

Avalanche Safety Resource Package

This resource package is designed to assist forestry companies to identify and assess avalanche risks. It is intended to provide basic information on avalanche safety and is not to be used as a replacement for an avalanche risk assessment or safety plan.



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The importance of this information to a forestry operation

Forestry activity often takes place in and around avalanche terrain. Avalanches can be a risk to workers and machinery from early winter well into the summer months. Harvesting activities can increase the risk of avalanches occurring.

When an avalanche risk is present, this triggers the requirement for a qualified person to complete an avalanche risk assessment or avalanche safety plan.

Planning for avalanche hazards is important for forest worker safety and, since 2009, has specific requirements under WorkSafeBC regulation: www2.worksafebc.com/publications/OHSRegulation/Part4.asp#SectionNumber:4.1.1

The purpose of this resource package is to provide information and tools to assist forest companies and employees identify and assess avalanche risks. It only provides basic information on avalanche safety and is not to be used as a replacement for the avalanche risk assessment or safety plan.

This resource package will help identify:

- Introduction to avalanche safety for forestry operations.
- Information on avalanche safety regulatory requirements.
- Tools to help identify the presence of avalanche hazards.
- An example of avalanche safe work procedures.
- Links to additional resources.



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Photo Source: Parks Canada

1. Definitions

AVALANCHE

This document refers to a snow avalanche; the requirements related to landslides are not covered in this resource package.

An avalanche (or snow slide) is a volume of snow, usually more than several cubic metres, moved by gravity at perceptible speed. Snow avalanches may contain rock, broken trees, soil, ice or other material

There is no universally accepted classification system for different forms of avalanches. Avalanches are typically described by their size, their destructive potential, their initiation mechanism, their composition and their dynamics.

SLAB AVALANCHE

An event that occurs when a cohesive slab of snow lying upon a weaker layer of snow fractures and slides down a steep slope. Avalanches are typically triggered in a starting zone from a mechanical failure in the snowpack (slab avalanche) when the forces of the snow exceed its strength but sometimes only with gradual widening (loose snow avalanche). After initiation, avalanches usually accelerate rapidly and grow in mass and volume as they entrain more snow.

QUALIFIED PERSON

This refers to anyone with knowledge of the work, the hazards involved and how to control those hazards. They must also have the education, training and experience to provide qualified input on avalanche risk assessment and planning.

AVALANCHE RISK EVALUATION

Employers can determine if there is a possible risk of an avalanche at a workplace by doing an avalanche risk evaluation. This resource package provides an Avalanche Risk Identification Tool which is a form that employers can use to complete this evaluation.

Avalanche Information:

- An avalanche is a rapid flow of snow down a hill or mountainside.
- Early winter through springtime is when most avalanches tend to occur. However, avalanche incidents have been recorded for every month of the year.



AVALANCHE RISK ASSESSMENT

When an avalanche risk is present, this specific risk assessment is completed by a qualified person. This assessment must consider all hazards and risks associated with avalanches including topography, vegetation, snow conditions, avalanche history, nature and duration of work activities and the workplace including any buildings and structures (including temporary ones). It also must consider how the work activities may affect the topography, vegetation and snow conditions.



AVALANCHE SAFETY PLAN

An avalanche safety plan is developed and implemented based on the information gathered in the Avalanche Risk Assessment that has determined that a person working at the workplace will be exposed to a snow avalanche risk. This plan must include measures and procedures to eliminate avalanche risks. If risk elimination is not reasonably capable of being done, risks must be minimized, including implementing an avalanche safety program.

AVALANCHE SAFETY PROGRAM

This program is part of an avalanche safety plan when avalanche risk cannot be eliminated. An avalanche safety program must include regular monitoring of weather, snow and avalanche conditions and this monitoring must be done as per what a qualified person deems to be effective.

2. Avalanche Facts*

Thousands of avalanches occur in Canada each year. They happen in many regions of Canada but are more frequent in the mountains of British Columbia, Yukon and Alberta. Avalanches can be triggered by weather including wind and rain, by warming temperatures, snowpack conditions, slope steepness, slope orientation, wind direction, terrain, vegetation and earthquakes. They can also be triggered by skiers, snowmobiles, hikers, vibrations from machinery or construction. Different combinations of these factors can create different avalanche conditions and avalanche risk. Some of these conditions, such as wind, precipitation, temperature and condition of the snowpack, can change on a daily or even hourly basis.

- An avalanche occurs when a layer of snow collapses and slides downhill. There are two main types: loose-snow (or sluff) and slab avalanches. Both types may be wet or dry. Slab avalanches are generally larger and more dangerous.
- Slab avalanches require a stronger, more bonded layer of snow over a weaker layer.
- Avalanche triggers may be natural (weather factors such as wind loading, snowfall, rainfall, solar radiation, etc.) or human caused (skiing, snowmobiling, heavy equipment, explosives etc.)
- Avalanches are caused by three factors: terrain capable of producing avalanches, sufficient snowpack and the weather. An avalanche is triggered when stress (load) applied to the snowpack exceeds its strength.
- Avalanches can travel up to 120 km/h.
- An avalanche has three main parts the starting zone, avalanche track, and runout zone. The starting zone is where unstable snow can fracture from the surrounding snow cover and begin to slide. Typical starting zones are higher up on slopes. However, given the right conditions, snow can fracture at any point on the slope.
- The avalanche track is the path or channel that an avalanche follows as it goes downhill. Large vertical swaths of trees missing from a slope or chute-like clearings are often signs that large avalanches run frequently there, creating their own tracks. This is where the avalanche gains the most speed.
- The runout zone is where the avalanche slows down and eventually stops. There may be a large pile-up of snow and debris at the bottom of the slope, indicating that an avalanche has run through.
- The runout zone is where the snow and debris finally come to a stop. Similarly, this is also the location of the deposition zone, where the snow and debris pile the highest.
- After 10 minutes fully buried there is a less than an 80 percent chance of survival for an avalanche victim. The most common causes of death are asphyxiation, wounds and hypothermia.

Avalanche Facts

AVALANCHE TERRAIN

- Slope angle is the most important factor.
- Dangerous slab avalanches occur most frequently at angles between 30° (58%) and 45°

GROUND ROUGHNESS & FOREST COVER

• Rough ground surfaces and vegetation helps to anchor the snowpack.



• The roughness of the ground determines how much snow is required for avalanche initiation. In general, a deeper snowpack is required for avalanches to occur on rough ground (cut blocks with high stumps and slash, talus slopes, etc.) than on smooth ground (road cut slopes, grass, rock slabs, etc.).

- The threshold snowpack depth for avalanche initiation ranges from 30 cm to > 100 cm depending on ground roughness.
- Avalanches may start and run through forested terrain. Forest densities of > 1000 stems/hectare are required to effectively prevent avalanches from initiating.



*source: Government of Canada – Get Prepared, National Snow and Ice Data Center, Avalanche Canada, Interfor Workplace Avalanche Safety Brochure

3. Avalanche Safety & Regulatory Requirements

INTRODUCTION

Section 4.1.1.1 of the WorkSafeBC Occupational Health and Safety Regulation requires employers whose workers travel through, work around or within an avalanche hazard zones to conduct an evaluation to determine if there is a risk from an avalanche. If the employer determines that the risk exists, a qualified person must conduct an Avalanche Risk Assessment and develop an Avalanche Safety Plan that includes measures and procedures to reduce the risks associated with avalanches. If the avalanche risk cannot be eliminated then an Avalanche Safety Program must be developed.



4. Risk Identification Tool

Snow Avalanche Risk Identification

(Complete this form prior to beginning operations)

Completed by	y:	Date and Time:		
Location:				
GPS Coordin	ates:			
Type of Work	c being done:			
When any o a detailed beginning o	of the risk factors are present, a qual Avalanche Risk Assessment and c operations.	ified person should be create an Avalanche s	e retained to Safety Plan	conduct prior to
Risk Factor	Evaluation Crite	ria	Risk F Prese	actor ent?
Avalanche History	Are there observations or reports of a planned area of operations?	valanches in the	□ Yes	□ No
	Observed avalanches are the best evide problem. Planned area of operations incl well as the access.	nce of a potential ludes the worksite as	Notes:	
Vegetation	Is there evidence of damaged vegetat	ion from avalanches?		
	broken off their uphill sides, tracks with n brush.	n trees, branches no vegetation or just	Yes Notes:	No
Snow Depth and	Is the snow depth at least 50cm great roughness and do slopes exceed 47%	er than ground		
Terrain	Large slab avalanches require depth of a than ground roughness.	at least 50cm greater	Notes:	NO
	For example, if rock and bushes are 50cm in 100cm of snow would be required for a destrustart.	height, then approximately uctive slab avalanche to		
	The slope angle of the potential starting important factor affecting frequency. Typ higher up on slopes and may exist above operations.	zone is the most ical starting zones are e the planned area of		
Additional co	mments / observations:			
Reviewed an	d signed off by:			

5. Safe Work Procedures

The following is a quick-reference guide, courtesy of Interfor, to help identify risks and work safely around avalanche hazards. They should be used in conjunction with a site-specific Avalanche Safety Plan and Program and are not a substitute for a plan or program.

INDICATORS OF SNOWPACK INSTABILITY

INDICATOR	EXPLANATION
Recent Avalanche Activity	This is the most reliable indicator of snow instability and elevated avalanche hazard. Observe the characteristics of the terrain and look for similarities to your worksite.
New Snow	Most avalanches occur during or soon after heavy snowfall. Snowfalls of over 30 cm in 24 hours or sustained snowfall rates at over 2 cm/hour are red flags.
Wind Loading	Wind can transport large amounts of snow into lee areas, significantly increasing the amount and rate of snow loading. Look for signs of wind loading such as snow drifts and snow blowing off ridge crests.
Rainfall	Rainfall frequently triggers avalanches by adding load to the snowpack while at the same time reducing its strength.
Rapid Warming & Solar Radiation	Avalanches are frequently triggered when the snowpack is weakened by rising air temperatures (especially to above 0° and if there is no overnight freeze) and solar radiation.
"Whumphing" & Shooting Cracks	"Whumphing" is a sound that occurs when a buried weak layer fails; it is a very strong indicator of an unstable snowpack. Shooting cracks indicate slab properties in the snowpack.

AVALANCHE PROCEDURES

	WHAT	TO D	O IF CAUGHT IN AN AV	/ALA	NCHE
On	Foot:	In a '	Vehicle:	If R	oad is Blocked:
1.	Call out to alert companions	1. 2	Remain in the vehicle	1. 2	STAY IN VEHICLE Back out to a safe area if
2.	Try to get to edge of	2.	headlights	2.	it is safe to do so
3.	Discard equipment, but	3.	call for assistance using radio, cellular phone, or	3.	Radio for assistance from heavy equipment
А	leave your pack on Swim kick and fight to		satellite communication device	4.	Advice on current
ч.	stay on the surface	4.	Activate hazard lights		residual hazard, and
5.	Grab trees or rocks	5.	If vehicle is buried and		avalanche deposit
6.	Create an air pocket by reaching with one hand to your opposite shoulder and burying		an avalanche probe is available, push it to the surface to provide a visual clue for searchers		sought from an avalanche technician concurrently with
	your face in the crook of your arm as the avalanche slows down	6.	Ensure avalanche transceiver is transmitting		equipment.
7.	Thrust the other arm towards the surface as	7.	DO NOT smoke or re- start engine		
_	the avalanche slows	8.	Await rescue team.		
8.	Relax and await rescue.				

	Avalanche Hazard Ratings	
Avalanche Hazard	Avalanche Hazard Definitions	Typical Action
гом	Avalanches are unlikely. OR Small avalanches are possible but are expected to terminate far above the road or worksite.	Normal operations with routine avalanche safety measures.
MODERATE	Small avalanches are probable but are expected to terminate above the road or worksite. AND/OR Large avalanches are possible but are expected to terminate far above the road or worksite.	Additional site-specific avalanche mitigation measures may be required to reduce avalanche risk.
CONSIDERABLE	Small avalanches are likely and may reach the road or worksite. AND/OR Large avalanches are probable but are expected to terminate above the road or worksite.	Site-specific travel or work restrictions may be required to reduce avalanche risk.
нісн	Numerous small avalanches are expected to affect the road or worksite. AND/OR One or more large avalanches are expected to affect the road or worksite.	Road or worksite is closed.

Standard Operating Procedures for Work in Avalanche Hazard Areas

6. Avalanche Resources

WorkSafeBC's guidelines for Snow Avalanche Assessments

www.worksafebc.com/en/law-policy/occupational-health-safety/searchable-ohs-regulation/ohs-guidelines/guidelines-part-04#SectionNumber:G4.1.1

Avalanche Canada – public recreational avalanche forecast information

www.avalanche.ca

Canadian Avalanche Association – training and additional information

www.avalancheassociation.ca