

PARTIAL-CUTTING SAFETY HANDBOOK



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Preface

The need to manage forests effectively for a wide variety of uses will undoubtedly lead to an increase in the application of partial-cutting systems across the province. Increasing the area harvested through partial cutting will require significantly more pre-harvest planning, design and engineering of harvesting operations. It will also require increased levels of forest worker retraining to acquire the advanced skills and knowledge needed to implement partial-cutting systems in the field.

As this process unfolds, issues and concerns regarding worker safety have emerged. This Partial-cutting Safety Handbook has been developed to address these safety issues.

An initial project to evaluate potential safety risks associated with partial cutting in British Columbia was initiated in 1994 by the Ministry of Forests, in cooperation with the Workers' Compensation Board. The project sought to describe potential hazards, identify safety concerns, and develop recommendations to minimize work hazards.

Several of the recommendations from the project identified the need for a handbook to describe and address these hazards. This handbook is intended for workers, logging supervisors and forest planners involved in partial-cutting operations. A project team of Ministry of Forests, Ministry of Environment, Lands and Parks, and Workers' Compensation Board members was established in 1995 to guide the development of this project.

The material presented may be used to plan and implement safe partial-cutting operations. It is not intended to replace, but rather to supplement, existing (WCB) handbooks and standards.

Acknowledgements

Many individuals have contributed their time and expertise to the development of this handbook. Special thanks are extended to those persons from around the province who provided such thorough review of the various draft versions. In particular, we would like to thank the following people for their input and support: Peter Bradford and Janet Agnew (Ministry of Forests, Forest Practices Branch); Stewart Guy (BC Environment, Resource Stewardship Branch); David Rowe, Cary White and Lorne Pelto (Workers' Compensation Board); Dean McGeough (Integra Forest Consulting); Allan Lundgren (TimberWest Forest Ltd.); Bill Golding (Silvicon Services); Fred Marshall (Marshall Forestry Services); Terry Gordon (Sylvan Forestry) and Jim Allman (previously with Ministry of Forests).

The final version of the handbook and accompanying field cards were prepared by Nick Baggs (N.G.B. Forest Management Consulting) and Todd Manning (Branta Consultants). Illustrations were provided by George McLachlan. Field card design and layout were provided by Soren Henrich. Sheilagh Ogilvie did the layout and design of the handbook. Bill I'Anson did the English editing.

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Purpose of This Handbook

This handbook of safety guidelines for partial-cutting operations was produced cooperatively by the BC Forest Service, Ministry of Environment, Lands and Parks, and the Workers' Compensation Board of BC, at the request of industry, labour and other interested agencies.

The handbook does not replace WCB Regulations; rather, it supplements them by providing examples of safe work procedures to follow when partial cutting. Complying with WCB Regulations, following general safety regulations while harvesting (see the list of references), and applying the guidelines in this handbook will reduce harm and injury to forest workers.

It has been designed for use by planners, logging supervisors and forest workers involved in partial-cutting operations. While there are differences between coastal and interior operations—terrain, timber size, weather conditions, etc.—these basic safe work procedures apply to the entire province.

How to Use This Handbook

This handbook covers the implementation of partial-cut logging methods through all phases of planning and operations. Starting with general considerations given to partial cutting in the forest development plan, the handbook introduces progressively more detailed planning concepts for partial cutting, from initial layout and design, through to the development of silviculture prescriptions. Finally, the handbook outlines safe operating procedures and checklists for conducting actual harvest operations.

It has been divided into two main sections. The first section, *Planning for Safety in Partial Cuttings*, proposes safe guidelines for *planning* partial-cutting silvicultural systems. The second section, *Working Safely in Partial Cuttings*, offers safety guidelines for *carrying out* partial-cutting operations.

Safe planning guidelines and work procedures for felling, cable, helicopter, ground-based and horse-logging operations are outlined in this handbook.

For purposes of this handbook:

- *Planners* include those individuals responsible for all phases of plan development, including initial layout and design, forest development plans, and silviculture prescriptions (e.g., strategic planners, foresters and technicians).
- *Logging supervisors* include those individuals (e.g., the landowner, logging contractor, licence holder, or their designate) who are responsible for supervising logging operations.
- *Workers* include those individuals (e.g., fallers, yarding and hill crews, machine operators, teamsters and climbers) who actually carry out harvesting activities.

Although planners may wish to read only the first section of the handbook, they should also read the second section to gain a better appreciation of the operational details that must be considered by workers implementing their plans.

Logging supervisors should read both the first and second sections to help them integrate planning objectives with the management and supervision of daily logging operations.

Workers may choose to read only the second section dealing with operations, but are advised to also read the first section to better understand the planning process and management objectives.

It is the responsibility of all participants to acquire a working knowledge and understanding of each other's job responsibilities, concerns, and work hazards, as well as the legal requirements for ensuring safe implementation of partial-cut logging methods.

Introduction

As public expectation grows for the consideration and protection of non-timber values such as wildlife habitat, water quality, soil conservation, biodiversity, recreation, aesthetics and cultural heritage, smaller clearcuts and partial cuttings are being employed more and more frequently in B.C. logging operations. Maintenance of environmental integrity, economically sustainable development and forest regeneration must all be achieved by the wise application of appropriate silvicultural systems across the forested landscape.

The *Forest Practices Code of British Columbia Act* requires that all silvicultural systems be considered in harvest planning, and that partial cutting be used in specific areas where the protection of wildlife habitat, water quality or other resource values require the maintenance of a partial forest canopy. Partial cutting is a general term for silvicultural systems in which some trees are left standing after logging.

These trees are retained to provide forest structure and wildlife habitat requirements necessary to meet the social, cultural and environmental demands placed on our forests.

Individual leave-trees distributed across the cutblock are intended to provide seed or shelter for the regeneration of the site, while undisturbed reserves or wildlife tree patches are most often intended to protect:

- watershed and riparian areas (rivers, streams, lakes, wetlands, gullies);
- biodiversity (fisheries, nest and den sites, wildlife trees, rare and endangered plants and animals);
- visual quality or scenic values/resources;
- recreation;
- sensitive areas (unstable soils, steep terrain, rock outcrops, windthrow-prone areas);
- cultural heritage (archaeological sites, trails, culturally-modified trees, and other examples of historic use).

The main operational difference between clearcutting and partial cutting is that partial cutting leaves varying numbers of trees on site following harvest. Therefore, workers are exposed to the hazards and risks associated with felling and yarding under a partial canopy or near reserves.

Silvicultural Systems

In British Columbia there are four different silvicultural systems in use:

Clearcutting: the removal of all trees from an area in a single harvest entry. Patch cutting is a form of clearcutting, where small openings less than one hectare in size are created. Clearcutting with reserves is a form of partial cutting where some trees are left within the cutblock to provide wildlife habitat and aesthetic value.

Shelterwood: a form of partial cutting which involves the removal of trees in a series of harvests to establish a new even-aged crop under the shelter of older trees. The shelter trees may also provide a source of seed for the next generation. Shelter trees may eventually be harvested or left to help provide biological diversity, wildlife habitat and aesthetic value.

Seed Tree: a form of partial cutting which involves leaving selected trees standing in the cutblock, either individually or in small groups, to provide natural regeneration for a new even-aged stand. The largest and healthiest trees are left to provide high quality seed for the next generation. The seed trees may be harvested after regeneration or left to provide structural diversity, wildlife habitat and aesthetic value.

Selection: a form of partial cutting which involves maintaining or achieving a continuous uneven-aged forest by harvesting a limited number of trees, of various ages and sizes, over intervals of 5 to 40 years either in small groups (group selection) or individually (single tree selection). Regeneration occurs in the gaps created by logging.

Intermediate Cuts

Intermediate cuts are another form of partial cutting for the purpose of commercial thinning or pole removal. They are done as a single-entry in stands which contain merchantable timber.

Safety in Partial Cuttings

Safety risks in partial cuttings can be reduced long before work begins by:

- adequate advance planning, beginning with the forest development plan, through to the development of the silviculture prescription;
- initial layout and design that takes site-specific hazards into account, and considers equipment limitations;
- designating an experienced individual to make decisions regarding changes to standard operating procedures or to deal with extraordinary events: this “person in charge” should be familiar with the type of partial cutting being practiced;
- flexible leave-tree options that allow fallers to make use of their experience and knowledge of the site to compensate for hazards and felling difficulties present within the stand;
- ensuring workers know their duties and responsibilities and how to do the job.

Planners responsible for the design of partial-cutting systems require training and experience in harvesting methods and operational safety. Foresters must be trained to a level that will enable them to develop practical, safe silviculture prescriptions that meet the specific objectives for the land base.

Workers in partial-cutting operations are often responsible for a wide variety of job functions and will almost certainly need additional training or upgrading to meet the requirements of the work. Training should aim to improve skills and knowledge related to:

- operational sequences for different cutting patterns;
- machine operation for new harvesting methods;
- felling in partial cutting;
- partial cutting on potentially unstable slopes and near riparian reserves/wildlife tree patches;
- assessment of wildlife/danger trees;
- windthrow hazard assessment;
- map reading and interpretation.

Risks and Responsibilities

Risk is associated with the implementation of any logging method or silvicultural system. However, those involved with partial cutting face additional risks and must therefore promote and maintain special safe-work practices.

- Managers must take responsibility for safety in overall planning, production and economy of the operation.
- Supervisors must take responsibility to ensure safe procedures are followed during all phases of the logging operation.
- Workers must take responsibility for their own safety, and for the safety of their fellow workers.

Unsafe work procedures must be identified and corrected. If safety concerns cannot be resolved among workers, the supervisor must be notified immediately to help resolve concerns. As workers have to make many routine decisions throughout the work day without direct supervision, understanding one’s responsibilities and following safe work procedures will minimize exposure to danger and the risk of injury.

Section One

Planning for Safety in Partial Cuttings

Safety in the Operational Planning Phases

This section recommends safety guidelines for partial cutting in each of the planning phases—the forest development plan, initial layout and design, and the silviculture prescription. General safety concerns for each planning phase are followed by safety guidelines specific to felling, cable, helicopter, ground-based, and horse-logging operations.

Planners are responsible for the identification of hazards unique to the partial-cutting system selected in each of the planning phases. They must implement measures and safe operating procedures which ensure that worker safety is adequately considered in both logging and silviculture.

Guiding principles for partial cutting should be built upon standard operating procedures used for conventional harvest methods in order to minimize hazards and optimize worker safety. Planners must be knowledgeable of measures to minimize harvesting risk. Forest workers need to have an understanding of the silvicultural system and its goals. Worker safety requires the integration of management objectives and harvesting activities, both in the office and in the field.

Planners are often hampered by a lack of detailed knowledge or familiarity with site conditions for the area under consideration. Consequently, planners should avoid setting overly restrictive operating criteria and place increased emphasis on communicating management objectives to supervisors and workers. In this way, individuals who are actually carrying out the logging may apply their knowledge and expertise to meet the stated management objectives safely and efficiently.

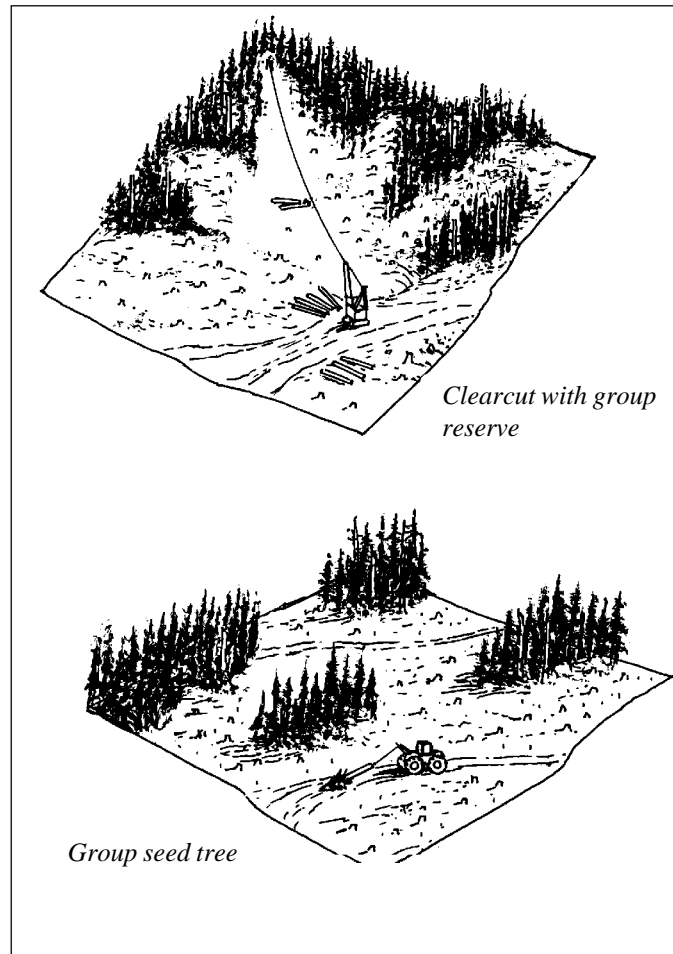


Involve fallers and other forest workers in the decision-making process, to ensure safe harvesting operations.

Phase I: Forest Development Plan

The forest development plan describes and illustrates where harvesting and road development for a specific area will be undertaken for a period of at least five years. In this broad-based plan, safety and partial cutting are considered at a nonspecific landscape level: for example, safe operating procedures for steep slopes, burns and difficult terrain may determine which harvest methods and silvicultural systems are most appropriate for certain cutblocks.

- Planners preparing the forest development plan should:
 - ~ review any landscape-level management objectives identified in higher-level plans and identify the range of silvicultural systems that might be applied under different stand and site conditions to meet those objectives
 - ~ identify probable or known locations of hazardous/problem/special resource areas (e.g., unstable class IV and V slopes, landslide and blowdown events, avalanche tracks, wind-exposed areas, floodplains, old-growth management areas, wildlife habitat areas or other significant wildlife/recreational/cultural features)
 - ~ consider traditional weather patterns (e.g., wind direction, seasonal storm events) and operating restrictions
 - ~ propose mitigative measures where operations may impact identified values and other resource uses.



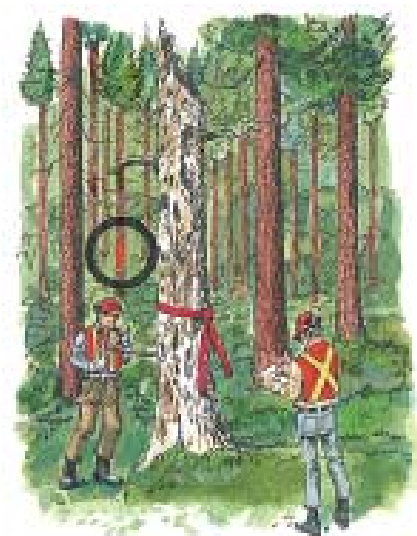
Choose a silvicultural system to meet landscape-level management objectives identified in higher-level plans.

Phase II: Initial Layout and Design

In the layout and design stage, the planner clearly marks out the operating area within the cutblock. At this stage, the planner is identifying or confirming the presence of site hazards, critical stand characteristics, safety concerns and resource values that may influence the choice of silvicultural system. This information should be considered within the context of both landscape- and stand-level objectives identified in the forest development plan, and will be instrumental in the development of the silviculture prescription and actual operations. Final layout will be modified by the planners to ensure both feasibility and worker safety.

- Planners must consider worker safety as it relates to:
 - ~ felling patterns and techniques
 - ~ yarding/skidding methods
 - ~ equipment access limitations/operability
 - ~ ground stability: risk of rock and mud slides
 - ~ riparian reserve and management zones, and no-machine zones
 - ~ danger tree removal
 - ~ wildlife tree patch retention
 - ~ wind exposure hazards and windfirm stand characteristics
 - ~ snow slide hazards
 - ~ fire protection
 - ~ emergency evacuation and first-aid requirements.
- Planners should ensure that boundaries, access trails and riparian management zones/ reserves are clearly marked to orient fallers and machine operators within the cutblock.
- Planners should consider and note the location of anticipated emergency evacuation routes.
- Planners should ensure that first-aid procedures and equipment can be adequately located on site.

Any wildlife tree that potentially impacts the work area must be assessed by a qualified wildlife/danger tree assessor to be considered for retention.



No-Work Zones and Wildlife/Danger Trees

A no-work zone (NWZ) is a zone created to prevent workers from entering areas made hazardous by the presence of danger trees or other hazards.

- No-work zones are normally delineated by ribbons at the initial planning stage. In silviculture or other low-impact activities, ribbons alone are acceptable for the duration of the project. In construction and timber harvesting, the no-work zone must be enhanced by selecting and marking sound green trees that are not to be felled.
- No workers other than fallers or assessors may enter no-work zones at any time. Fallers may enter no-work zones to eliminate hazards, but must leave any trees felled for safety reasons on site, unless approved for removal by the Forest Officer. All workers must stay clear of no-work zones with standing timber during periods of high wind.

Any wildlife tree that potentially impacts the work area must be evaluated by a qualified wildlife/danger tree assessor before it can be designated for retention within a wildlife tree patch (WTP) or no-work zone along the cutblock boundary. This must occur in conjunction with initial block layout, to ensure that the location of no-work zones and wildlife tree patches does not compromise the felling plan.

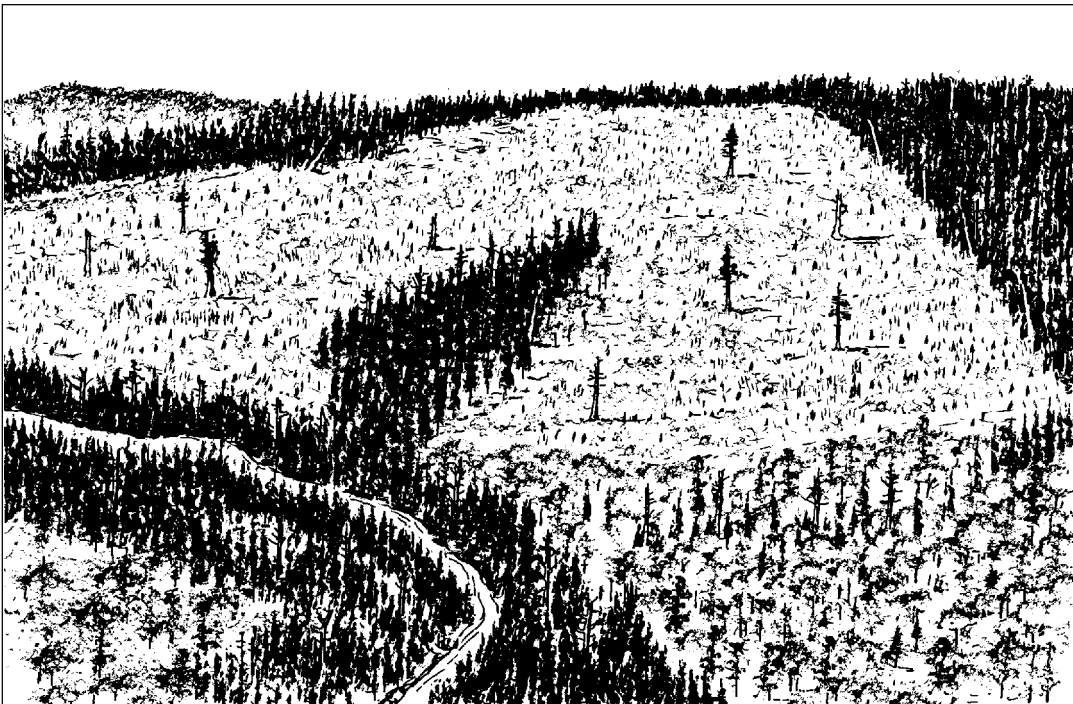


Phase III: Silviculture Prescription

The silviculture prescription is a site-specific plan which describes the harvesting method, reforestation and stand tending activities required to meet the legal and contractual obligations of the licence holder to regenerate a free-growing stand of trees. It must be consistent with the provisions of the forest development plan, but flexible enough to allow for the implementation of the proposed silvicultural system under the range of site and stand conditions likely to be encountered. At this stage, it is essential that planners identify and understand potential work hazards and the actions which can be taken to minimize or eliminate them.

- With the increased complexity of planning for partial cutting and the retention of leave-trees and reserves under different silvicultural systems, planners should call on the expertise of operations personnel for input on layout, reserve area locations, yarding corridors, and leave-tree selection.
- Planners should identify and map:
 - ~ the location of potential hazards or problem areas (e.g., shallow soils, steep slopes, high water seepage areas)
 - ~ critical site factors that may affect worker safety using the stated silvicultural systems and harvest methods (e.g., slope stability, windfirmness of a stand)
 - ~ the location of danger trees having high value for wildlife, which may be designated for retention within a wildlife tree patch or an appropriate no-work zone along the cutblock boundary to meet specific stand-level biodiversity/wildlife objectives stated in the forest development plan.
- Planners must recognize that damage and hazards created during partial cutting (e.g., cut roots and stem damage, widowmakers) may persist until the next harvest entry or planned forest activity (e.g., planting, spacing, brushing), and should therefore plan for future assessment and hazard mitigation.
- In selecting the silvicultural system and harvesting method, planners must consider the following:
 - ~ landscape- and/or stand-level objectives identified in the forest development plan
 - ~ traditional weather patterns (e.g., prevailing wind direction and seasonal storm events)
 - ~ hydrological impact on soil stability
 - ~ ground slope, soil type, rooting depth and moisture regime as they relate to windfirmness
 - ~ stand density, structure and species composition
 - ~ tree species for removal and retention, rooting habit, and crown form as they relate to windfirmness
 - ~ indicators of poor tree health (e.g., root rot; mistletoe; beetle infestations; damaged/defoliated trees; stem, crown and root deterioration)

-
- ~ hydrological and soil disturbance impacts on root disease initiation
 - ~ wildlife tree requirements—patch and dispersed
 - ~ number and distribution of danger trees
 - ~ production levels and maintenance of safety performance standards
 - ~ availability of trained and experienced staff.
- For intermediate cuts, good site layout is essential, and planners must consider special safety issues created by:
 - ~ high stem densities
 - ~ frequent small-diameter snags
 - ~ worker-level branch hazards
 - ~ obstacles and remnants of the previous harvest, such as dead-top vets, springboard stumps, large remnant logs, snags and previously damaged trees.



Wildlife tree patch.

Wildlife Tree Patches

When determining the best location for wildlife tree patches, try to incorporate as many of the following desirable characteristics:

- abundance of high quality wildlife trees
- mix of live and dead trees (decay classes 2–6)
- range of large and small stems; some stems should be in the upper 10% of the diameter range distribution for the site
- coarse woody debris (range of decay classes and piece sizes)
- evidence of wildlife tree use (nesting, denning and feeding)
- deciduous component (trees and shrubs) where present
- live deciduous trees that have external fungal conks or cankers
- representative stand densities
- windfirm stand characteristics
- closeness to, or including riparian habitat, streams, wetlands, gullies, ravines, rock outcrop complexes, and meadows
- maintenance of intact forest floor structure, and protection of sensitive soils, seepage areas, unstable slopes
- areas already constrained from logging (e.g., riparian reserves, inoperable terrain, steep slopes and sensitive soils).

It is especially difficult to plan for the retention of wildlife trees where uniform distribution of residual trees is the objective under a seed tree, shelterwood, single-tree selection or clearcut with reserves silvicultural system. The overlapping no-work zones of even a small number of designated wildlife trees may necessitate leaving group reserves rather than uniformly distributed leave-trees.

Safety Planning in Harvest Operations

General Safety Considerations During Harvest Operations

Prior to actual logging operations, it is essential that planners identify and understand potential hazards, and prescribe the actions necessary to minimize or eliminate them. All operations must be planned to ensure worker safety.



Efficient layout and corridor design are essential for safe operations.

Considerations include:

- corridors flared at landings;
- corridors cut cross-hill where necessary to control runaway log hazard;
- corridor spacing appropriate for equipment;
- adequate deflection;
- minimal hazard created by lateral movement of skyline;
- windthrow hazard assessment.

Planners should:

- build safe work procedures into every aspect of logging operations;
- call upon the expertise of operations personnel for input on layout, reserve area locations, yarding corridors and residual tree selection;
- consider optimum economic and safety objectives in determining log lengths to be harvested;
- involve fallers in the determination of felling direction (or lay) at the planning stage, so that corridors of an appropriate width may be safely located, rub trees selected, landings appropriately placed, and the need for carriages with lateral yarding capacity, etc. determined;
- consider windfirmness in the location of cutblock boundaries and yarding corridors;

-
- walk riparian boundaries to ensure that danger trees with high wildlife value are protected by adequate riparian reserves or appropriate no-work zones;
 - select for retention:
 - ~ only firm, stable rub trees adjacent to harvesting corridors
 - ~ leave-trees that will pose the least danger to workers (i.e., windfirm, healthy, with minimal crown hazard);
 - consider the density and degree of decay in the existing stand, volume or basal area removal targets, and terrain:
 - ~ Safety hazards increase with increasing stand density, stand decadence and steepness of terrain
 - ~ Where timber is dense and decay is prevalent, the safer choice may be to harvest a higher volume to provide more room for felling and harvesting, or to leave retention patches (no-work zones);
 - locate reserves in such a way that timber can safely be felled away from the reserve area;
 - consider how reserve location affects the feasibility and safety of future harvest and silviculture operations within the block;
 - establish windspeed shutdown criteria specific to the type, age and health of the timber on the block. Drainage and soil conditions should also be considered in formulating these criteria;
 - prepare a detailed map or otherwise identify to workers:
 - ~ prescription area boundaries and harvesting method
 - ~ location of potential hazards, hazardous areas, danger trees
 - ~ wildlife tree patches, riparian management areas, leave strips, no-work zones, and any other special management areas
 - ~ logging corridors for dropline carriage logging systems, including all intermediate spars, back spars and tailhold stumps/trees
 - ~ yarding corridors and landings
 - ~ direction of yarding
 - ~ guyline stumps
 - ~ skid roads
 - ~ access routes
 - ~ emergency evacuation routes.

This information will be used by workers to highlight and identify potential hazards and where safe operating procedures are required.



Engineer and faller discuss proposed harvest operations.

In the design of landings, planners should:

- provide a safe work area for landing workers, large enough to safely accommodate yarding and loading equipment, the landing and processing of logs, and the number of required log decks and vehicular traffic;
 - provide enough space for safe bucking and limbing in whole tree logging operations. Consider sorting elsewhere, possibly in the mill yard, if other requirements dictate a small landing size;
 - provide an adequate number of landings in appropriate positions to facilitate the yarding method employed;
- select locations that are suitable for level landing construction;
 - ensure that landings are designed to provide adequate drainage, and that any excavated banks are stable and free of loose material which may roll/slide down onto workers;
 - consider bucking and limbing or processing in the bush to reduce excessive slash accumulations on the landings.

In considering safe felling, planners should:

- discuss with the fallers and the logging supervisor:
 - ~ the harvesting method to be used
 - ~ the cut and leave-tree selection criteria for the cutblock
 - ~ felling direction (or lay) as it relates to boundaries and reserves
 - ~ hazards identified at the time of layout;
- ensure that felling patterns and layout minimize the need for upslope felling wherever possible. Where upslope felling is necessary, the degree of slope, tree lean, and obstacles to movement (e.g., windfalls, loose material, broken ground) should be taken into account when deciding which trees to fell and in choosing a clear escape path. Trees should not be felled upslope greater than 15% from the perpendicular.



Supervisor, faller and engineer discuss the block.

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