Cutting Patterns

Example of a cutting pattern that leaves 70 merchantable stems/ ha.
A merchantable jack pine or black spruce is left every 12m on the right side of the trail.

> Try to maintain straight trails. This is the best way to deliver the desired amount of scattered retention. Go around excessively steep slopes or sensitive ecosystems and pick up the trail on the other side.
> Stay on trails except to turn around.
> Where machines are used to harvest, cut on both sides of the trail but leave a merchantable jack pine or black spruce on one side at a spacing to be determined by the forest planner. Leave the tree that is closest to the retention point. Where chainsaws are used, retention trees will usually be on the east side of the skid trail.
> Leave an extra tree if you come to an area where the next tree is missing (e.g. an opening on an outcrop).
> If you are adding trails to the right as you work, leave trees on the left. If you are adding trails to the left, leave trees on the right. That way the retention trees will always be one the side of the trail that you have already cut regardless of which way you are facing on the trail.
> Scatter slash and tops evenly.
> Forwarder or skidder operators: Pile wood inside the cut-block boundary.

To Contents

First Step In Measuring Success- Operator Audit Sheet

Operating Area:_____
Stand ID:_____
Operator:_____
Audit Date:_____

Poor Fair Average Good Excellent

A Retention
1. Correct spacing and species. 0 1 2 3 4
2. Aspen left standing. Fire intolerant tree species removed.
0 1 2 3 4
3. Black spruce advanced regeneration retained. 0 1 2 3 4

B Site Impacts
1. Slash scattered in cut-block. 0 1 2 3 4
2. Rutting avoided. 0 1 2 3 4
3. Compaction avoided. 0 1 2 3 4
4. Sensitive sites avoided. 0 1 2 3 4

C Overall Cut-Block Rating 0 1 2 3 4

Comments:_____

_____

Signatures
Operator:_____ Auditor:_____

To Contents

Affecting A Cut-Block Like Fire- What Needs To Be Done After The Operator Is Finished

The operator is just the first person that determines whether the cut-block will recover to something like a natural forest. No matter what the operator does, there will still be some big differences between the effects of logging and fire. This is where follow-up activities come in.
Site preparation is the first follow-up activity. Sometimes machines are used to break up the forest floor and expose patches of mineral soil. Some provinces use controlled burning to restore site fertility, prepare

a good seedbed and control competition.
Seeding and/ or planting are carried out after site preparation to assist in the regeneration of a dense forest.
We expect that the combination of a wildfire based landscape design for an operating area, modified logging operations, site preparation and assisting tree regeneration will help logged areas quickly recover to something like a natural forest. By achieving this we hope to keep forests healthy and continue to reap benefits for many generations to come.

Aerial seeding.
Source: Pine Falls Paper Co.

Breaking up the forest floor to prepare a seedbed.
Source: Pine Falls Paper Co.

Follow-up activities such as site preparation and seeding are critical to regenerating a cut-block to a forest that looks, feels and operates like a natural forest.

To Contents

to Manitoba Model Forest main page